



 SPNHC

 BHL
Biodiversity Heritage Library

 NatSCA
Natural Sciences Collections Association

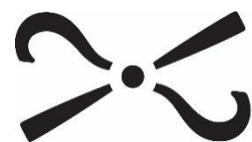
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Royal
Botanic Garden
Edinburgh



National
Museums
Scotland

19th century taxonomy and the invisible skeleton of the Ward Project and Ward's Natural Science Establishment

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Ward's Natural Science Establishment of Rochester New York played a central role in the early development of natural history education, collections, and museums. By the late 1880s, Ward's had sold materials to approximately 250 institutions, 69 of which remain active, and still hold and display those specimens. The Ward Project (wardproject.org) presents specimens, correspondence, catalogs (some annotated), invoices and personal diaries from the collections in the Department of Rare Books and Special Collections at the University of Rochester. Taken together, this material chronicles in detail the unmatched growth of the natural history movement in the last half of the 19th century. The website design uses the Darwin Core and Dublin Core metadata standards to facilitate data sharing with the biodiversity community. It is a virtual museum that invites those outside University of Rochester to add images of specimens, documents and other relevant materials, and to transcribe letters.

Taxonomy and perceived evolutionary relationships were a central component of the cabinets that Ward's Natural Science Establishment sold, but many of the names of the organisms in those cabinets are outdated, misspelled, and not accepted today. This talk discusses the importance of the scientific names of organisms to the Ward Project's structure and cohesiveness: its invisible skeleton. We use the Specify program to link the taxonomic changes of a name to the currently accepted name and have developed a program that allows us to populate the Taxonomic tree in Specify with synonyms linked to their accepted names we download from GBIF. Connecting currently accepted taxonomy to those 19th century names used in price lists, catalogs, letters, and specimen labels helps users to seamlessly collate information on specimens in their own collections.

3D images of herpetological collections: a new horizon for systematics research and public outreach in a tropical hotspot

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Natural history museums and scientific collections represent a great heritage for humanity and its invaluable information has implications in different disciplines from systematics, ecology, biodiversity conservation to education in environmental sciences. Traditionally, visiting museums by experts represent a big limitation due to the costs associated with the movement of researchers both regionally and globally. With the new global dynamics associated with the covid pandemics, numerous strategies for the knowledge exchange have emerged. Additionally, recent technologies are improving the capture, visualization and analysis of museum specimens. Here, we show how to implement image processing to generate 3D models of museum specimens in a herpetological collection from northwestern Colombia, a hotspot with high species richness and endemism. We developed 3D models for frogs and lizards and propose a low-cost protocol that can be used for small but important regional herpetological collections. To create the 3D images, we use a low-cost structure that consists of a rotating plate on which the specimen is placed and a fixed base for capturing the 2D frames. We can use semi-professional or cell phone cameras. We build the 3D model using free software such as Meshroom and we can expose it on a conventional screen or in a montage made up of a conventional LCD television and acrylic sheets. We are convinced that it is imperative to develop new efficient strategies to promote the use of natural history collections and their specimens, not only to improve our scientific knowledge based on them, but also to make the collections available to the society in general.

A century of old confusion elucidated: a trace of the collapse of the Chinese imperial monarchy in the collection of the herbarium BR

Prof. em. Dr. Elmar Robbrecht¹, **Ms Sofie De Smedt**¹, Piet Stoffelen¹, Scientific Manager of the Herbarium Ann Bogaerts¹, Filip Verloove¹

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The herbarium of Meise Botanic Garden (BR) is full of stories. One of these stories highlights the importance of expert curation.

The Belgian agronomist Henri Homblé collected plants in Guangxi, China, in 1909-1910, while teaching in Guilin. Troubles in the revolution year, 1911, in which the imperial monarchy was overthrown and the republic established, meant Homblé had to flee. He came to Belgium where he deposited his collection at BR, then moved to Congo. There Homblé was one of the first people to collect and document the flora of Katanga.

Many Homblé specimens were described as taxonomic novelties; 107 tropical African plant species are named after him. His incompletely labelled Chinese collections were erroneously considered as collected in Katanga. This supposed African origin has led to confusion with regard to the identification, and even resulted in the description of four species believed to be new for science.

Robbrecht E., De Smedt S., Goetghebeur P., Stoffelen P. & Verloove F. (2021) Four flowering plant species described from Katanga (Democratic Republic of Congo) are based on specimens collected in Guangxi, China, *Blumea* 66(1): 82-92

<https://doi.org/10.3767/blumea.2021.66.01.04>

A digital species index: an underrated tool for natural history collections

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Digitisation of natural history collections has been ongoing for quite some time now. It opened up data held in natural history collections in an unprecedented way. Collection digitisation is usually linked to if not considered synonymous with specimen digitisation. Although specimen digitisation is the single most important level of digitisation in natural history collections, it is very time consuming. Depending on available resources and the goals we want to achieve, there is also another level of digitisation to be considered. This presentation will zoom in on the digital species index: the result of digitising natural history collections at the species level. Based on recent efforts undertaken at the Academy of Natural Sciences of Drexel University (Philadelphia) and Naturalis (Leiden) to create a digital species index, the presentation will look into workflows, planning and costs. The added value of digital species indexes will be illustrated with examples. Challenges and issues linked to species indexes will be highlighted and some recommendations and lessons learned shared.

A Herbarium's most wanted; not dead nor alive. An overview of IPM at the Herbarium, Royal Botanic Gardens, Kew.

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The Herbarium at Royal Botanic Gardens, Kew, houses around 7 million vascular plant specimens, one of the largest collections in the world. The Herbarium contains a complex variety of collections storage areas with different environmental conditions and challenges. Collections are stored in wings built as early as 1877 up to modern climate-controlled vaults from 2010. Equally as important as risk from fire or flood, damage to the collections from pests is a top priority and several species of pests are known as major threats to Herbarium collections. Our IPM programme has operated successfully for many years and follows industry standards for best practice of IPM in the cultural heritage sector. Our well trained and dedicated IPM team employ a variety of different strategies and equipment to deliver a successful IPM programme, incorporating many elements such as deep freezing new incoming material, training staff to identify signs of an outbreak, keeping areas clean and tidy and the careful monitoring of insect traps. We target our responses to pest hotspots and changes in pest distribution and frequency as well as focusing on the identification of pests new to the Herbarium, such as the grey silverfish (*Ctenolepisma longicaudatum*). This overview uses examples of our most commonly found pests to illustrate our IPM practices and shows how careful identification is crucial to distinguish between pest and non pest species.

A Museum of Biology in the capital of Brazil

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¹*University Of Brasilia, Brasilia, Brazil*

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture
Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Brasília is the capital of Brazil, located in the middle of the neotropical savanna called Cerrado. There are constant threats to this biome caused by the expansion of cities and agricultural development. For the last 60 years, researchers from the University of Brasília have been studying, describing, and collecting the Cerrado's fauna. Thus, ten zoological collections and an herbarium were assembled and comprehend several of the largest collections of Cerrado species. However, the research in the university often remains in the academic realm, not reaching the population. An efficient way to make the academic knowledge accessible is through scientific dissemination, in natural history museums. Regardless, Brasília is one of the few important capitals in the world that does not present a natural history museum. Furthermore, curators suffer with similar problems among themselves, and have scarce university support. Therefore, creating a Biology Museum, in the Institute of Biological Sciences at University of Brasília, will promote temporary and permanent exhibitions that may bring awareness of scientific discoveries to the general population and connect the people to the university. Also, the Museu will stimulate the scientific production and strengthen the collections. Exhibitions inclusive to people with several disabilities are one of our main goals, with objects that stimulate tactful, visual and auditory interaction. The museum can also present a positive impact on conservation, since people familiarized with the nature that surrounds them tend to cause less human impact because of the interest generated by this engagement. Therefore, this museum intends to be a place of coexistence, with direct contact with nature and the research on this nature, being a site for scientific dissemination. Also, virtual visits are planned to add accessibility for people worldwide.

A new approach to mammal specimen storage at LACM

Collections Manager, Mammals Shannen Robson¹

¹*Natural History Museum Of Los Angeles County, Los Angeles, United States*

(ML1) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

The Natural History Museum of Los Angeles County (LACM) mammal collection has about 80,000 specimens housed in cabinets of various sizes in the primary collections space. Skins, skulls, and skeletons have traditionally been organized in a single mixed series for each species, with multiple preparations stored together in the same drawer. In 2019 we undertook a large cryofumigation and taxonomic reordering project, with a secondary goal of freeing up existing storage space for future acquisitions. We decided to approach specimen storage in a new way and reinstalled specimen skins and skeletons preparations separately. By doing so, we discovered this was an exceptionally efficient use of space and freed up 30 quarter cabinets, or about 15% of our total storage space. Approaching the storage of specimen parts by preparation type allowed us to optimize drawer spacing and specimen density, thus making it easier to integrate overflow specimens and accommodate future expansion. This process also improved collections management of skeletal material in many ways, including specimen security and stability. We can confidently track and find specimens parts because our reinstallation included a thorough inventory and the incorporation of location data in our database. To solve issues of finite space, curators and collections managers will need to consider new organizational approaches beyond the typical or “traditional” ways. Relational databases that tie together the location of parts within a specimen record provide opportunities and flexibility for novel storage organization of varying collections materials.

A New Era of Provenance Research? How the Yale Peabody Museum is looking at provenance today

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G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

The term provenance has long been associated with art museums, but rarely do you find it used in the halls of natural history museums. However, the landscape is changing, and all museums are now under increased pressure to share as much information as possible about their stewarded collections. The terms ethical collecting and informed consent are becoming normalized within our field and more museums are beginning to surface their histories and examine past collecting and documentation practices. Additionally, museums are now, more than ever before, acknowledging the effects of those practices on source communities and the surrounding natural world.

With a Yale University-wide push to make provenance digitally accessible for Yale collections, initial phases of our work have focused on identifying ways to standardize our definitions of provenance across diverse collections, both within the Peabody, as well as across campus in art museums, libraries, and other physical collections. Making this information accessible requires a two-fold approach: addressing the lack of provenance documentation associated with legacy collections and setting in place procedures to vet new collections according to contemporary provenance standards. Through the lens of the Yale Peabody Museum, an institution that has historically amassed such diverse collections, we identify the methods, challenges, and successes experienced during the inception of this provenance initiative.

A new romance between taxonomic literature and specimen data? News from Paris

Gildas Illien, Alice Lemaire, Dr Clément Oury, Chloé Besombes

¹MNHN, Paris, France

(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Natural history researchers manipulate a great deal of resources, among which publications and archives play a critical part. However, biodiversity literature databases have historically developed independently from specimen and Museum databases, each community following different standards.

The digital Age did not really improve things: most current databases describing specimens and documents (notably at MNHN) are using heterogeneous formats and ontologies. It prevents researchers from the full exploitation of data potential for lack of aggregation or linkage of resources still in silos.

The proposed communication will present the overall vision and some specific projects designed by MNHN to challenge this situation, with a global intention to address the Holy Grail of the "extended specimen".

We will start with a progress report on the Datapoc project (whose initial goals were presented at the Biodiversity Next conference in 2019). It aims at demonstrating the potential of data aggregation and search through various local and national databases (natural collection databases, library catalogues, academic press, open archives), using the "person" and related unique identifiers as a linking key.

We will then consider the potential of unique identifiers for articles in serials. In taxonomic practise, whenever a specimen is published, the author is expected to cite the article having originally described it. This is not an easy task for retrospectively digitized publications as those available in biodiversity digital libraries, as they generally cannot be cited at the article level, only at the issue level. MNHN library is currently using BHL to "segment" digitized issues in articles; in a next step, DOIs will be assigned to these articles.

These two examples will illustrate some of the principles upon which a more ambitious project is currently being launched in Paris: the full redesign of MNHN collection and research Information System. Its goal is not to merge all data in a common store but to create smarter bridges between existing silos and communities. To that end, the use of common standards and identifiers will be a critical factor of success. More importantly even, it will challenge our capacity to align professional habits and curation practises among MNHN collections staff.

A proposal for the entomological collection workflow to study diversity applied to forensics and conservation: from the field to data publishing.

Dr. Luz Miryam Gomez Piñerez¹, Miss Yesica Durango Manrique¹, Dr. Andrés López¹, Dr. Eduardo Amat¹, Dr. Mariano Altamiranda Saavedra¹, Andrés Felipe Maya¹, Miss María Paula Cifuentes¹

¹*Tecnológico de Antioquia - Grupo de Investigación Bioforense, Colección Entomológica, Medellín, Colombia*

G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

A good corporate workflow allows defining and following tasks to execute a particular process properly. The excessive number of functions involved in the biological collections operation might become overwhelming without a suitable, precise, and efficient workflow. The entomological collection in the Tecnológico de Antioquia, Institución Universitaria (CETdeA), focused on forensic importance flies, took the challenge together with its staff of proposing a logical strategic plan. This proposal encompasses academic Integrity, willingness to serve, teamwork, and quality processes to bring on the workflow proposal. Four macro-processes are recognized as follows: administrative management, biological sample processing, physical space management, and visualization of the collection.

In detail, such processes include field working conform the environmental legislation, curatorial process, specimens loans and donations, processes involved in morphological and genetic analysis (morphometrics, DNA extraction, amplification, and sequencing), info publication on the global infrastructure data networks (GBIF, CBOL, GenBank), up to publishing processes about alpha taxonomy, bionomy, systematics, species distribution modeling in high impact journals. The Methodology of the collection alludes to perceiving biological specimens not only as a physical element but a more integrative vision. Within the concept of the extended specimen, an approach where biological entities deposited in collections contribute to the knowledge of biodiversity, promote research teaching, and build a framework from the basic research to the applied forensic entomology and conservation biology as here is detailed exposed.

A schema to calculate MIDS scores

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(MI) MIDS - A digitisation standard for natural history collections, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The MIDS standard (Minimum Information about a Digital Specimen) is an emerging TDWG standard currently in development to quantify the digitization status of natural history specimens. Depending on the available data on these specimens, a MIDS level of 0 ('bare') up to 3 ('extended') may be assigned. MIDS levels should be calculable in different contexts, from local databases for digitized collection data to large aggregating repositories such as the Global Biodiversity Information Facility (GBIF).

We propose a schema that maps between the source data model and the MIDS properties, taking into account known values for missing, withheld or undeciphered data elements and allowing for MIDS calculations to be made in a documented and reproducible manner. The schema is flexible and can be adjusted for different data standards and different interpretations of these standards, as is for instance not uncommon with implementations of Darwin Core. Also, the schema can be modified as the MIDS standard matures further in its development, allowing it to serve as a testing tool for the implications of adjusted, added or removed properties.

To illustrate the operation of this schema, we developed a tool that makes use of it to calculate MIDS scores for a given dataset and provides visualisations and analyses of these scores. The workflow behind this tool could eventually be integrated into existing data publishing tools such as the IPT or Biocase, introducing MIDS into specimen data pipelines that are already in operation.

References

Hardisty, A., Addink, W., Dillen, M., Groom, Q., Haston, E., et al. (Draft) Minimum Information about a Digital Specimen (MIDS) v0.14, 29 Mar 2021. <https://github.com/tdwg/mids>

A Snake in the Glass: Wet tank setup and focus stack imaging method for reptile and amphibian specimens

Ms Emily Braker¹

¹*University of Colorado Museum of Natural History, UCB 265, United States*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Fluid-preserved reptile and amphibian specimens are challenging to photograph due to their complex three dimensional forms and reflective surfaces when removed from solution. A wet tank setup combined with focus stack photography is a useful approach to counteract these issues and generate high-quality images for publication and remote examination of fine traits. Imaging specimens beneath a layer of preservative fluid reduces risk of desiccation and glare, while focus stacking merges multiple images taken at different focal depths to create a single composite image with a broad depth of field, ensuring all anatomy is in focus even under zoom magnification. This presentation will provide an overview of wet imaging station components and the focus stack photography workflow implemented by the University of Colorado Museum of Natural History Herpetology Collection for the NSF-funded oMeso digitization project (NSF #2001474 Digitization PEN: Opening Mesoamerican Herpetofaunal Diversity to Whole Phenome Imaging).

A Stable Future - The importance of stable and sustainable Oddy tested materials within taxidermy.

Ms Jazmine Miles-long¹, Ms Bethany Palumbo²

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G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022,
9:30 AM - 11:00 AM

Taxidermy collections play a vital role in our understanding of biodiversity, evolution, population genetics and climate change. They form a large part of our natural history collections and as such their long-term preservation is imperative. Historically, taxidermy was created using natural and stable materials with examples dating back to the 16th century. However in the last 50 years, taxidermists have moved away from these materials, preferring to use new chemicals and plastic-based materials in their work for ease of application and effectiveness when creating a realistic piece. One such example is polyurethane, a very widely used material to build the form that goes under the taxidermy skin. Polyurethane is widely tested (not in the context of taxidermy) and has already shown to be unstable and unsuitable for long term use. An awareness of conservation grade materials is not still commonplace within the taxidermy community and the result of this is that many pieces of modern museum taxidermy are made with untested and potentially unstable materials.

In 2021, Taxidermist Jazmine Miles Long was awarded an Arts Council England grant to explore and experiment with conservation-grade, natural and sustainable materials for use in taxidermy manufacture. Her research has two main aims. Firstly, to understand further what modern taxidermy materials are composed of and how they deteriorate. This includes the oddy-testing of existing materials, which was undertaken by Cardiff University. The second aim is to develop new materials that are conservation-grade but still versatile and able to create a realistic piece. This paper will present all her research so far, including preliminary testing results, potential alternatives and future plans for this continued research.

Through this project Jazmine aims to raise awareness within the taxidermy and museum community of the importance of best practice in creating taxidermy, not just in caring for it. It is imperative now more than ever that we look at our own practises to see where improvements can be made. Looking at the materials we use and questioning is this material stable? And is this material ethical and sustainable?

A Swiss sense of compromise: Planning a new museum building in an eco-friendly city

Dr Alice Cibois¹

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(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The Natural History Museum of Geneva is a 200 years institution that has experienced, like many museums, several phases of expansion and relocation. Its current building, located in the left bank of the Geneva Lake, has recently celebrated its 50 years and is now facing several issues like modernizing the conservation of the fluid collections and expanding collection space, both in terms of safety regulations and of preventive care. During the initial planning procedures, we were able to convince the decision-makers to orientate the new project towards the building of an extension of the current structure rather than moving the collections to an off-site storage facility. On the other hand, this choice raised challenges regarding the preservation of the park surrounding the Museum and the feasibility of using the underground in a densely urbanized neighbourhood. The City of Geneva has developed ambitious priorities towards the ecological and social transition facing climate emergency: the Museum's project has also to comply with these criteria, in limiting the impact of the new structure in terms of energy and environment. The solution proposed has fulfilled all problematics in what can be seen as a compromise between the creation of new spaces for collection storage and research and the preservation of the Museum's urban and natural surroundings.

A toolset for combining legacy collections data with data from modern digitization efforts into a relational database.

Ms. Maricela Abarca¹

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Natural history collections are each at their own stage of digitization. Some collections have already undergone large digitization efforts, while others are just beginning to undertake specimen digitization. In both scenarios, there is a need to ingest newly created data into a database, often a relational database. An additional challenge may be presented by combining legacy data that is not readily Darwin Core (DwC) compliant, with newly generated data that is DwC compliant. This was the case for our fossil collections at the California Academy of Sciences. In order to mesh legacy data with new data, field headers and definitions were first resolved between non-DwC compliant legacy data and data generated from the Eastern Pacific Invertebrate Communities of the Cenozoic (EPICC) TCN that concluded in 2021. A Python script utilizing set theory on specimen unique identifiers was then used to resolve cases where legacy specimen lots were inadvertently digitally duplicated by staff during grant work. A separate script was also developed to merge collaboratively georeferenced coordinates with historic locality descriptions as well as check their accuracy by utilizing interactive maps using the Folium Python library. All of the merged data were then ingested into a MySQL (MariaDB) database, and a web interface was developed to access and work with the data. We will demonstrate the data merging scripts, Folium map generation, data ingestion, and web interface. All of the code is available at <https://github.com/myabarca>.

A whole lotta jars: revision of the historical wet collections of the Museu de História Natural e da Ciência da Universidade do Porto

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The historical collections of the Museu de História Natural e da Ciência da Universidade do Porto (MHNCUP), Portugal, represent an important but yet understudied scientific heritage. These collections, which data back to the late nineteenth century, are some of the most important natural history collections in the country. They have had a pivotal role for the development of zoological sciences in late nineteenth/early twentieth century Portugal, as well as to teaching of natural history in the University of Porto. The MHNCUP collections are constituted by the typical assortment of categories of specimens present in most natural history collections: herbaria, mounted taxidermies, study skins, pinned insects, osteological collections, shells, fluid preserved specimens, etc.

The “wet collections”, constituted by specimens preserved in different types of fluid preservatives (from formalin to ethanol) represent a considerable part of the zoological collections (over 5000 jars), ranging from invertebrates, fishes, amphibians and reptiles, birds and mammals. Besides the presence of some more recent specimens, most of the collection dates back to the late 1890’s to 1930’s.

Following decades of abandonment and improper curation, the wet collections are now being reviewed, recatalogued and recovered. In this presentation we aim to present an overview of collections in terms of taxonomic coverage, origin of the specimens, the diversity of type of jars present in the collections, the preservatives used, the main conservations problems and the subsequent adopted solutions to its recovery and curation. This represents a study case on the recovery of an entire historical liquid collections, as well as can serve an illustrative example on what a “typical” late nineteenth/early twentieth century wet collections looks like.

Adapting Arctos for Paleontology Collections

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G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Arctos is a collaborative web-based collection management solution managed by a community of collecting institutions. This system serves data not only on all types of natural history specimens but also archaeological and cultural objects. Arctos is a flexible system, designed to be adapted to the needs of its users. In 2018, staff at the New Mexico Museum of Natural History and Science (NMMNHS) decided to migrate its biology and paleontology databases to Arctos. Containing over 81,000 fossil specimens, NMMNHS is the largest paleontology collection in Arctos to date. Prior collections (approximately 87,000 specimens) laid the groundwork for paleontological and geological data in Arctos, including the University of Alaska Museum of the North, the University of Alabama, the University of Texas – El Paso, and the University of New Mexico. As an incoming collection, NMMNHS assessed how the current Arctos data structure could be improved for its paleontological data. Then, we worked collaboratively with other Arctos users and the database programmer to plan modifications to the database. These discussions considered consistency, ease of querying, mapping to Darwin Core, and complying with laws that regulate the sharing of fossil locality data. New types of data included more complex specimen parts and relationships, locality ID numbers, biostratigraphy, land ownership, United States Geological Survey quadrangle maps, and public land survey coordinates. We continue to discuss paleontology data needs as they arise, for example, ichnotaxonomy and taphonomy. Most of these data types are more heavily used in paleontology and geology collections than in other types of natural history collections, with some being very specific to paleontology. The most significant change we have made is to modify our geology attribute structure into a new system of locality attributes. This new structure allows us to handle a variety of locality specific data in a predictable manner that will increase discoverability without de-normalizing the core idea of a locality in Arctos, which is simply a unique point or polygon in geographic space. This new structure will benefit the entire Arctos community, and not just Earth science collections.

Advancing Interdisciplinary Collaboration between Natural History and Cultural Heritage Collections

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G12: General, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Cultural Heritage samples archives share many commonalities with natural history collections – not only in their content (as many will contain natural history materials), but also in their function and importantly in the challenges that they face. This paper will present the work of the Heritage Samples Archives Initiative (HSAI) and its initiative to connect and collaborate with efforts in the Natural History archives community. HSAI was launched in September 2020 by ICCROM, an intergovernmental organization working in service to its 136 Member States to promote the conservation of all forms of cultural heritage, in every region of the world. In promoting the long-term survival and use of heritage samples archives, and the need to make these archives more accessible online, HSAI has started to explore the commonalities between Natural History archives and Cultural Heritage archives, and the opportunities that greater interdisciplinary collaboration and sharing offer for much needed practical, low-cost accessible solutions.

Many cultural heritage institutions around the world hold material samples archives comprising samples collected from heritage objects and sites, reference materials and replicas. These historic resources are non-renewable and have huge potential for future research and didactic purposes, but they are often little known, and their value under recognized. In addition, they pose very particular challenges concerning their physical safeguarding, access and use. As a result, they are critically threatened. Together with a partnership of over 25 institutions around the world, ICCROM is working to enhance the recognition and sustainable use of heritage samples archives, pursuing the following objectives:

- Raise awareness of the value and importance of heritage sample archives.
- Develop good practices, through improved policies, tools, and methodologies for sample archive management.
- Increase the accessibility and use of heritage samples archives, connecting them through open digital platforms.

Adventures in globally unique identifiers at the Smithsonian

Ms. Rebecca Snyder¹

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ID2) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

In early 2020, the Smithsonian used our Open Access initiative as a driver to introduce an institution wide approach to persistent and globally unique identifiers, building on the existing implementations at the National Museum of Natural History (NMNH) and Smithsonian Libraries and Archives (SLA). Our solution had to simultaneously:

- work across multiple domains from collections, to library and archives, to art and humanities
- be applied to legacy and new datasets
- be automated within all the various databases, infrastructure, workflows, and data sharing already in place

This talk will outline the reasoning behind key decisions, provide lessons learned and pitfalls to look out for, as well as what having these identifiers in place enables NMNH and the Smithsonian to do going forward.

Alcide d'Orbigny and the Paris Foraminifera: story of a collection under Byne attack

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G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

In 1858, the National Museum of natural History, Paris, acquired the prestigious foraminiferal collection of the French naturalist Alcide Dessalines d'Orbigny (1802-1857). Pioneer in the fields of micropalaeontology and biostratigraphy, d'Orbigny's deep interest in tiny shells and micro-fossils led him to publish the first classification of the Phylum of Foraminifera in 1826. He later became the first professor of palaeontology at the Museum. However, quarrels in the teaching community resulted in multiple vacancies at the chair of palaeontology after d'Orbigny's death. His collection, which includes about 800 slides of type specimens, 3D sculptures enlarged 40-200 times, hundreds of "unpublished plates" and a thousand small bottles of sediments, was progressively abandoned. For almost a century, the foraminifera have been left to the care of scientists external to the museum. In 2007, a position of professor of micropalaeontology was finally created and micropalaeontological collections were gathered. Until then, the conditions of conservation of this outstanding scientific resource have been relatively unknown.

Today, the collection is threatened by Byne decay. About a fifth of the foraminifera is suffering from the development of white calcium-based efflorescence that fragilize the structure of the specimens. Presence of wooden-based materials can explain the emergence of the salts. Yet, the variety in the distribution and mineralogical nature of the crystals seems to indicate different degradation mechanisms linked to the storage conditions. Thereby, a key to understand the current state of the collection leans on its past. This presentation is thus an invitation to travel through time. It deals with the history of the collection care, taking advantage of the few testimonies (archives, photographs...) that reached us.

Alexgeorgia: recognizing a botanical legacy through a distinctive genus

Dr Mare Nazaire¹

¹*California Botanic Garden, Claremont, United States*

Alexgeorgia is a genus in the Restionaceae family (also commonly known as restiads) and native to Australia. Alexgeorgia is distinctive in that the female flowers of these plants are invisible for most of the year, the flowers borne below the surface of the sand, with only the styles appearing inconspicuously above the ground and soon wilting. Sherwin Carlquist (1931 - 2021), perhaps one of the most influential botanists of our time, described the genus and two species in the Australian Journal of Botany in 1976. Carlquist, who passed away this last December, made significant contributions in plant systematics, wood anatomy, evolutionary and ecological theory, and island biogeography, and published prolifically on these subjects, with over 300 publications over the course of his distinguished career. The specimen chosen for the Specimen Spotlight is the holotype for Alexgeorgia subterranea to highlight this amazingly unusual plant and pay tribute to the botanical legacy of Sherwin Carlquist.

All the cool stuff a taxonomic journal can (should?) showcase through semantic enhancement

Mrs Laurence Benichou¹, Dr Fabio Cianferoni², Mrs Isabelle Gerard³, Dr Tony Robillard¹, Dr Niels Raes⁴, Mrs Radka Rosenbaumova⁵

¹Museum national d'Histoire naturelle (MNHN), Paris, France, ²Consiglio Nazionale della Ricerche (CNR), , Italy, ³Royal Museum of Central Africa (RMCA), Tervuren, Belgium, ⁴Netherlands Biodiversity Information Facility (NLBIF) - Naturalis Biodiversity Center, Leiden, the Netherlands, ⁵Departement of Botany, Department of Botany, National Museum, Prague, Czech Republic

(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The European Journal of Taxonomy (EJT), a journal jointly published by 10 Natural History Institutions in Europe, was created in 2011 with the intent to enable its members to collectively tackle the strategic and technical challenges related to the visibility, access, format and financial structure of academic journals, especially publicly-funded titles. Publishing being an important component of the research cycle, EJT was designed, from the beginning, with the aim to liberate the data contained within its articles to the ecosystem of dynamic, stable, free-to-use and interconnected platforms available on the Web, such as the Global Biodiversity Information Facility (GBIF).

Even though EJT publishes only online, it remains a traditional journal in regards with its production workflow. To extract the data contained within its papers, the technical process begins with the decoding of the born-PDF by Plazi followed by the semantic enhancement, tagging taxonomic names, material citations, bibliography, images etc. (Benichou et al. 2021). Once liberated, the data becomes an integral part of research and is accessible through data portals like GBIF and the Biodiversity Literature Repository (BLR), provides specific access to material citations and makes them FAIR, and thereby multiply their citability and reusability.

The lessons learnt from this approach reveal that avoiding discrepancies in the data remains time-consuming and represents a cost. It is clear that publishing in PDF is adding legacy to the already huge amount of data published and digitized. Yet, most institutional or learned society journals currently publish only in PDF, which might remain the predominant way of publishing in the academic publishing landscape for a long time.

As part of CETAF E-publishing WG efforts and Bicikl project, EJT is updating its production workflow to publish semantically enhanced papers in the future that make the annotated data directly accessible (FAIR), and to provide bidirectional links within the publication itself.

The presentation aims at showcasing the cool stuff a journal can obtain by extracting the data from its papers, even by retro-conversion. The authors will demonstrate that such efforts are worth it for any taxonomic journal, providing it with useful metrics and indicators of their own success.

An advanced method of non-traditional bird skin preparation, to ease applications of scientific methods and enhance the value of avian collections

Mr Bernhard Bock¹, Mr Matthias Krüger¹

¹*Friedrich-Schiller-Universität Jena, Institut für Zoologie und Evolutionsforschung mit Phyletischem Museum, Ernst-Haeckel-Haus und Biologiedidaktik, Jena, Germany*

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Birds are among the oldest taxidermized animals, started with mummification as grave goods by Egyptians (Schulze-Hagen, Steinheimer et al. 2003, Wasef, Wood et al. 2015). The methods of preparation have changed, but not its value – be it for veneration, burial goods, art, or scientific research (Winker 2005, Ikram 2015). For the latter one birds are traditionally prepared with folded wings and a straight body, which has more historical than scientific reasons (Carrillo-Ortiz, Guallar et al. 2021). Despite every taxidermist has his own ‘handwriting’ which more specifically means, that even if the method of preparation remains the same the results will be different (e.g., stretched neck, elongated arms) and therefore measurements taken are already distorted. This type of preparation neglects correct scientific use of the object, as it impedes the interpretation of moult and key features e.g., for age identification. To be able to examine color patterns and moult correctly, wings should not be folded as on a traditionally prepared bird skins, where the correct determination of these parameters often causes unavoidable damage to the specimen. Another nowadays huge disadvantage, that is hardly mentioned, is that on ‘classic’ bird skins, that the skull, leg bones and distal ends of wing bones are usually left within the skin, even though they can provide crucial scientific data (Winker 2000, Tsai, Schedl et al. 2020). We want to advance the trend set by Norris (1961) of non-traditional bird skin preparation (Hendry 2016), a method which attempts to achieve maximum potential for future scientific use of avian collections. In addition, the digital recording, storage, and handling of the object was considered, to aim for further ease and precision in obtaining relevant information.

An aerial view: a top down approach to digitisation using whole drawing imaging

Miss Elizabeth Devenish¹, Ms Robyn Crowther¹

¹*The Natural History Museum, London, United Kingdom*

Unlocking specimen data through digitisation is the goal of many natural history museums, but often this mammoth task is limited by available resources. Alternatively, capturing data for a group of specimens may be a more cost and time efficient process, providing a basis for future digitisation of individual objects.

The Natural History Museum, London (NHM) is currently preparing for the largest collections move in its history. This will require capturing data to track specimens moving between locations, and documenting conservation status. Where possible, this will be completed for individual specimens, however certain collections are of such high-volume that it will be impossible to complete this in time and within budget. One such collection is the Museum's nine million specimens of pinned Coleoptera, which will instead require data capture at a broader level.

By imaging individual drawers, this level of data can be documented quickly, capturing an overall specimen count, label data, presence of type material, and a basic conservation condition assessment. Drawers of pinned entomological specimens particularly lend themselves to this imaging approach. A photographic reference of a collection also has the advantage of allowing a user to examine the contents of each drawer remotely, likely to be particularly valuable in light of the COVID-19 pandemic and resulting lockdowns.

Using a portion of the NHM's 28,000 drawers of pinned Coleoptera specimens, we completed a project comparing two contemporary imaging setups: a high-cost scanner and comparatively low cost camera and light box. In this presentation, we will evaluate the differences in image quality, capture rates and overall costs of each method, whilst addressing limitations in historical drawer scanning projects. We will also discuss the potential replicability and utility in other collection types and museums, as well as the use of images both by curators and external users via the NHM's open-access data portal.

An Agate a Day Gets the Public Engaged

Ms Emily Brown¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Introducing @ScottishAgates, National Museums Scotland's newest twitter account showcasing our extensive Scottish agate collection to the general public. Inspired by a flippant comment about how we had enough pretty agates to show one a day for a year, this account now delivers effective public engagement to new audiences while feeding into the Museum's digitisation strategy. With the increased expectation and demand for online content during various lockdowns, this project has been a fantastic way to share a beloved part of our collection that doesn't usually get seen and has also fed into other novel engagement methods.

An integrated knowledge hub for the natural science collections community - the example of the DiSSCo Knowledgebase

Dr Sabine von Mering¹, Ms Sabine von Mering¹, Mr Falko Glöcker¹, Ms Mareike Petersen¹, Julia Pim Reis

¹Museum Für Naturkunde , Berlin, Germany

(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Natural history collections (NHCs) are crucial resources and infrastructures for scientific research in many fields but also important for the exchange with society about nature. In the last two decades, various projects and initiatives have conducted research on how to share, exchange, and link information about collections and resources related to e.g. digitization and preservation of objects. Knowledge bases are becoming a useful tool to aggregate information from organizations or communities, thus improving the quality of the knowledge transfer and acting as a single point of access.

In this DemoCamp, we will demonstrate the current version of the DiSSCo Knowledgebase (KB, <https://know.dissco.eu/>), a pilot implementation developed within the preparatory phase of DiSSCo (Distributed System of Scientific Collections). This central and freely accessible hub aims to become a trusted source for project outcomes, publications and other relevant resources. The functionalities of the KB include: the capability of uploading, storing and downloading documents and free text for referencing publications, internal guidelines and best practices, training material and much more; Full-text search index method (including the capability of indexing of customizable metadata), meaning that every word in all stored documents will be searchable; Hierarchical structuring of pages and other entities (important for structuring the content to be added to the Software); Single Persistent Identifier linking to the submitted items and a customized workflow for the submission process.

This KB provides an example for the natural history collections community by providing access to a wide range of resources and by cross-linking to other information systems and services (including knowledge bases), thereby helping to improve productivity of knowledge transfer

An introduction and overview to the new SPNHC publication 'Best Practices in the Preservation and Management of Fluid-Persevered Biological Collections'.

Mr Julian Carter¹, Mr Dirk Neumann^{2,3}, Mr John Simmons⁴

¹*Amgueddfa Cymru National Museum Wales (UK), Cardiff, United Kingdom*, ²*Staatliche Naturwissenschaftliche Sammlungen Bayerns, Zoologische Staatssammlung, , Munich, Germany*, ³*Leibniz Institute for the Analysis of Biodiversity Change, Centre of Natural History of the University of Hamburg (LIB-CeNak), Hamburg, Germany*, ⁴*Museologica, Bellefonte, USA*

BEST PRACTICES IN THE PRESERVATION AND MANAGEMENT OF FLUID-PRESERVED BIOLOGICAL COLLECTIONS is a newly published book that establishes effective and achievable standards for the maintenance and care fluid collections of different sizes. The best practice recommendations are holistic and take into account resource limitations for maintaining collections in stable condition. Additional recommendations are provided in three un-ranked categories that reflect the differences in institutional curation capacity, storage environment, collection size, laboratory facilities, frequency of specimen use, and available resources (e.g., budget, collection care staff) in major research collections vs. smaller regional collections. The development of these best practices began with a 2013 initiative funded by a Clothworkers Foundation grant directed by Chris Collins (NHM London) and were further refined in workshops at SPNHC conferences in Cardiff (2014), Berlin (2016), and Denver (2017); an experts meeting at the Smithsonian (2018) directed by Catharine Hawks; and a symposium on the “Preservation of Natural History Wet Collections: Feedbacks and Prospects” (Paris 2018) organized by Sophie Cersoy, Julian Carter, Marc Herbin, Dirk Neumann, and Véronique Rouchon. Information and critical comments from these interactive meetings served as a framework to enhance our understanding of the care and conservation of fluid preserved objects and develop key questions and baselines for future research. This presentation will summarise the way this book has brought together current collective knowledge on the management and care of fluid preserved collections while also drawing attention to how much we still do not understand. This enables the community to more clearly identify and prioritise the collaborative research needed to further enhance our understanding of these valuable and unique collections.

An introduction to the marine invertebrate wet collections at National Museums Scotland

Ms Fiona Ware¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The collection of marine invertebrates at National Museums Scotland is one of the largest of its kind in the UK and is estimated to contain over 4 million specimens.

A large collection of invertebrates, collected by Scottish naturalist, oceanographer and experienced polar scientist William Speirs Bruce during the Scottish National Antarctic Expedition (SNAE) in 1902-04, was donated to the museum in 1921 and until the 1970s this formed the largest part of the wet collection.

More recently, collecting has focussed on Northeast Atlantic marine invertebrates with a particular emphasis on the Scottish fauna. Samples from the Marine Nature Conservation Review, a government funded survey exploring the shallow coastal flora and fauna of British waters, were acquired by the museum in the 1990s.

In recent years National Museums Scotland has acquired several large and scientifically important collections of marine invertebrates through collaboration with government, academic and commercial institutions.

In 2014 the collection was moved to a new, purpose-built storage facility at the National Museums Collection Centre. This has had many benefits including better storage, an updated taxonomic sequence, better facilities and improved access for visiting researchers.

This paper will explore the history and development of the marine invertebrate wet collection at National Museums Scotland. It will also look at the current opportunities and challenges facing the collection.

And We're Live: Utilizing Livestreaming and Digital Technology to Engage Audiences with Natural History Collections

Collections Manager and Outreach Coordinator Gabriel-Philip Santos¹, Collections Technician Brittney Stoneburg²

¹Raymond M. Alf Museum of Paleontology, Claremont, United States, ²Western Science Center, Hemet, United States

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Natural history collections are important in many fields of scientific study and are also incredible tools for education and engaging the public – however, natural history collections remain inaccessible to most of the general public simply due to logistical constraints and for the sake of specimen preservation. This creates a long-running tension for education and outreach specialists on how to best utilize natural history collections for engagement and learning while also protecting fragile and often irreplaceable specimens. Digital media technologies have opened new methods of inviting the public into collections spaces. The growing culture of live-streaming and the accessibility to increasingly user-friendly streaming technologies provides an incredible opportunity for museums and other institutions to engage with the public, educate on the importance of collections, showcase rare and fragile specimens, and share science-driven stories. Streaming also allows for direct engagement with scientists from different backgrounds, fields, and perspectives around the world through instant video chatting to a wide audience. Most livestream services and apps now also have captioning services and other accessibility accommodations for a more inclusive experience. “Fossil Friday Chats”, for example, is a livestream production created in collaboration between the Raymond M. Alf Museum and the Western Science Center to “share stories from the world of paleontology”. With over 60 produced episodes featuring diverse paleontologists from around the globe, the livestream has introduced thousands of viewers to amazing scientists and intriguing specimens. In addition, the availability of metadata on streaming sites such as YouTube and Twitch aids in evaluating the reach and success of such programs. Although there can be a steep learning curve to developing quality livestreams, the availability of such technologies can help to further access to natural history collections and broaden perspectives on their importance.

Applying Colorimetry to Minerals: Limitations and Applications

Miss Kathryn Royce¹

¹*University of Oxford, Oxford, UK*

G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Colorimetry is a valuable tool for the heritage sector, as it is an easy to use, increasingly affordable, portable, and non-destructive means of quantifying change over time within heritage contexts. It is used most commonly within the sector to determine the effects of light, pollutants, and conservation treatments on objects such as artwork, mosaics, wall paintings, building materials, and textiles. Colorimetry has also been recently applied to herbaria specimens. To determine additional applications within the natural history museum, experiments were conducted to verify possible use with geological specimens, specifically minerals. Although initial experiments identified some challenges in applying currently available portable colorimeters, it proved to be a great success with metallic minerals (such as pyrite and hematite) and could accurately represent various stages of tarnish. Current work is examining the correlation between pyrite colour and tarnish by utilising an AI algorithm. This has been developed into an app that can predict the likelihood of tarnish, in an attempt to design a tool that aids preservation decision-making.

Applying the Digital Extended Specimen: building collections and integrating data

Sara Hansen¹, Rachel Hackett², Blake Cahill¹, David Cuthrell², Michael Monfils², Michael Belitz³, Ryan Goebel¹, Logan Rowe², Anna Monfils¹

¹Central Michigan University, Mount Pleasant, United States, ²Michigan Natural Features Inventory, Michigan State University, Lansing, United States, ³University of Florida, Gainesville, United States

(MI) MIDS - A digitisation standard for natural history collections, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Digital Extended Specimen (DES) data are critical resources for research and conservation efforts aimed at mitigating biodiversity loss. Discussions among the Distributed System of Scientific Collections (DiSSCo), Biodiversity Collections Network (BCoN), GBIF's Alliance for Biodiversity Knowledge, TDWG's Task Group on Minimum Information about a Digital Specimen (MIDS), and others have converged to define the DES and explore next steps. As the collections and research communities move into the next phase of the DES, there is a need for examples that illustrate the practical application of the DES to new and existing datasets. Here we present case studies that demonstrate our process for creating, curating, and disseminating extensible specimens and associated data to inform ongoing research and conservation. We have applied our DES-based workflow to two urgent biodiversity issues: the invasive, aquatic plant European frog-bit (*Hydrocharis morsus-ranae* L.), which has rapidly spread throughout the Laurentian Great Lakes region since 1939, and the IUCN-listed Poweshiek skipperling butterfly [*Oarisma poweshiek* (Parker 1870)], which has experienced a precipitous decline in the last two decades and now only occurs in small populations in Michigan, United States and southern Manitoba, Canada. Partners on these projects have developed shared sets of goals, methods, and data practices based on the FAIR Guiding Principles and Open Science values, which allow for seamless integration and sharing of data among data providers and users. We will highlight the critical roles for building and maintaining DES data at each step of the process, including database design and oversight by a data architect, fidelity to best practices for specimen and associated data collection by a field researcher, and curation of specimens with associated digital data by herbarium personnel. We will share our perspective as a regional collection (Central Michigan University Herbarium, CMC) and discuss our decisions for project management, data collection and curation, and quality control that maintain the integrity of data in our research database, herbarium collection, and published DES objects. By creating and sharing high-quality DES data for ongoing projects and downstream use, we emphasize the importance and possibilities of the DES in applied research.

Approaching sustainability through strategic reduction of concerns

Dr Robert Waller¹

¹*Protect Heritage Corp., Ottawa, Canada*

(ML2) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Investing resources to address concerns that ultimately will not benefit the world is clearly antithetical to sustainability. Can we identify examples of collection management and care initiatives that are either useless or inefficacious? If we can, then eliminating those investments would seem to represent low hanging fruit for improving sustainability.

The application of risk assessment to collection care has demonstrated that many of the plausible risks to collections that we apply considerable effort to further mitigating are not quantitatively significant in the long run. Those resources, whether financial, energy, political capital, emotional reserves could all be saved for more useful endeavors. Even understanding how long is the “long run” we should be thinking of helps identify resource allocations that ought to be considered irrational based on an unrealistic estimation of the net present value of the future existence of collections. For example, investing now to assure preservation benefits beyond 100 years is arguably inappropriate, as difficult as that may be to accept emotionally. Of course, this will involve a sliding time frame where in 2022 we target preservation to 2122 while in 2082 our successors will strive to preserve what remains of our 2022 collections until 2182.

These challenges can all be considered more rationally by thinking in terms of the Net Present Value (NPV) of future availability of collection items. The same kind of rational analysis can be applied to decisions of what to keep and what to abandon at any stage of collection work, beginning with field work, accessioning, retaining, consumptively using, and deaccessioning. Treating selection decisions at these steps in rational ways can effectively change sins of omission to sins of commission. That simple fact may explain why our collection management field might be slow to address the need for more rational decisions. To address this problem, we must collectively develop a theory of strategic collection management to provide a necessary intellectual foundation for such decisions. The challenges of, and current attention to, sustainability issues must be recognized to fuel progress in that development.

Arctos - GloBI Collaboration Update: Continuing to Extend Digital Records across Communities, Platforms, Collections, and Institutions.

Jorrit Poelen^{1,2}, Dr. Elizabeth Wommack³, Teresa Mayfield-Meyers⁴, Andrew Doll⁵

¹Ronin Institute, Montclair, United States, ²Cheadle Center for Biodiversity and Ecological Restoration, UC Santa Barbara, Santa Barbara, United States, ³University of Wyoming Museum of Vertebrates, Laramie, United States, ⁴Arctos, Albuquerque, United States, ⁵Denver Museum of Nature & Science, Denver, United States

Hallway discussions at SPNHC 2019 in Chicago set in motion a long-discussed collaboration between Arctos and Global Biotic Interactions (GloBI). We have come a long way in the three years since, and the number of documented relationships in Arctos that are indexed by GloBI doubled in 2020/2021 to include about 150K specimen-based interaction claims and continues to grow. Nonetheless, there still remain hurdles for both platforms to achieve the goals we have set out for connecting related museum records across collections and documenting their biotic interactions. We will discuss the backgrounds of Arctos and GloBI and how their goals align. Also, we'll explore our shared desire to deepen our collaboration; primarily by extending the digital records managed in Arctos through the interactions resolved in GloBI. We will show how GloBI's ability to index biotic interactions enhances the quality of Arctos' records, improves management features, and adds documentation. By sharing our hands-on experience in extending the reach of our Natural History collections beyond their institutional silos, we hope to inspire discussion in the broader biodiversity data community about how to better integrate the valuable evidence-based knowledge in our collections data.

Arctos: Collection Data Management, Publication, and Community in Support of the Extended Specimen

Community Coordinator Teresa Mayfield-Meyer¹

¹*Arctos, Albuquerque, United States*

(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

This demo will provide a brief overview of data and search tools in Arctos, an online multi-institutional collection management information system and publisher of museum collection data. Arctos' mission is to connect natural and cultural history collections within a digital ecosystem that promotes high quality data to empower research, education, and conservation. Arctos is continuously developed by its members, a consortium of museums and organizations that participate in a self-governing community of museum professionals, who share expertise to support and shape the Arctos experience. The Arctos community strives to rigorously document collections with data that are standardized, discoverable, linked, and secure to enable the broadest usage for science, society, and future generations. This demonstration will highlight shared features that enable integration of museum records within and across collections, institutions, and external resources to maximize usage, extension, and discoverability.

Arctos: Community-Based Collaborative Collection Management for Natural and Cultural History Data

Senior Collection Manager Mariel Campbell¹, Ms. Emily Braker², Ms. Carla Cicero³, Mr. Andrew Doll⁴, Ms. Kyndall Hildebrandt⁵, Ms. Lindsey Frederick⁷, Ms. Michelle Koo³, Ms. Angela Linn⁵, Ms. Teresa Mayfield-Meyer¹, Ms. Carol Spencer², Mr. Christopher Witt¹, Ms. Elizabeth Wommack⁶

¹*Museum Of Southwestern Biology, University Of New Mexico, Albuquerque, United States*, ²*University of Colorado Museum of Natural History CO 80309, Boulder, United States*, ³*Museum of Vertebrate Zoology, University of California, Berkeley, Berkeley, United States*, ⁴*Denver Museum of Nature & Science, Denver, United States*, ⁵*University of Alaska Museum of the North, Fairbanks, United States*, ⁶*University of Wyoming Museum of Vertebrates, University of Wyoming, Laramie, United States*, ⁷*New Mexico Museum of Natural History and Science, Albuquerque, United States*

Arctos (arctosdb.org) is a web-based collaborative collection management system and data portal serving global data on ~4.3 million biodiversity and cultural records from more than 247 collections with nearly 800,000 media objects (images, audio, CT scans, documents). Arctos is a leader in providing museums with community-driven solutions to managing and improving collections data and developing workflows for data cleaning and publication. Pioneered in 1999 and securely hosted since 2012 at the Texas Advanced Computing Center, the portal (arctos.database.museum) provides numerous tools and services to manage museum data and make them publicly available. A web interface supports data entry and editing, with integrated tools for transaction and permit management, geocoding, mapping, citations, object tracking, and automated IPT publishing. Arctos strives for superior data quality through its highly-normalized model, controlled vocabularies, and authorities. Shared standardized data has led to innovative ways of relating objects within or between collections (e.g., predator-prey, host-parasite relationships), promoting data exploration and interdisciplinary research. Arctos also leverages external services to extend capabilities and generate reciprocal links with collaborators, including Barcode of Life, GBIF, GenBank, Global Biotic Interactions, Global Genome Biodiversity Network, Global Names, iDigBio, IsoBank, iNaturalist, MorphoSource, World Register of Marine Species, and VertNet. Furthermore, Arctos is a community of museum professionals who collaborate on best practices and work together to improve data richness and expand functionality. Arctos collections benefit from this community approach, and members share equally in its development through the Arctos Working Group. Arctos connects and integrates biological, earth science, and cultural data and media as well as emerging data types such as environmental DNA and microbiomes. By connecting natural and cultural history collections within a digital ecosystem and promoting high quality data, Arctos enables data access and use to ultimately empower research, education, and conservation.

Are you prepared? Preparation, response, and recovery of collections in unanticipated disasters

Dr Mare Nazaire¹

¹*California Botanic Garden, Claremont, United States*

G12: General, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

With 86 acres, California Botanic Garden is the largest botanic garden devoted to California native plants and maintains five collections: living, seed, herbarium, library, and archives. On 21-22 January 2022 a devastating windstorm with gusts approaching hurricane force speeds toppled hundreds of trees in the city of Claremont where the Garden resides and caused severe damage to the Garden's living collection. Numerous living collection accessions were damaged or destroyed, including dozens of trees. Other collections and areas in the Garden sustained minor damage. Prior to the windstorm event two Garden committees – the Emergency Preparedness & Response Committee and the Collections Committee – had implemented routine disaster planning and response training to Garden staff, including presentations, practice drills, exercises, and written protocols. Although this windstorm was unanticipated, and not the type of disaster the Garden had been specifically preparing for, it provided Garden staff an opportunity to put into action its disaster response and recovery plan and to assess what elements of the plan worked, identify gaps, and where improvements to the plan could be made. In this presentation we share our experience with the response and recovery of the windstorm event and the Garden's approach to disaster planning, preparation, response, and recovery and the lessons that we learned.

As Dead as a Dodo: Extinction Narratives and Justice in the Museum

Ms Anna Guasco¹

¹*University Of Cambridge, Cambridge, UK*

(EX) Exhibiting Extinction and Endangerment, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

This paper raises questions about the relationship between narrative, storytelling, and environmental justice in the context of museum engagement with extinction. Focusing on narrative and rhetorical devices such as invocations of a universal human 'we' in the context of mass extinctions, I argue that how 'we' tell stories about extinction in and through museum spaces matters. I use a more-than-textual approach to narrative analysis to examine the case study of a permanent gallery on extinction, evolution, and biodiversity loss: the Survival Gallery of the National Museum of Scotland. This paper explores the range of ways that the Gallery relates stories of 'natural' extinction to the contemporary anthropogenic 'Sixth Mass Extinction' and the 'Anthropocene'. I will provide additional examples of how museums can narrate complex stories, whilst also calling attention to why museums should be cautious of the potential both to obscure social and environmental justice concerns and to present problematic depictions of a universalized humanity. This paper aims to share some of the possibilities and challenges of museum storytelling in grappling with complicated pasts and envisioning potential futures of survival, coexistence, and flourishing.

Ask and Ye Shall Receive: Implementation of a Digital Entomological Loans Workflow

Mr Peter Wing¹, Jennifer Pullar¹, Nicola Lowndes¹, Kate Holub-Young¹

¹*Natural History Museum, London, London, United Kingdom*

(VA1) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

For many people who work with natural history collections, the ongoing pandemic has substantially limited access to the specimens and objects they require to continue their work. This disruption has been the case for both those internal and external to many institutions and has the potential to create sizeable backlogs of work or requests for material to be loaned either physically or via digital surrogate.

In 2019, the Digital Collections Programme of the Natural History Museum, London (NHMUK) undertook a pilot project to examine the feasibility of supporting digital loans from the Insects Division by providing a bespoke imaging service to the relevant curators which could then be used to fulfill these requests.

During this initial pilot, 40 digital loans, containing 232 specimens and providing a total of 850 images, were processed in order to develop a suitable workflow in conjunction with the curators and data management team.

Subsequent to this work, and the somewhat intermittent “return to normal” during 2020–2022, the processing of entomological digital loan requests has become business as usual for the NHMUK’s Digitisation Team and the imaging methods and equipment used has expanded to fulfil requesters’ needs where necessary.

This centralised service has ensured consistency of image quality for our digital loans and that metrics are standardised and trackable. All resulting specimen records and images, unless embargoed, are released publicly in a timely manner helping to free up some much needed curatorial time.

In this presentation we will discuss the workflow developed over the last three years and what is required from all those involved for this service to run smoothly and efficiently. We will describe how projects of different sizes can be managed with a view to providing “digital on demand” collections, including: assigning unique identifiers to specimens, completing relevant loan paperwork, through imaging and uploading data to a collections management system, to fulfillment of the request by sharing data and images on the open access NHMUK Data Portal.

Assessing marginalized undergraduate students use of Natural History Collections

Mrs Adania Flemming¹, Ms Temi Aloa², Ms Molly Phillips¹

¹Florida Museum/ University of Florida/ iDigBio, Gainesville, United States, ²University of Florida, Gainesville, United States

(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Natural History museums (NHM's) are composed of millions of specimens which provide an opportunity for scientists to understand the biodiversity of our planet. To find solutions for a myriad of ecological, evolutionary and behavioral problems research collections are used by scientists to ask big questions. Making NHM's more accessible to a diverse array of audiences has therefore been a primary focus of NHMs in the 21st century. As a result of increased digitization efforts, many publications have argued that the unprecedented access to specimens and their accompanying data render NHMs more accessible to a diverse audience. In our study we were interested in understanding how undergraduate students from marginalized backgrounds were accessing and using NHMs and what role museum specimens play in this process of learning and career development for undergraduates. A comprehensive literature review was conducted and primary data using a 23-item web-based Qualtrics survey (N= 103 instructors) was collected and analyzed to answer our question. The items varied in response dimensions, ranging from close-ended responses to open-ended responses. The open-ended inquiries provided further nuance and insight to our understanding of how tertiary level students interacted with natural history museums using various in person and online platforms. In this presentation we will share preliminary findings from the literature review and survey.

Assisting digitisation and specimen data enhancement through Digital Specimen Identifier DOI infrastructure and services

Dr Sharif Islam¹, Ir Wouter Addink¹, Mr Anton Güntsch²

¹*Naturalis Biodiversity Center, Leiden, Netherlands*, ²*Botanic Garden Berlin, Berlin, Germany*

(ID1)Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

The Digital (Extended) Specimen (DES) concept provides a vision and a framework to process digital objects on the internet containing specimen information. These objects can be maintained independently of their source systems, for example, a collection management system (CMS) and can have an indefinite lifespan that both precedes and succeeds the physical specimen they represent. They can be created during a gathering event in the field but also can be curated and enriched after the lifetime of a physical specimen. The minimum required information for these objects is just a persistent identifier (PID), plus a type (which refers to a definition for machines what kind of object it is and which operations are possible) and some minimum provenance metadata: who created the object and when. These objects can then be used to share e.g. a specimen image via online services that can add information derived from that image, the label data or morphological features. Because the objects have a PID, they can also be linked to other data that can be either derived information such as sequence data or related data such as species level data or environmental data.

PIDs are a foundation for achieving the FAIR Guiding Principles (“findable, accessible, interoperable and reusable”) (Wilkinson et al. 2016). Modern data-driven research relies heavily on connecting different data classes (i.e. specimens, genomics, observations, taxonomy and publications) and FAIR plays an important role. For DES, we aim to implement a PID system based on DOIs and Handle to make sure that identifiers are globally unique, persistent and resolvable. This system should also manage associated metadata, facilitate provenance, enable discovery, manage states/life cycle of the PID, link to other derived data and digital content, and allow content providers to enforce metadata constraints. This talk presents a PID design document that has been created in the BiCIKL (Biodiversity Community Integrated Knowledge Library, Penev et al. 2022) project to facilitate community wide discussion for a pan European PID system for digital specimens. We will introduce the design ideas and describe how these will assist with large scale digitisation and specimen data enhancement.

Associating Arachnids, Broken Boxstones, Curating Clams, Documenting Diptera and Tackling Taxonomy: lessons learned through the EONS project

Miss Karen Banton¹

¹*Sedgwick Museum of Earth Sciences, University of Cambridge, Cambridge, United Kingdom*

The loss of subject specialism in regional museums often leads to curators having to learn about their collections on the fly. The Evolving Our Natural Sciences (EONS) project at Colchester and Ipswich Museums, a John Ellerman Foundation funded three-year programme, aimed to train a natural science specialist curator. They would gain experience working with a wide range of natural science collections and be familiarised with their various collection needs and hazards.

Each of the five-month sub-project held unique challenges, from re-uniting disassociated fragments of boxstone fossils to documenting spirit collections with restricted collections access. Despite this variety, they all started with having to learn about the collection-type.

I will share the lessons I learned on how to document, identify, and curate collections in tight time frames. This will include describing strategies from how to automatically generate object descriptions in Excel while documenting over 10,000 Diptera specimen to the importance of masking tape when curating three cabinets of Mollusca into taxonomic order. I will also share the advantages and pitfalls of relying on species matching tools in taxonomic databases when validating the scientific names in your CMS and how these can be used to proof any taxonomic data entry done and create the base of a taxonomic hierarchy in Axiell Online Collection Database.

Aublet - Going against the current in the 18th century

Ms Krisztina Lohonya¹

¹*The Natural History Museum, London, London, United Kingdom*

A wonderful example of a herbarium sheet collected by Jean Baptiste Fusée Aublet, an 18th century pharmacist, botanist and one of the first to study ethnobotany in the Neotropics. Although we do not know much about the collection information of this specimen, other than that it was collected in Mauritius—he wrote an incredibly detailed description of the plant in a little booklet format, attached to the sheet.

BM013712400 - *Psophocarpus tetragonolobus* (L.) DC.

Collector: Jean Baptiste Christophore Fusée Aublet (November 4, 1720 – May 6, 1778)

Site: Mauritius

Permanent object URL: <https://data.nhm.ac.uk/object/7985c9e8-f8d4-4067-93e3-1af9cd5ba1ea>

Being strategic: reassessing the use and interpretation of collections

Dr Julianne Snider¹

¹*Earth and Mineral Sciences Museum & Art Gallery, Penn State, University Park, United States*

(ML2) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

As the museum of a research-focused college, the Earth and Mineral Sciences Museum & Art Gallery has persisted for more than 125 years. The museum's collections reflect the research foci and interests of its parent institution as it grew from a Department of Mining Engineering to a School of Mineral Industries to the College of Earth and Mineral Sciences. As the college shifted away from traditional natural science object-based research and teaching the museum has had to shift its use and interpretation of its collections to remain relevant within the college. Taking a critical look at the museums' mission and evaluating how the museum's geoscience-centric collections could be reinterpreted have been instrumental in developing strategies that have the potential to ensure the museum retain institutional relevance. The goal of the museum is to be more strategic in setting priorities that ensure its collections of natural history, related technologies, and industrial art maintain applicability as physical objects that embody data and knowledge, that foster new pathways of engagement with science, technology, engineering, art, and history, that have application in new research, and that enhance science communications and STEM learning. Outcomes and success of these strategies and priorities are dependent upon not only the collections cared for by the museum but on the museum creating and maintaining relationships with individuals and groups that are able to connect the museum to new and diverse audiences. All the while, concerted efforts to maintain the health of the collections and uphold standards of collections care must be balanced with the reality of limited budgets, limited space, limited staff positions, and increasingly non-traditional use of the collections for research and education.

Best Practices for the Preservation Fluid Collections: Where are we?

Mr John Simmons¹

¹*Museologica, Bellefonte, Pennsylvania, United States*

G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The need to share knowledge about the care and preservation of fluid-preserved collections emerged with a 2013 initiative funded by a Clothworkers Foundation grant directed by Chris Collins (NHM London). This was reinforced during several workshops at SPNHC conferences in Cardiff (2014), Berlin (2016), and Denver (2017), and followed up by an experts meeting at the Smithsonian (2018) directed by Catharine Hawks and the 2018 Paris symposium (Preservation of Natural History Wet Collections: Feedbacks and Prospects) organized by Sophie Cersoy, Julian Carter, Marc Herbin, Dirk Neumann, John Simmons, and Véronique Rouchon. Information and critical comments from these interactive meetings served as a framework to enhance our understanding of the care and conservation of fluid collections and to formulate key questions. This session will present a brief overview of current knowledge and baseline questions for future research to better define conservation standards for fluid-preserved collections.

Better publications for better research. BHL's efforts to improve accessibility of research publications

Mrs Elisa Herrmann¹

¹*Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science, Berlin, Germany*

RE) Reflections on the Biodiversity Heritage Library: Value in Collections and Collaboration (, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The Biodiversity Heritage Library digitises biodiversity information resources worldwide and strives to lift embargoes to improve the access to freely available literature. Through permanent referencing via DOIs and data networking, it adds information on biodiversity to the global knowledge network. The consortium also relies on strong partnerships to integrate more information resources. Cooperations with publishers and editors are playing an increasingly important role. In a first project in 2019, an automatic ingest was tested together with Pensoft Publishers to upload two of the Museum für Naturkunde Berlin's OA journals to BHL directly after the issue was published. By the time the issue is published, the articles are already indexed and searchable. In this way, scientific relevance, reliability and continuity are achieved for the BHL and current research is merged with historical findings in a single source. For institutions such as the museum, this results in new insights into journal history, (historical) publication behaviour, but also the use of the collections and their referencing. This contextualisation can lead to a deeper understanding of the collection and be inspiration for further research approaches. For the journals, the advantage is a possible increase in visibility through easier discoverability, accessibility and contextualisation in the BHL. This is also particularly interesting for institutions that self-publish their journals. If not already accomplished, the upload of journals to BHL can empower them as a publication platform and help to transform their journals into Open Access publications.

Beyond these infrastructure options, BHL aims to contribute to the development of information resources, for example by enhancing metadata and data within publications. Through envisaged collaborations and participation in working groups and initiatives such as the CETAF E-Publishing Working Group or e-BioDiv, we aim to be able to extract data from research publications more quickly and efficiently in order to improve the data and knowledge network on biodiversity.

Boots on the Ground: Success Stories of Reaching Underrepresented Groups across Puerto Rico

Miss Janelle A. Peña-Jiménez^{1,2}, Mr. Rafael A. Rivero-Vega^{1,3}, Mr. Gabriel Rivera-Rivera^{1,2}, Dr. James D. Ackerman^{1,2}

¹Museo de Zoología de la UPR-RP, San Juan, Puerto Rico, ²Universidad de Puerto Rico - Recinto de Río Piedras, San Juan, Puerto Rico, ³University of Michigan, Ann Arbor, United States of America

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Natural History Collections (NHCs) play a vital role in providing accessible education to local communities. At the Universidad de Puerto Rico – Recinto de Río Piedras, the NHC consists of a Zoology Museum and a Herbarium. Besides its mission as a repository of specimens and a research resource, there is also an active outreach program that serves communities benefiting from the institution’s centric location, fully free services, and plentiful educational materials. The institution also participates in or coordinates a myriad of activities to raise awareness of the importance of local biodiversity, conservation, culture, and education. However, attempts to extend the institution’s network beyond the metropolitan area of the island have required additional efforts. In response, the institution has focused on three main strategies to reach traditionally underrepresented groups of varying socioeconomic backgrounds that have been excluded from the educational privilege of living in the region: (1) increasing the institution’s physical footprint at public schools outside of the urbanized zone; (2) leveraging collections for internal exhibition or external outreach during in-person events; and (3) providing workshops and lectures to supplement public, private, and homeschooling groups across the archipelago. Unfortunately, a lack of consistent funding, the ongoing COVID-19 pandemic, and the uncertain future of the University due to the unstable fiscal health of the island, have erratically hampered the continuity of these services. In spite of these turmoils, and as many other groups have done, the institution has also expanded its visibility among local communities through live social media events. These have become the “new normal,” attracting a large audience over the last two years, and have proven especially impactful when involving volunteers, including undergraduate students. Nevertheless, we are acutely aware that a subset of our population does not have access to amenities that we take for granted, such as portable electronic devices and stable internet connections. For these reasons, we must ensure that as NHCs democratize educational opportunities for disparate groups in the face of global changes, they do not lose sight of the unique equity needs of their local communities.

Botanic Garden Environmental Education for Sustainability Evaluation

Ms. Tanya MacDonald¹

¹*University Of Dundee Botanic Garden, Dundee, United Kingdom*

Botanic gardens have made efforts to inform, motivate, and empower people to making lifestyle changes that support sustainable living (Willison, 2006). Dodd and Jones (2010, p.7) state, “botanic gardens are uniquely placed to address climate change, but they are not taking a visible and active role.” Environmental education at botanic gardens play an important role in providing opportunities for people to connect with non-human nature with the potential for change to more pro-environmental behaviors but many botanic gardens lack documentation of their contributions and impact on their communities (BGCI, 2021). Hestness et al. (2021, p.10) calls for more “robust” evaluations of botanic gardens highlighting “the need for measuring impact over activity (Smith and Harvey-Brown, 2018), for using evidence to guide decision making at the institutional level (MacPherson, Hammerness and Gupta, 2019), and for contributing new knowledge to our field at large (Fu, et al., 2016).” As all botanic gardens are unique in their missions, vision, and approach, as well as having geographical, cultural, and political differences, research on individual gardens is required to properly evaluate and measure impact. This includes research into current practices and the potential for change based on the needs of the community of people and local environment that the botanic garden serves. Answering this call to action, subsequent research aims to identify and evaluate the University of Dundee Botanic Garden’s impact on the community it serves through public engagement in relation to environmental education for sustainability. While still in the early stages, the research looks to gain insight into intended and current impact of the botanic gardens on the community which will inform the overall strategy and allow for targeted and impact driven education that is informed by the community.

Botanic Gardens Conservation International. 2021. About Botanic Gardens | Botanic Gardens Conservation International.

Dodd, J., & Jones, C., 2010. Towards a new social purpose the role of botanic gardens i
Hestness, E., Bolton, A., Dotson, D., Coykendall, L. and Mims, R., 2021. New Beginnings with Evaluation. Roots Botanic Gardens Conservation International Education Review, [online] (Vol 18(2), pp.10-13.

Willison, J., 2006. Education for sustainable development guidelines final

Breathing New Life into Collections

Dr Klara Scharnagl¹

¹*University Of California Berkeley, Oakland, United States*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Natural history collections are in simultaneous disrepair and expansion around the world. Larger collections take up orphaned collections, but in the meantime support for collections and collections staff is dwindling. How can smaller groups of curators, collections managers, staff, volunteers and students find a way to breathe new life into collections to promote and preserve their importance for future generations? Here I share my experience with the Tucker Lichen collection at the University & Jepson Herbaria at Berkeley, which has included tracking down misplaced specimens, a massive digitizing effort, forming a volunteer cadre to help curate a backlog of unaccessioned specimens, and forming unique collaborations to help share our rich collections with both local and global communities. My main takeaway is that enthusiasm for natural history collections is out there - we just need to find a way to locate and harness it!

Bringing Florida Museum of Natural History 3D Collections into K-12 Schools to Teach About Adaptations, Evolution, and Climate Change

Stephanie Killingsworth^{1,2}, Brian Abramowitz^{1,2}, Dr. Kate Carter³, Dr. Bruce MacFadden^{1,2}, Jeanette Pirlo^{1,2}
¹University of Florida, Gainesville, United States, ²Florida Museum of Natural History, Gainesville, United States, ³Phillip and Patricia Frost Museum of Science, Miami, United States

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Florida's public school system encompasses more than 4,000 schools, many of which serve historically excluded populations living in both rural and urban low-socioeconomic regions of the state. Economic disadvantage coupled with geographic disadvantage, given the stretched geography of the state, translates to issues in accessibility and equity for students in science education. The Florida Museum's Vertebrate Paleontology (FM-VP) collections, which provide the most complete study of Cenozoic vertebrate life in the eastern United States, have sought to digitize collections and develop alternative models of interaction to overcome these inequities and allow more K-12 students to experience collections.

The Scientist in Every Florida School (SEFS) program, has successfully incorporated museum collections and outreach into K-12 classrooms through its free and innovative programming. Its mission is to engage Florida's students and teachers in cutting-edge research by providing science role models and experiences that inspire the future stewards of our planet. Program components consist of classroom visits by scientist experts and role models from diverse communities, professional development workshops (PD) and research experiences for teachers, and livestream events throughout the year.

Classrooms have interacted with curators and graduate students to learn more about their research and collections, contributing to the program's reach of more than 55,000 students during the 2020-2021 school year alone. Livestream events such as Florida Museum 360° have captivated students as they explore the Florida Fossil Hall and Early Native Peoples exhibits alongside scientists. Additionally, hundreds of teachers have participated in collections tours and active research sites for fossil collection.

One PD, Adaptations, Evolution and Climate Change, included 18 Miami-Dade County middle and high school teachers, impacting over 2,500 students. Teachers were provided a classroom set of 3D printed fossil horse teeth scanned from museum collections to execute the lesson to their students. In addition, participating teachers will visit the Phillip and Patricia Frost Museum of Science's Mammoths: Iced Aged Giants exhibition with their students, connecting the concepts of Chewing on Change to mammoth ecology. An overall grade of A was given for the PD by 100% of participating teachers.

Bringing together 13 million specimens: A case study on relocating and uniting CSIRO's National Research Collections

Margaret White¹, Federica Turco¹, Tonya Haff¹, Brendan Lepschi¹

¹CSIRO, Canberra, Australia

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is an Australian Government agency responsible for scientific research. CSIRO's National Research Collections consist of 15 million specimens housed within six different collections, located across three cities. The collections are a vital resource for describing, managing, and conserving Australia's rich and unique biodiversity. Currently, over 85% of those specimens are in the process of being relocated as part of CSIRO's Canberra Collections Accommodation Project.

Jointly funded by CSIRO and Australia's Department of Education, the project will co-locate all Canberra-based collections – the Australian National Herbarium, the Australian National Insect Collection, and the Australian National Wildlife Collection – for the first time into one precinct, featuring the new National Collections Building. The collaborative approach to the design process has allowed for an unparalleled level of expert input, ensuring the new facility will provide environmentally controlled storage facilities optimised for each collection, new laboratories and research spaces, and dedicated digitisation facilities.

Whilst this new purpose-built facility will ensure access to, and long-term preservation of the National Research Collections, the physical relocation of staff, equipment, and 13 million specimens over the next three years presents a unique set of opportunities and challenges. Scientific research is the primary purpose of the CSIRO collections, and historically the management of each collection has occurred autonomously with minimal shared systems and practices.

This presentation will discuss the planning and preparation of the CSIRO Canberra Collections Accommodation Project to date. We will explore the processes currently underway, and the challenges and opportunities we are encountering in physically uniting collections and people, and bringing together existing and entrenched practices.

Whilst relocations present significant risks to the collections, it is hoped that CSIRO's dedication to collaboration, planning, and sharing lessons learned, will maximise the positive impacts on the collections through this period of vulnerability, and enable future projects to leverage our experiences.

Broadening Access by Embracing Digital Accessibility: Guidelines for Writing Alt Text and Extended Descriptions for Natural History Images

Assistant Registrar Cailin Meyer¹, Photographer James Tiller¹

¹*Smithsonian Institution - National Museum Of Natural History, Washington, D.C., United States of America*

Increasingly, museums are making their collection images available as digital media for online audiences. Simultaneously, governments are beginning to require and enforce digital accessibility standards, ensuring that people with disabilities can engage equally with digital media. As such, it is critical for natural history museums to actively engage in digital accessibility, which includes providing accessible image descriptions (alt text and extended descriptions) for their online images.

Most existing museum guidelines for writing accessible image descriptions primarily focus on art pieces and installations, whose images serve a very different purpose compared to scientific images and images of natural history specimens. Before now, guidelines for these image types did not widely exist. Over 2020 and 2021, the authors developed guidelines concerning the unique challenges of writing standards for scientific images.

This presentation defines the accessibility tools alt text and extended descriptions, discusses the importance of their inclusion in digital media, and introduces guidelines for writing images descriptions for scientific media that reside in databases. It also covers methods for ensuring the alt text and extended descriptions remain embedded within the images throughout several media forms and context changes. By incorporating this text in the embedded metadata fields, these descriptions can always travel with the image ensuring that proper scientific labeling and description is available to the public, regardless of the context of the image.

Building the Community through Biodiversity Literacy

Dr Anna Monfils¹, Sara Hanson¹, Debra Liton¹, Dr Natalie Douglas¹, Dr Elizabeth Elwood², Dr Libby White³

¹Central Michigan University

²DigBio, Los Angeles, United States of America

³University of California Museum Of Paleontology, Berkeley, United States

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

BLUE (Biodiversity Literacy in Undergraduate Education; biodiversityliteracy.com) is a community effort to define core biodiversity and data competencies, share Open Education Resources, develop strategies that can infuse biodiversity data into formal and informal education, and improve training to meet increasing workforce demands in data and biodiversity science. BLUE strives to develop materials and professional development opportunities that span a range of educational settings and modalities and that address the needs of new communities not currently engaged with digital data and biodiversity science. BLUE network participants have built the network spanning all career stages and institution types. Through BLUE initiatives, we have engaged 1000s of participants (virtual and face-to-face) in faculty development workshops, data literacy and workforce development discussion sessions, and informational webinars and outreach that promote biodiversity literacy and data acumen. BLUE partners have worked with biodiversity scientists and science educators to develop and vet over 40 data- and biodiversity-centric Open Education Resources: (https://qubeshub.org/community/groups/blue_data/blueresources). Through discussion sessions, workshops and working groups, and a survey of over 350 community members, we have defined a community derived set of core biodiversity data competencies for students completing and undergraduate degree. We will introduce BLUE products, partnerships and current and on-going initiatives including addressing the ongoing challenge of building the 21st century workforce to create the Digital Extended Specimen; building community with international partners and bridging data-literacy initiatives; extending the network to include STEM and non-STEM disciplines; and creating inclusive materials that bridge biodiversity science, digital data, and open inclusive science.

Care and Repair of Collection Cabinets

Tiana Rehman¹, Ashley Bordelon¹, Jessica Lane¹

¹*Fort Worth Botanic Garden | Botanical Research Institute of Texas, Fort Worth, United States*

Cabinets utilized in natural history collections serve as an important element of preventative conservation measures, isolating the specimens within them in a smaller and more controlled environment insulated from external environmental fluctuations, and preventing the movement of insect pests. As such, it is critical that these containers are maintained in order to meet these functions. The Philecology Herbarium at the Botanical Research Institute of Texas was established in 1987 and houses acquired collections established as early as 1935 in cabinets of different types and ages. A review of herbarium cabinet types and maintenance concerns reported failing cabinet seals as the most frequently observed functionality issue. A protocol was developed to replace the cabinet seals utilizing materials acquired from local hardware or industrial supply companies, and tested on 156 metal herbarium cabinets.

Caring for Insect Collections – taking our entomology training online

Miss Ashleigh Whiffin¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

In previous years, the entomology curators at National Museums Scotland have delivered in-person workshops on how to care for insect collections. These free events formed part of the museum's National Training Programme and were a popular way to share knowledge and skills throughout the Scottish museum sector. These workshops were created for non-entomologists with a responsibility for insect collections and aimed to enhance the participants' knowledge of collections care and management and develop their confidence. Workshops were held at the National Museums Collection Centre in Edinburgh and comprised a basic introduction to curation and management of entomology collections and featured several practical elements.

The pandemic forced us to rethink the format of this training, as we could no longer deliver it in-person. We have now re-designed and created content, which is delivered online, via a mixed media approach. This new training course is self-guided and contains a series of short films and reading materials, which are hosted on our website. This has presented an opportunity to make our training resources available to a wider audience, supporting our colleagues in Scottish museums and beyond.

Here we will provide an overview of our new training course and the challenges faced in creating it.

Case Study: Relocating the Crane Hollow ATBI to a new collections space at the Ohio University Museum Complex

Professor Nancy Stevens^{1,2}, Executive Director Heather Stehle³

¹Ohio University Museum Complex, Athens, United States, ²HCOM and Center for Ecological and Evolutionary Studies, Athens, USA, ³Crane Hollow Nature Preserve, Rockbridge, USA

The OHIO Museum Complex (OMC) is a transdisciplinary museum engaging campus and community to connect science and wellness with everyday life. Located in the southeast corner of Ohio in a rural underserved region of Appalachia, the OMC is the only collections-based natural science museum for K-12 and general audiences within a 1.5 hour radius, serving southeast Ohio, northern Kentucky and parts of West Virginia.

The OMC is situated as the centerpiece of the Ridges Green on Ohio University's Athens Campus, where a historic state hospital designed in the 1800s by famed architect Thomas Story Kirkbride was transformed into a stunning museum facility featuring dynamic galleries and interactive learning laboratories. The Museum campus is interconnected with a sculpture garden, astronomy observatory, and a network of nature trails that span hundreds of acres through the university's land laboratory and conservation land, promoting opportunities to connect collections-based learning and wellness for campus and community.

In 2019, grant funds were leveraged to establish an immersive nature gallery at the OMC. In 2020 an agreement was made for the OMC to acquire the Crane Hollow All-Taxa Biodiversity Inventory (ATBI), a pivotal local biodiversity collection from the Crane Hollow Nature Preserve, spanning over 155,000 specimens representing ~12,000 taxa of local plants, fungi, and invertebrates (several new to science). In 2021 the OMC leveraged donor funds to establish a state of the science research space to house that collection.

This case study shares the process of developing legal agreements for the natural history collections transfer, and renovations required to transform existing space in a historic building into a climate-controlled and environmentally monitored collections storage and research facility. Considerations related to HVAC, accessibility, collections storage and digitization, lighting and workstations, and specimen-based microscopy are shared. We also outline the planning team's process for the physical relocation of the collections, including consultation and timeline for transition, with additional considerations and lessons learned along the way.

Catalog of names of Moroccan taxa described by Font Quer from the Iter Maroccanum collections

Mrs. Andrea Shugulí¹, Dr. Noemí Montes-Moreno¹, Mrs Neus Nualart¹

¹*Botanical Institute of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain*

Pius Font Quer (Lleida 1888 – Barcelona 1964) was a great botanist and scientist disseminator who carried out an important research work on the flora of northern Morocco. His main collection campaigns were the exsiccatae Iter Maroccanum (1927–1930) in which he collected more than 2000 numbers and 40,000 plants that distributed among the herbaria subscribed.

This study is based on a list of 169 names of taxa described by Font Quer based on botanical specimens collected during the Iter Maroccanum. For all these names, nomenclatural status, previous typifications, synonymy and accepted name have been evaluated verifying their correct citation in floras and databases. Among all taxa, 24,9 % were already typified, 66,3 % were described by Font Quer and Pau and have been studied in a recent paper published in *Phytotaxa* (Nualart et al., 2021), and 8,9 % will be typified by us in a new paper that we are preparing. On the basis of this catalogue, Font Quer's scientific contribution to the knowledge of Moroccan flora has been evaluated. His study of the variability of taxa in this territory was remarkable, describing 67 species, 98 varieties and 4 taxa without specifying the taxonomic rank. One third of the total taxa (38,5%) described are currently accepted and even some proposed taxa have risen from taxonomic rank to species or subspecies (23,1%).

In this contribution we present a characterization of the taxa described by Font Quer in the Iter Maroccanum collection campaigns, the temporal and geographical distribution of the original material and a selection of some types of interest.

Nualart, N., Soriano, I., Pérez-Prieto, D., & Ibañez, N. 2021. Catalogue and typification of the Moroccan taxa published by Carlos Pau. *Phytotaxa* 519,1: 1- 94.

Caught between a Rock and a Pandemic: Finishing an Institute of Museum and Library Services (IMLS) Fossil Digitization Project during the Covid-19 Pandemic

Mr Paul Mayer¹

¹*The Field Museum, Chicago, United States*

The Field Museum in partnership with the Milwaukee Public Museum are finishing a three year IMLS grant to digitize our Ordovician fossil invertebrate collection. The project started in 2018 and was originally scheduled to end in 2020 with groups of interns photographing specimens and entering data from handwritten labels into our digital collections management system for each of the three summers. Due to the Covid-19 Pandemic the museum was shut down and access to the collection was restricted for staff and all onsite internships were canceled. We applied and received a one-year extension from IMLS for 2020, but could not get a full second year extension in 2021 due to their funding cycles.

This meant we had to complete the project with no onsite interns. For the last summer session, we needed to digitize approximately 3,100 bryozoans, 1,000 bivalves, 500 graptolites, 500 sponges, 300 tabulate corals, 100 stromatoporoids, and a few miscellaneous specimens. The Field Museum opened up slowly to staff during the pandemic. Initially staff were allowed into the collections just one day a week. The plan I developed was to photograph as many specimens and their labels as possible while at the museum. Normally interns would photograph specimens using a copy stand in our digitization lab, but this would be too slow. Instead I photographed the specimens in the collection area, hand holding the camera and in order to get a good depth of field used a moderate F-stop while setting the ISO to automatic on the camera. The resulting jpg images were better than expected and perfectly acceptable for the project.

As I photographed the specimens they were placed on our server. For the summer of 2021 two 'virtual' interns were hired to remotely access the label files and using their own computers at home they accessed remote desktops at the museum to enter the label data into our EMu database. We trained the interns and answered questions using Zoom. Currently we have finished digitizing the bivalves, sponges, corals, and stromatoporoids and are nearly finished with the bryozoans, leaving the only graptolites to finish in February.

Celebrating an herbarium milestone: CONN's 200,000th databased specimen

Dr Sarah Taylor¹, Ms. Michelle Hernandez¹, Dr. Bernard Goffinet¹

¹*University Of Connecticut G.s. Torrey Herbarium (conn), Storrs, United States*

The George Safford Torrey Herbarium at the University of Connecticut initiated a major effort to database its entire vascular plant herbarium in 2009 supported by an NSF Collection grant. A small army of over fifty undergraduate students digitized most of the specimens within the five-year grant period. Since the grant ended, the pace of digitization has been steady at about 5,000 specimens per year. We are looking forward to celebrating our milestone 200,000th databased specimen in early 2022. An undergraduate student conducting an independent study in the herbarium will collect, mount, and digitize a specimen of a native shrub (*Lindera benzoin* L. Blume, Lauraceae) for this honor. This milestone provides an opportunity to highlight the mission of the collection to the university community and to draw attention to the importance of student participation in documenting our native flora.

Changing Natures. Developing a Shared Participatory, Digital Collection of the Anthropocene

Dr Elisabeth Heyne¹, Prof. Frédérique Chlous², Dr Romain Julliard², Ulrike Sturm², Marie Delannoy², Mira Witte¹

¹Museum für Naturkunde Berlin - Leibniz Institute for Research on Evolution and Biodiversity, Berlin, Germany, ²Muséum national d'Histoire naturelle, Paris, France

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

In today's age, described as "The Age of Humans", the world around us is defined by human choice, collapsing the distinction between humankind and nature. Leaving this division behind, also radically changes the concept and task of natural history collections. Hence, we need new impulses for the reorganisation of knowledge for our present.

In our joint project between Museum für Naturkunde Berlin and Muséum national d'Histoire naturelle Paris we connect different perspectives of two museums, interdisciplinary scientists and, in particular, the voices of citizens. Our aim is to explore the cultural, local, and multi-perspective knowledge of human impact on nature. Therefore, we invite different communities to contribute to a new kind of collection representing their perspective on natural change.

Together we develop a joint online platform that will enable collecting in a participatory bottom-up process based on a citizen science approach. This trilingual platform (German, English, French) allows participants to submit objects from the past to which they have a personal connection and that tell stories of past experiences of nature. In addition, participants are invited to describe and enrich their collection object (community generated metadata). Allowing comments and links between the contributions and objects, the collection aims to show the dense, decentralized network of humans and nature in the Anthropocene in a new polyphony and to create a sense of community among the users.

Based on our shared experimental collection, we aim to explore questions for broader reflection: Whose knowledge needs to be represented in the natural history collections of the future? What scientific approach do we need to integrate multiple social and cultural dimensions in natural history collections – and to create spaces for mutual learning in the face of the environmental challenges of the present? How do we motivate communities – between digital platform and on site events in and outside the museum – to share their perspectives?

In our talk, we will present the first version of the online platform, first participant contributions and give insight into our community engagement and plans for future development.

Characterization of old jar sealants: use of organic membrane and metal foils

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(NW2) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Since the XVIIth century, finding the perfect jar sealant has been a key issue in ensuring the preservation of specimens kept in fluid. The fluid must not evaporate from the container! Furthermore, exchanges with the outside must be minimized to avoid contamination, acidification of the fluid and oxidation of the specimens.

Consequently, very early, the curators of fluid collections thought that multiplying the layers would improve the seals, and also their aesthetics. Thus, some historical collections contain jars covered with complex closure systems composed of organic membranes and/or metallic-looking foils which could be both painted, and whether or not completed underneath by sealant (e.g wax, putty ...). Recent sources report the efficiency of this type of systems when kept over time, independently of the possible supports on which they were applied (e.g. glass, schist plates, cork etc.). Certain pieces prepared early in the 18th century by the famous Albertus Seba are still preserved in good condition with their original closure, notably in the collection of the NHM, London.

Although this complex sealant was quite common in the past, the exact composition of these various components is not well known. The presence of such closures system, in the reserves of the French natural History museum, allowed us to analyse them and inspect their state of preservation, with the participation of trainees.

Chemical analysis have been performed on the membrane when they were present to: (i) specify the nature of the organic membrane supposed to be a sheep or pig bladder (species identification using proteomics) and (ii) characterize its state of degradation (infrared spectroscopy). X-ray fluorescence was used to identify and classify by compositions metal sheets, supposed to be made of tin or lead, and revealed also the presence of toxic elements (e.g. mercury sulphide in painted inventory numbers). Finally, microscopic observation and elemental analysis (using SEM-EDX) allowed to study the degradation of some of these sheets.

On the basis of this knowledge, closure systems will be reconstructed and their effectiveness with regard to permeability to oxygen and evaporation of the conservation fluid will be studied.

Citizen Science Initiatives as Sources of Fungal Biodiversity Data

Dr Gregory Mueller¹

¹Chicago Botanic Garden, Glencoe, United States, ²IUCN SSC Fungal Conservation Committee, ,

MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Vouchered specimens with associated metadata housed in natural history collections are the gold standard for documenting species diversity and distributions. They likely will remain so for the foreseeable future. However, for megadiverse under-documented taxa like fungi, data in these collections are too incomplete to provide an accurate estimate of the distribution, population size, or change in population size of most fungal species. Given the relatively small number of professionally employed mycologists, it is not reasonable to expect that this problem will be rectified by that community. Because fungal diversity and distributions are still poorly documented, there is great opportunity for discovery. While there is a long history of amateur mycologists and other field naturalists contributing important data, for the most part, their efforts have not been coordinated and the results of their findings were often not captured. Sites like iNaturalist now provide a platform to capture observation data. In January 2022, iNaturalist had over 5.5 million fungal observations posted by over 450,000 observers! However, the quality of observations and the amount of metadata varies greatly, and high-quality observations are needed for documenting diversity, distributions, and plant and habitat associations of fungi. Additionally, the data being compiled on these sites are for the most part random observations, and efforts are not coordinated to target gaps in knowledge on species of interest. Several recent initiatives are addressing these issues, e.g., Australia's fungimap, UK's Lost and Found Fungi Project, and the US's Fungal Diversity Survey (FunDiS). In the US, FunDiS integrates three core citizen science projects – focused fieldwork targeting species of interest, curating a database of high-quality observations, and facilitating DNA sequencing of targeted species. Such citizen science initiatives provide data of high utility for documenting fungal species of conservation concern. Continued conversations among developing citizen science initiatives and the conservation/research community are needed to agree on data and data standards, and manage expectations, processes, and timelines. At the same time, significant challenges of funding, developing leadership pipelines, and continued engagement by participants are issues facing such initiatives.

Clean NFTs: how Tezos can build long-lived, sustainable digital assets

Professor Anil Madhavapeddy¹

¹*University Of Cambridge, Cambridge, United Kingdom*

The Cambridge Centre for Carbon Credits (4C) is creating a trusted decentralized marketplace where purchasers of carbon offsets can confidently and directly fund trusted nature-based projects that ties together corporate funders to conservationists via automated and transparent verification systems. The marketplace integrates remote sensing (e.g. satellites) to provide evidence that nature preservation interventions are happening as intended. This evidence mechanism is very similar to that used by Non Fungible Tokens (NFTs) used in digital marketplaces today.

The system underpinning this marketplace needs to scale to global levels but also be long-lived, since it is common for nature-based projects to span decades. In this talk, I will describe how 4C selected the Tezos blockchain to use as the basis for our conservation marketplace. There are four key factors considered. Firstly, the blockchain must itself use an energy-efficient technology for its own operation. Secondly, there must exist a healthy ecosystem of diverse entities with a governance procedure that ensures that the blockchain does not depend on a single organisation which may shut it down at short notice. Thirdly, the blockchain must have a "smart contract" mechanism which permits for the coding of flexible policies for the manipulation of NFTs. Fourthly, it should be possible to easily and cheaply swap between tokens and fiat currency, without undue fees being paid to brokers or the blockchain itself.

After going through the various choices involved, I will show how Tezos meets all these requirements, and also discuss how future developments involving smart contracts may affect how digital assets may be used by natural history museums, particularly around linking any revenues raised from the sale of digital assets to specific conservation outcomes needed by the museums.

Collaborative Georeferencing Natural History Collections using GEOLocate/CoGe

Mr Nelson Rios¹

¹*Yale Peabody Museum, New Haven, United States*

(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The vast number of collection records in need of georeferencing and verification requires human resources beyond that which the natural history collections community alone can deliver using traditional approaches for georeferencing. The goal of the GEOLocate project is to overcome this impediment through intelligent workflows, software and services for automated georeferencing, validation and verification of specimen occurrence data. It has resulted in a suite of web-based tools and services which have become critical components of workflows to digitize and mobilize biodiversity collections information, ultimately giving researchers and the public access to the vast archive of specimens held in natural history collections. Community-based workflows that leverage collaboration across collections can provide an efficient mechanism for georeferencing. This submission will provide a demonstration of the combined GEOLocate/CoGe platform for collaborative georeferencing with emphasis on recent feature enhancements, such as representation of complex spatial types, geospatial entity tagging and capacity to provide custom user provided map layers.

Collection and specimen data life cycle completed: The case of Pensoft's journals and OpenBiodiv Knowledge Graph

Prof. Lyubomir Penev^{1,2}, Mr. Teodor Georgiev¹, Mrs. Mariya Dimitrova^{1,3}, Mr. Georgi Zhelezov¹

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(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

There are three key challenges that need to be addressed by journal publishers: (1) increasing machine-readability and semantic enrichment of the published content to allow text and data mining, aggregation and re-use; (2) adopting open science principles to expand from publication of mainly research articles to all research objects through the research cycle, and (3) facilitating all of this to authors, reviewers and editors through novel and user-friendly technological solutions.

Pensoft's publishing platform ARPHA has been launched to address the above challenges through novel XML-based solutions for more than 30 biodiversity journals it currently hosts. ARPHA stands for: Authoring, Reviewing, Publishing, Hosting and Archiving, all in one place. ARPHA is the first publishing platform to support the full life cycle of a manuscript within a single online collaborative environment, allowing for:

- (1) Tagging, displaying and harvesting of Collection and Institution Codes usages in the article texts.
- (2) Direct import of specimen data from GBIF, BOLD, iDigBio and PlutoF into manuscripts to be peer reviewed, published and re-used.
- (3) Submission of specimen data to GBIF on the day of publication.
- (4) Auditing, cleaning and publishing of large collection data sets in GBIF-linked data papers.
- (5) Submission of taxon treatments containing specimen data to Plazi and PubMedCentral.
- (6) Alerting natural history collections on the use of their data.
- (7) Converting specimen data into RDF and Linked Open Data.
- (8) Asking complex questions and providing answers to different use cases through the OpenBiodiv Knowledge Graph.

The workflows are illustrated with examples from the everyday publishing activities of Pensoft. Further improvements and development of bilateral linkages with biodiversity research infrastructure are developed within the frame of BiCIKL - Biodiversity Community Integrated Knowledge Library project funded from the European Union's Horizon 2020 Research and Innovation Action under grant agreement No 101007492.

Collection Discovery and Development at the Museum für Naturkunde Berlin

Dr Jana Hoffmann¹, Dr Christiane Quaiser¹

¹*Museum Für Naturkunde Berlin, Berlin, Germany*

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The Museum für Naturkunde Berlin has been given the unique chance to transform the entire organization in a 10 year, 660 Mio EUR project funded by the German Federal Government and the Federal State of Berlin. This process does not only comprise remodeling of main buildings but at the same time an institutional transformation and not at last a comprehensive development of its collection. Fighting for necessary resources most of the time in the past, this situation provides us with new challenges, asking for long-term perspectives and a clear vision. We are presenting our approach, questions and principles that have been guiding us, as well as first experiences and pitfalls.

Our overarching aim is an open knowledge infrastructure for nature that promotes multi- perspective thinking and action. Following the motto “from object to knowledge”, we develop and explore our knowledge, data, and objects and open them to all, for responsible research and for innovation. Within the ten year project the collection at MfN will become an open, digital-analog and internationally well-connected research information infrastructure, a platform with access and services for research, dialog and innovation. As guiding principles, (1) we are developing the collection along scientific and societal needs, (2) we are integrating analog and digital workflows in collection management and knowledge transfer and (3) we are balancing stability, quality and flexible services. How do we translate this strategic framework into project plans and action? What does it mean for decision-making? How to find practical solutions integrating building processes and digital transformation of the collection?

We would like to share and discuss our thoughts on our strategic approach, our guiding principles, and what it takes to transform a comprehensive collection.

Collections are Helping Avian Biomechanics Research Take Off

Ms I. Szabo¹, Dr V. B. Baliga², Dr C. Harvey³, Ms J. Wong², Ms F. Ciocca², Dr D. L. Altshuler²

¹University of British Columbia Beaty Biodiversity Museum, Vancouver, Canada, ²Department of Zoology, University of British Columbia, Vancouver, Canada, ³Department of Aerospace, University of Michigan, Ann Arbor, United States

Museum collections have a role to play in biomimicry research. At the University of British Columbia Beaty Biodiversity Museum (BBM), the Cowan Tetrapod Collection is assisting members of the UBC Altshuler Lab by providing cadavers and post experiment, archiving a subset of the biological material used. Museums hold the necessary permit plus have frozen inventories not available elsewhere, enabling researchers to tap into a broad catalogue of biodiversity. For one of the studies highlighted, frozen avian cadavers representing 50% of the worlds bird orders were procured and supplied by the museum.

The study of how animals fly is an intrinsically multidisciplinary field that involves aspects of anatomy, biomechanics, and evolutionary biology (among many others). Integrating laboratory experiments with evolutionary comparisons increases our understanding of how flight control evolved.

Inspired by avian morphology, the search in on to design aircraft that can change the shape of its wings during flight. This ability, termed “morphing”, allows birds to fly in diverse conditions and shift between aerodynamic optima. Natural history collections, as the repositories of biological diversity and libraries of comparative morphology, are natural partners in this quest to understand how living organisms fly. By providing insights on avian global diversity and avian ecology, museum curatorial staff are invaluable informal advisors and mentors to physiology and engineering graduate students. Knowledge gained from working with natural history specimens and especially from unprepared cadavers is contributing to the next generation of aerial vehicles which may transport us out of this world.

Connect-Conserve Cyswllt-Cadwreath Cymru - a new way of working together as conservators in Wales

Ms Kate Andrew¹, Dr Vicky Purewal¹, Mrs Annette Townsend¹, Mrs Phillipa Rader¹

¹*Connect-Conserve Cymru, Carmarthen, United Kingdom*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Connect-Conserve/ Cyswllt-Cadwreath Cymru is a new Community Interest Company (CIC) set up in the summer of 2021. The Covid pandemic has seen conservators often working alone and in very rural locations isolated and unsupported and frequently competing with each other or larger commercial conservation companies for work.

Dr Vicky Purewal started in the early days of Covid lockdown seeking out fellow local conservators in Wales, meeting for coffee, and visiting each other's workspaces. Being able to talk about life and businesses was invigorating and great relationships developed. However, she realised that when Covid fully retreated and normal working practice resumed, conservators could be in competition with each other. Every one had struggled in some way during lockdown but having developed a network and relationships, working together would allow individual conservators to be more supportive and stronger as a team.

The conversations also highlighted that collections had suffered during lockdown. Limited access to collections for staff meant that spaces and specimens had begun to moulder, a particular problem in Wales for small collection owning community groups.

The CIC structure we set up in October 2021 enables Accredited Conservators to work collaboratively and to therefore effectively tender for projects as a team. Any profits made can then be used to support smaller Welsh museums and community organisations with free collection care initiatives. Three of Connect-Conserve Cymru's four Directors are natural science conservators, two are long term SPNHC members, encouraged and supported in their early careers by knowledge sharing, exchange of ideas, enthusiasm and buzz of SPNHC meetings.

By January 2022, we had employed 8 conservators, undertaken 3 projects and appeared on prime time television on "David Attenborough and the Mammoth Graveyard". We are working with students and non-accredited conservators too, who are offered the opportunity to work alongside accredited conservators undertaking varied and interesting roles to broaden their experience and add to their portfolios. We actively support emerging professionals and those on the accreditation pathway and have already offered training and student placements.

Conserv Cloud: Data Analytics Software for Preventive Conservation

Liaison Melissa King¹, Yadin Larochette, Claire Winfield, Allison Lewis

¹*Conserv Solutions Inc., Birmingham, United States*

Data collection and analysis is at the core of preventive conservation. This is exemplified when we collect environmental data about light, humidity, temperature, vibration, and pests. Aside from sensors and pest monitors, we constantly assess our environment and monitor for other risks through human observations. The process of collecting and analyzing this data has been historically cumbersome with manual data collection and interpretation of complicated spreadsheets. Conserv is a free cloud-based software tool with both a web and mobile application. It is designed specifically for collections professionals seeking to spend less time on data collection and analysis and more time implementing risk management strategies. The software allows unlimited data import of CSV files containing temperature, humidity, and light data to view the data and generate reports. It uses preservation metrics and key performance indicators aligned with user-assigned environmental parameters to quickly assess the performance of spaces and share with other stakeholders. Users can contextualize their data with time-specific observations about events taking place in their spaces that appear while viewing their data. Conserv Cloud also includes a tool for inputting data for integrated pest management programs, which utilizes a database composed of images of insects and vertebrates that pose a particular risk to collections that was compiled by the organizers of MusemPests.net. Preventive conservation is often accomplished as a team, and Conserv Cloud allows for unlimited users per account. The software is designed to make sharing data and facilitating conversations effortless through data annotations and smart graph-sharing capabilities. In this presentation, we will walk you through the Conserv Cloud software and give you the resources you need to get started with improved preservation analytical tools.

Conservation and photogrammetry of subfossil Quaternary walrus (*Odobenus rosmarus*) from the Bay of Fundy, Canada

Ms Dee Stubbs-Lee¹, Mr. Matthew R. Stimson^{1,2}, Ms. Olivia A. King^{1,2}, Dr. R. Andrew MacRae², Dr. Donald McAlpine¹

¹New Brunswick Museum, Saint John, Canada, ²St. Mary's University, Halifax, Canada

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

This presentation explores how the New Brunswick Museum, a small provincial museum, was able to successfully stabilize the waterlogged semi-fossilized remains of two Quaternary walrus dredged by scallop fishermen working in the Bay of Fundy using very simple, low-tech and accessible materials and methods. The specimens were first desalinated by gradual replacement of sea water with tap water, followed by a controlled and monitored slow drying process that took place over many months, using only minor surface consolidation where necessary at the end of the process. By using this method, the museum avoided the problem of the dramatic spalling and disintegration upon drying so common among wet fossil specimens retrieved from salt water environments, while at the same time not precluding the possibility of future analytical testing of the specimens since they were not subject to irreversible immersion consolidation. Thus, the specimens remain useful to the museum for future exhibition and scientific research purposes. Partnering with St. Mary's University allowed for inexpensive detailed recording of the morphological details and creating of a 3D digital model through photogrammetry. The results of the project were published in the journal *Geological Curator* and presented virtually as a poster at the Symposium on Palaeontological Preparation and Conservation in 2021. It is our hope that other museums with limited resources will find this method to be a useful and practical way to preserve and record fragile marine faunal fossils in house.

Considerations for Digitization Requests and Digital Asset Rights of Smithsonian Paleobiology Collections

Ms Jessica Nakano¹, Paleo Informatics Manager Holly Little¹

¹*Smithsonian National Museum Of Natural History, Washington, United States*

(VA1) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The global influx of collections digital access inquiries encouraged new approaches by the Paleobiology Department (Paleo) at the Smithsonian National Museum of Natural History (NMNH). Creation of digital assets through 3D/CT Scanning and 2D imaging is not new for our collections, but pandemic closures pushed the need to review open-questions about usage terms/permissions for external and internal entities, and standards for processing and tracking digital assets. New strategies also required expanded coordination across departmental informatics and registration work.

In 2020, the Smithsonian launched a new Open Access (OA) initiative requiring reevaluation of existing digital assets and previous protocols for designating usage rights. NMNH established an Intellectual Property and OA working group to address varying unit concerns and preferences for managing digital assets, mostly due to collection type and professional structure. This motivated us to identify Paleo's specific needs first and consult resources nationally and abroad, including initiatives like DiSSCo.

Here we share our findings, building a perspective on digital transformation and transparency. Our roles, as Informatics Manager and Registrar, aligned as key views to condense and clarify our understanding about applicable rights and permissions for digitizing Paleo collections and ensuring long-term care and management of digital assets. We assembled department resources that established and dispensed our knowledge base. Each form, policy and workflow accounts for the evolving needs of our unit, NMNH community, Smithsonian Policies and US Intellectual Property landscape. These major components powered our approach, adaptation, and implementation:

- Understanding core legal and ethical considerations for digital assets of natural history collections in the US and dispersing that knowledge.
- Status of digital assets, current management for tracking usage terms/permissions, and distribution.
- Utilize existing collections information system (EMu) or develop new tools for tracking record creation, embargos, and use/requests for digital assets.
- Professional structure and roles.
- Implementation of Smithsonian OA.

This information gathering and evaluation process helped us better engage in discussions within our Museum and with external communities. Ultimately, we aim to continue the collective focus on national and international efforts to standardize requests and usage terms for creation and use of digital assets for biodiversity collections.

Contribution of undergraduate botanical research on plant species' conservation in a biodiversity hot-spot

Dr. Alina Freire-fierro^{1,2}, Ing. Karla Fuentes³, Ing. Evelyn Zurita⁴, Ing. Andrea Pachacama⁵, Ing. Jeny Carúa⁶, Ing. Brayan Argüero⁷, Mag. Fabián Cerda⁸, Mag. Alexander Lascano⁹

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MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Botanical research in biodiversity rich Ecuador, like in many other Low to Middle Income Countries (LMIC) is carried out primarily by undergraduate students. These studies, though preliminary and short term, can be carried out thanks to the study of natural history collections from local institutions and/or online resources such as virtual herbaria and other botanical databases. Though preliminary, these studies generate biological/ecological and cultural data, necessary for future plans of sustainable use and/or conservation. They also contribute to the documentation of plant specimens for herbaria, and the documentation of intangible knowledge obtained from the people they interviewed. Several of these short-term studies carried out on vascular plants from Central Ecuador at Universidad Técnica de Cotopaxi, revealed for example, that medicinal plants from local markets were primarily of exotic origin, and that plants with promissory importance in Culturally or Naturally Based Tourism, on Graphic Design or for industry were primarily native. Natural history collections can be, therefore, of use not only for answering scientific research questions, but also for applied research that can also contribute with information needed for conservation of native plant species in biodiversity rich countries.

Converging Content Between Archives and Museums Using Existing Resources: T.D.A. Cockerell and the Florissant Fossils

Sean Babbs¹, Helen Baer², [Dr Talia Karim](#)³, Barbara Losoff¹

¹University of Colorado Boulder Libraries, Boulder, United States, ²Colorado State University Libraries, Fort Collins, United States, ³University Of Colorado Museum Of Natural History, Boulder, Unites States

Specimens from the Florissant Fossil Beds, collected by University of Colorado professor and naturalist T. D. A. Cockerell (1866-1948) in the early twentieth century and held at the University of Colorado Museum of Natural History (CUMNH), have significant interest in the biological and paleontological research communities. Starting in 2018, staff at The University of Colorado Museum of Natural History (CUMNH) and the University Libraries at the University of Colorado Boulder began collaborating on a pilot project to digitally integrate fossil specimens located at the museum with associated archival material found at the Libraries. The project was inspired by two current trends in the management of natural history collections: 1) convergence, or the digital integration, of collections between museums and libraries; and 2) the expansion of digitized specimen data to include non-traditional types of material, an approach championed by the Extended Specimen Network. The principal challenge of the pilot project was the lack of technical integration between the database platform used to manage the specimen data in the CUMNH Invertebrate Paleontology (IP) Collection, Specify 6, and the digital collections platform in use at the Libraries, LUNA. After exploring several options, staff opted to use stable URLs (ARKs) for items from the Libraries' collection of digitized archival Cockerell material; the ARKs were added to relevant specimen records in the CUMNH's IP Specify 6 database. The URLs were included in the CU Invertebrate Paleontology dataset available on GBIF (Global Biodiversity Information Facility) making the archival library resources accessible to a much wider community of end users. The final approach of the pilot project required a low level of technical expertise, partly out of necessity, but also with the hope that the approach could be utilized by other collections with limited IT resources and technical knowledge. There are still some unresolved issues with storing and sharing linkages to archival materials within the existing natural history collections data landscape, but ultimately a successful partnership between the University of Colorado Libraries and the CUMNH was achieved using the most basic metadata (stable URLs) to connect users of Florissant specimens with associated materials found in the library.

Creating Active Collections in Natural History Museums

Miss Laura Alejandra Rincón Rodríguez¹

¹*Museum Studies Master's, University Of Florida, Gainesville, United States*

(ML2) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Natural history museums as evolving institutions are places where museum professionals can acquire enough learning to be game changers in the field. However, museums have their own complexities and nuances that need to be addressed. Museums can undergo a real and progressive change only if museum professionals listen to past generations, acknowledge those past efforts, and implement active collections to avoid repeating the patterns that the field is still trying to overcome. Museum professionals could move forward through the implementation of active collection ideas to bring new visions, goals, and challenges with every generation of museum professionals.

I will present a proposed schematic representation of nine aspects of converting natural history collections into active places from a compilation of experiences as a museum studies student in a natural history museum, ideas from the Active Collections book, and other authors and implemented strategies. Additionally, my experiences as a Latina woman with a non-scientific background, discussions during my digital initiative called Collections Lit Club, and conversations with professors and mentors as a guide to the emerging museum professionals who are willing to implement fresh ideas in the field. It will be helpful for museum professionals who have been in the field for many years to rethink their practices and re-evaluate how they can contribute to diverse, inclusive, and active collections. Museums are adaptable and can respond to changes from internal and external sources, but only if museum professionals are open to uncomfortable discussions about changing old practices. It is the responsibility of museum professionals to be creative and open to implementing thought-provoking, novel ideas, to be receptive to the needs of current collections staff and the public, and to find ways that natural history collections can contribute and find solutions as active, diverse and inclusive spaces for everybody.

Creating Inclusive Spaces: Centering Gender Identity in Biodiversity Science and Natural History Collections

Dr Anna Monfils¹, [Sara Hanson](#)¹ Rhea Ewing²

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(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Communications about biological sex and sexual expression are rife with exclusionary language, which can alienate LGBTQIA2+ members of the science community. Vocabulary employed often does not represent the complexity of biological sex and social experiences of gender nonconforming, two-spirit, transgender, and intersex individuals, and creates environments in which these individuals do not feel welcome and are not free to contribute to science. Thus we lose their important contributions and unique insights that will enhance our understanding and provide new perspectives on the natural world. Natural history specimens and the institutions that house them can serve a critical role by increasing visibility and fostering understanding and acceptance of gender-diverse identities. As natural historians and professionals working in collections spaces, we have a unique perspective on the diversity of life and the opportunity to translate our understanding of biology to the breadth of human experiences and create inclusive spaces to embrace human diversity. Alongside emerging discussions within the community regarding decolonizing science, incorporating local and indigenous knowledge, and elevating contributions by members of underrepresented groups, we also have the opportunity to address LGBTQIA2+ issues including our problematic understanding of and language around biological sex and sexual expression. We will discuss the diversity of gender and sex among scientists, showcase examples of sex-based biological variance in nature, and illustrate the need for inclusion of transgender, nonbinary, gender nonconforming, two-spirit, and intersex voices in science and collections. We will introduce emerging projects that utilize art and biodiversity science to explore and challenge notions of gender and identity and connect these human experiences to the natural world. Developing projects include: Open Education Resources that teach core concepts in botany and center gender-diverse individuals within biodiversity research; community outreach that place gender identity and biological variance in the context of important biodiversity issues; and dynamic science communication strategies accessible to LGBTQIA2+ individuals and allies. Our community is in a unique position to engage a broad audience, foster conversations, and create inclusive spaces in science.

Creating order out of the chaos of cultivated names – The Royal Horticultural Society’s (RHS) new entity system

Ms Sian Tyrell¹, Mrs Lydia Walles¹, Mrs Mandeep Matharu¹

¹*Royal Horticultural Society, Woking, United Kingdom*

The RHS’s Herbarium (now known as The 1851 Royal Commission Herbarium) sits alongside our Living Collection and all the associated data is captured within the RHS Horticultural database. Many of the herbarium specimens are taken from plants living in the RHS gardens and so have a direct link to the accessions in the living collection.

With its focus on cultivated plants, the RHS is uniquely interested in cultivated plant names – a virtual wild west of names, with everything from names officially registered with an International Cultivar Registration Authority (ICRA), to names given to plants by garden centres to help them sell better, all coming into play. A single cultivated plant may have up to 50 names with various degrees of ‘rightness’ but all in use in the world and so needing to be tracked.

To tackle this apparent chaos, the RHS has developed a new Entity Model for cultivated plants that assigns a unique identifier to a plant, regardless of what it is called today. The features of that plant (from growing conditions, to fragrance and importantly whether it features in a living or preserved collection or both) stay with that Entity regardless of what name is used for it.

This new system helps us ‘find’ specimens in the herbarium even where the specimen itself makes no reference to the particular plant name searched for. If the searched for name, and a name associated with a specimen are associated with the same entity – we will find the specimen. After all – it is still the same plant, regardless of what you label it.

CryoArks – The UK’s first zoological biobank

Dr Andrew Kitchener¹, Dr Gill Murray-Dickson¹, Dr Helen Senn², Professor Michael Bruford³, CryoArks Consortium³

¹National Museums Of Scotland, Edinburgh, United Kingdom, ²Royal Zoological Society of Edinburgh, Edinburgh, United Kingdom, ³University of Cardiff, Cardiff, United Kingdom

(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Established in July 2018 with funding from BBSRC, CryoArks is a UK-wide collaboration that aims to create the first comprehensive zoological biobank in the UK. Working with lead collaborator Mike Bruford of Cardiff University and other consortium members, CryoArks is bringing together millions of samples held in disconnected collections across zoos, aquaria, museums and academia and provides a single web portal for researchers to access information about zoological samples in the UK. In addition, CryoArks partners offer sample storage and curation at one of several collection centres, including National Museums Scotland (NMS), the Royal Zoological Society of Scotland (RZSS) in Edinburgh, and the Natural History Museum in London. Building on >10,000 tissue samples collected by NMS’s Vertebrate Biology section over the last 30 years, CryoArks has provided biobanking infrastructure for NMS for the first time. This collaborative project is attracting more partners and samples since it went live during 2020. Issues that have arisen in creating a governance structure for CryoArks, adapting workstreams in different institutions, dealing with requirements for the Nagoya protocol and establishing protocols with the EAZA biobank will be discussed.

Crystal Model Collections in UK Museums

Mr Peter Davidson¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

This year (2022) has been declared the "Year of Mineralogy" by the International Mineralogical Association. 2022 was chosen as it marks the bicentenary of the death of Rene Just Hauy, one of the most important people in the history of mineralogy and, in particular, crystallography. His legacy for the history of our science cannot be understated but one of the most intriguing, long-lasting and recognisable are his sets of crystal models, usually of wood, which he created in and around 1801 to accompany his seminal work in mineralogy the *Traite de Mineralogie* in which he illustrated the crystallography of minerals with some beautiful line drawings. The models were made to give a 3D view of the 2d drawings as well as allowing for measurement of the interplanar angles. Hauy's models were not the first as twenty years earlier, Jean-Baptiste Louis Rome de Lisle another famous French mineralogist had created models in terra cotta to illustrate his own book on crystallography, but they were probably more influential and many makers across Europe began to produce sets of models in a variety of materials based on Hauy's system.

The National Museums Scotland has collections of Hauy crystal models as well as other makers. They number several thousand and are in excellent condition. Work remains to be done on them and the author intends to press on with this project.

The aim of this presentation is to bring to the attention of the delegates and attendees the importance of these collections in the history of mineralogy and crystallography and to broach the idea of setting up a register or catalogue of crystal model collections held in collections around the UK. Research into the history of crystal models is of growing interest and a listing such as this could be of benefit to researchers in this field.

Culturally Responsive Undergraduate Science Education: A model for equity and social justice academic biology

Dr Hillary Barron¹

¹*Bemidji State One Specimen Many Stories University, Bemidji, United States*

(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Science as an enterprise has been and continues to be exclusionary, perpetuating inequities among whose contributions are acknowledged as well as whose knowledge is recognized as valid. The National Science Foundation reports that women, minorities, and persons with disabilities are still vastly outnumbered in science and engineering by their White, male counterparts. These imbalances create a gatekeeping culture of inequity and inaccessibility, particularly for traditionally underrepresented students.

Utilizing pedagogies of empowerment, such as culturally responsive science teaching, can mitigate the gatekeeping phenomenon seen in science. The CRUSE program (Culturally Responsive Undergraduate Science Education) advances the conversations of equity and social justice in undergraduate science education by creating a localized approach to culturally responsive science teaching that is informed by the views and experiences of biology teaching assistants (TAs) and faculty.

At its core, CRUSE aims to ensure that all students – particularly those historically excluded from science – have opportunities to build positive science identities and experiences around science and maintain a rightful presence in college biology learning spaces. CRUSE furthermore draws on frameworks of anti-racist science teaching to interrogate how to dismantle systemic structures of inequity. There are three domains or focal areas of CRUSE: culturally relevant pedagogy, funds of knowledge, and social justice science issues. This presentation describes each of these domains in detail, and examines how biology TAs and faculty, through targeted training, have engaged with and enacted CRUSE teaching strategies.

Curation and Digitization of the University of California Museum of Paleontology Cambrian and Ordovician collections: Insight into early animal evolution

Dr Ashley Dineen¹, Dr. Lisa White¹

¹*University of California Museum Of Paleontology, Berkeley, United States*

At the University of California Museum of Paleontology (UCMP), we are currently working on rehousing, curating, and mobilizing our Cambrian and Ordovician (~541 to 445 mya) marine invertebrate collection via a Museums for America grant from the Institute of Museum and Library Services (IMLS). This collection records one of the most important intervals in life's history, providing insight into early animal evolution and the rapid diversification of life in the oceans. The Cambrian (541-485 mya) marks the time when most of the major groups of animals first appear in the fossil record, such as molluscs, echinoderms, arthropods, and brachiopods. As such, these fossils and their associated archival data represent an important scientific resource with incredible historical value, however much of the data is in danger of being lost due to deteriorating field tags and notes and lack of a digital catalog record to track the data. Our goals for this project are to: 1) rehouse specimens to improve their accessibility and prevent future deterioration; 2) create a digital record for every specimen that captures both taxonomic and locality data for roughly 14,000 Cambrian and Ordovician marine invertebrates; 3) digitize archival records, photographs, and field notes that provide important context to the age and history of the specimens; 4) provide the scientific community and the public with this information and data online; and 5) use the collection and associated data to develop web content containing short highlights of Cambrian and Ordovician fauna for education and public outreach. Our overall aim is to preserve this historical and scientific collection and increase the integration and accessibility of the collections and associated data for both research and educational purposes. Overall, this unique and idiosyncratic collection of fossils provide vital clues for understanding how life originated in the oceans, while also adding to our understanding of how early life shaped the evolutionary and ecological context of our world today.

Curatorial handover in the time of COVID

Mr Mike Rutherford¹

¹*Hunterian, University Of Glasgow, Glasgow, United Kingdom*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Starting a new post can be an overwhelming time for a curator as they have to cope with learning new systems, new ways of working, unfamiliar databases, collection histories, which are the prized objects and so on, doing this whilst working from home during a pandemic adds a whole host of further issues. It is also a worrying time for the curator moving on, what will happen to the collections and displays that they have cared for over the last few years or even decades? Fortunately my start at the Hunterian in March 2021 was made all the much easier by the steps taken by the departing curator and other colleagues and due to having a period of several months when the old and new curators could work side by side, hopefully alleviating the concerns of both. This short talk will examine the handover process with some hints and tips to make it easier for all involved, including how long a to-do list is too long, finding out who really gets things done and where to get a good coffee.

Darwin Tree of Life Project: Sample Tracking

Miss HEATHER Allen¹

¹*Natural History Museum, London, London, United Kingdom*

ID2) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

In 2020, the Darwin Tree of Life (DToL) project began with the aim to sequence the genomes of all 70,000 species of eukaryotic organisms present in Britain and Ireland. It is a partnership between various biodiversity, genomic and analysis partners with the goal to make all sequence data publicly available. One such partner is the Natural History Museum, London.

As with all new projects of this nature, serious thought needed to be put into the tracking and tracing of any and all samples involved; the need for this was highlighted even more due to embarking on this ambitious project during the pandemic.

In terms of the sample pipeline, there are two main areas to consider: the physical whereabouts of the sample and the accompanying data. The overview of the process in relation to the Natural History Museum is as follows: samples are collected, deposited, processed, sent for sequencing and then sequence data is returned. At each stage, different individuals and locations are involved, and data is accumulated.

As the DToL data manager and sample curator at the NHM, I use a variety of different techniques and systems to ensure that samples are trackable throughout this pipeline and that no data is lost. Here I shall discuss the successes as well as the lessons learned along the way.

Data cleaning an iterative process: lessons learned from the second mass digitization project at Meise Botanic Garden

Dr Henry Engledow¹, Ms Ann Bogaerts¹, Ms Sofie De Smedt¹, Mr Wesley Tack¹

¹*Meise Botanic Garden, Meise, Belgium*

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The second mass digitization project at the Meise Botanic Garden (Belgium), DOE2, finished in 2021. Most of the label transcription was done by a contracted third party. Despite the data being delivered at a quality controlled high standard, extensive data cleaning was still needed before it could be imported into our database. The poor data quality was the result of four main factors: (1) the herbarium being digitized is not as well curated as the previous project; (2) the content of the collection is poorly known; (3) specimen labels are often handwritten and barely legible; and, (4) the information on the labels is often ambiguous, unclear or absent. These issues led to a dataset that needed extensive cleaning. As the dataset comprises some 1,200,000 entries this allowed us to compare records within the dataset, fields could be sorted and grouped allowing us to normalise and link data. This first step allowed us to remove the most obvious errors. Semi-automated tools were tried, but they proved to be more work than help. Secondly, certain absent data important to the collection and data cleaning, such as the country of origin, could be deduced from other label information, like the locality. This required someone to interpret and group records lacking a country code. Again, a semi-automated approach was attempted, but with a high level of uncertainty. The more data one has the better one is able to clean other data, e.g. cleaning an ambiguous collector name can be cleaned by having data on the country and year of collecting event. Certain linked data is also important in our database, like taxon and collector. In many cases these data were missing from our database and needed to be created and linked before importing. Once the data are close to complete, one can enter the final stage that aims to look at logical inconsistencies in the data, such as the collecting date being out of the range of the collector's life span. Data cleaning is an iterative process, at first the image is out of focus, but with each iteration the picture becomes clearer.

Death Re-enlightened: The Conservation of the Wet Anatomical Preparations of Frederik Ruysch, the Rembrandts among Fluid Preserved Specimens.

Mr Andries van Dam¹, Dr. Abbie Vandivere², Dr. Carol Pottasch², Prof. Dr. Pancras Hogendoorn¹

¹*Leiden University Medical Centre, Leiden, Netherlands*, ²*Mauritshuis, The Hague, Netherlands*,

(NW2) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

In the 17th century, the Dutch anatomist Frederik Ruysch and his contemporary Rembrandt van Rijn were considered unrivalled in their own disciplines. Where Rembrandt created depth and realism in his paintings by mastering the translucence of light, Ruysch achieved a similar effect in his anatomical preparations by mirroring the transience of life. An investigation in their working methods and use of materials show that, with regard to conservation, these quite different types of objects have more in common than initially anticipated. Due to this unique comparison and multidisciplinary approach, several material degradation processes seen in Rembrandt's oil paintings, such as the formation of lead soaps in *The Anatomy Lesson of Dr. Nicolaes Tulp*, could be related to similar mechanisms observed in Ruysch's fluid preserved anatomical preparations. These findings have contributed to a better understanding of how to interpret, conserve and treat these outstanding works.

Decanting Dublin's Dead Zoo

M Paolo Viscardi¹

¹*National Museum Of Ireland - Natural History, Dublin, Ireland*

The exhibition building of the National Museum of Ireland - Natural History (affectionately known locally in Dublin as the Dead Zoo) was constructed in 1856 as the museum of a learned society, which was later developed further when taken over by the state in 1877. It is often regarded as a 'museum of a museum', which has been embraced as a deliberate aesthetic for the last few decades, but it is primarily the result of a century of lack of attention and investment.

However, the Irish Government's National Development Plan 2021-2030 expresses the will to address this with "refurbishment of the Natural History Museum to address structural and environmental issues and provide a fit for purpose set of galleries and ancillary facilities". In order to facilitate this welcome move, which will start with the conservation of the building's roof, the Museum team have been engaging in the process of decanting the upper galleries and behind-the-scenes storage. This process has so far seen the removal and rehousing of over a million specimens, ranging from microscopic insects to the skeleton of a fin whale.

The process was challenging at times as the historic building has no lifts, poor floor loading and restricted physical access. Nonetheless, the moves provided fantastic opportunities to manage pests and improve the storage of our collections. In this talk we will highlight some of our experiences and share the solutions we have embraced to safely decant Dublin's Dead Zoo.

Deciphering natural history and mapping the world through collection labels

Ms Krisztina Lohonya¹

¹*The Natural History Museum, London, London, United Kingdom*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Digitisation is a crucial part of making collections discoverable, and available to a wider audience. With digitisation, we are creating a digital record of the specimen and attaching an image to it. But at this stage, the information is still locked inside that image, to make it truly available, and searchable and researchable, we have to extract that information and that is where transcription comes into play.

With transcription, we are making the information discoverable, but this is not as straightforward as it seems. In an ideal world, the labels would be detailed, completely legible, and unambiguous - this is rarely the case, especially as the further you go back in time, the less information is available, or the harder it is to decipher. If we ignore how some collectors had a barely legible handwriting, we are still facing an entirely different problem - and for this, the "Tower of Babel" is to blame.

Our labels are written in a huge variety of languages as collectors were from many countries and their language heritage is preserved on the labels written by them. For these, we have to think outside the box and proceed with a different approach that accounts for this rich diversity of backgrounds, mother-tongues, interests, and linguistic and historical knowledge. The information on your label will hold a wealth of information, not just habitat or location - it encapsules a piece of history, a fragment of time that existed that moment and is usually long gone. Often you have to know that history to decode the information on the label.

In this presentation I will talk about misinterpreted labels and possible solutions to avoid these in the future. I will present a methodology specifically designed for Chinese labels, but also mention how this can be applied to labels with different writing systems (e.g., Cyrillic script). Using the proposed methodology can help with transcription and any subsequent geo-referencing.

“Deep Time” of Digitization: History of Biodiversity Digitization at National Museum of Natural History

Ms. Katherine Roberts¹

¹*Smithsonian National Museum of Natural History, Washington, United States*

For over fifty years the Smithsonian National Museum of Natural History (NMNH) has strived to increase and improve our digitization efforts. Throughout those years, biodiversity digitization has taken many different forms with ever-changing technology and improving accessibility. This poster provides a timeline with highlights of biodiversity digitization efforts at NMNH from inception to the present. When tracking the history of this work using a timeline, we are able to glimpse some of the milestones and progression: from achievements in mass digitization efforts, open access, 3D imaging, as well as enhancing and standardizing guidelines—all of which is improving the way we think about digital accessibility. One of the more obvious adaptations tracked in this timeline is the ever-changing advancement of technology. But no matter the tools and methods used throughout our history, one will notice that the implications are still the same: this digitization work is essential to help preserve our natural history collections, to better understand these collections, and to achieve broader outreach and greater accessibility. As stewards of the largest natural history collection in the world, utilizing biodiversity digitization is also vital to help us better understand the natural world and our place in it. Join us as we take a deep dive into the evolution of the Museum’s tools and methods, as well as its future goals and aspirations.

Despite being more than 150 years old, this taxidermy of a little bustard still looks brand new

Mr Lennart Lennuk¹

¹*Estonian Museum Of Natural History, Tallinn, Estonia*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The oldest taxidermy belonging to the Museum of Natural History is known to be of a little bustard who was shot in 1862 in Northern Tallinn in the area of the present-day Kopli district. The taxidermy's good condition is a great example of the museum's consistent care for its objects.

At the museum, the remains of the animal start a new life of nature education or serve a scientific purpose. In addition to the features of a specific species, present-day scientists are also interested in the knowledge hidden even from the keenest of eyes, stored in the DNA or tissues in the form of toxins. All of this gives us more information about evolution, the development of the species, toxins found in the environment and their effect on the living creatures.

Before modern scientific methods were developed, ornithologists used guns to study birds, as it was the only way to take a closer look at the more rare birds they had met. Nowadays we can also identify the species based on photos and recordings of their sounds. Bird migrations can be followed using rings, radars and GPS devices. Most specimens find their way to museums through accidents caused by glass surfaces, power lines, cars or even cats.

However, we shouldn't be quick to judge the seemingly cruel scientists who used guns to study nature, as thanks to them, we have research material dating back as far as 150 years or more. This is valuable for both present-day and future science.

Developing a collections NFT program at the Natural History Museum of Los Angeles County

Dr. Trina Roberts¹, Roshanna Sabaratnam¹

¹*Natural History Museum of Los Angeles County, Los Angeles, USA*

As the prominence of NFTs has grown, the Natural History Museum of Los Angeles County (NHMLA) has become increasingly interested in the idea of creating NFTs based on our own collection or our popular exhibits. In early conversations among our staff, it became clear that there was a great deal of confusion about what NFTs are (and aren't), and therefore no real agreement about whether they represent a genuine and exciting opportunity or a silly fad that we'd be better off letting pass us by. Continuing discussions have helped to clarify our understanding by focusing on several major question areas for our development of a collections-based NFT program. This talk will describe how NHMLA is currently thinking about NFTs in relation to the possible technical challenges and our capacity to solve them; our knowledge of our own audience and the potential NFT audience; the potential impact(s) that creating, minting, and selling NFTs will have on our current and future audiences; our institutional values of sustainability, equity, and access; the extent to which we want to maintain authority and control over our own objects and their derivatives; our responsibility to maintain the collection as a resource primarily for research and education; and our strategic goals for the collection and the institution. While we are not (yet) ready to create our own NFTs, this framework has helped us discuss more productively what museum NFTs might be and how they might fit an institution like ours.

Developing a strategy for Pest Tolerance levels in a Zoological collection

Ms Jen Gossman¹

¹*Zoological Museum Cambridge, Cambridge, United Kingdom*

Pests are an ever-present issue for museum collections. But at what level do they truly present a problem and when should we be concerned. While eliminating any pest seems the final solution it is basically an improbable goal, there will always be some even in the best kept collections.

At the Cambridge University Zoological Museum, we have been trying to understand what the pest tolerance levels could be for a zoological collection covering multiple different types of natural history specimen. Developing a tolerance level allows for realistic measures for prevention to be implemented and for alert levels and monitoring practices to be refined.

Building on the work of J. Henderson and C. Baars at the National Museum Wales, we have been using the determination of a pest occurrence index which allows the calculation of the mass of potential pests in each space by M2. This we then coupled with determining the given condensed mass of specimens per storeroom and specimen material type in M2 and the pest population that each store could support on this mass. This we implemented through a combination of extensive room dimensions and collection surveys and pest behaviour and population research.

This poster presentation will outline the methods and processes used to gather and determine the initial pest occurrence levels for the collection stores at Cambridge University Zoological Museum and the work undertaken to develop these into an initial estimate of tolerance levels.

Developing specimen and sample citation guidelines in collaboration with publishers

Dr. Sarah Ramdeen¹, Dr Andrea Thomer², Adam Mansur³, Dr. Lesley Wyborn⁴, Chris Erdmann⁵, Shelley Stall⁵
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Specimen and sample citation is a complex topic. Journals have varying recommendations for listing materials examined; there are varying standards for listing specimen identifiers; and some journals still do not provide space for listing all materials examined in a sufficiently detailed manner. However, while it is challenging, citation is also crucial for making samples and specimens a part of the research data ecosystem. Citation makes specimens more accessible for reuse, helps support the reproducibility of studies that use specimens, and is important in measuring the impact of natural history collections.

The Earth Science Information Partners's (ESIP) Physical Samples Curation Cluster is currently working to develop author guidelines and recommendations for physical samples (including natural history specimens). The Physical Samples Curation Cluster is a forum for the community supporting physical samples in the earth, space, and environmental sciences which includes but is not limited to geological, marine and biological samples and specimens. These guidelines are intended to help journals and publishers communicate expectations for authors. Our aim is to improve the discoverability of specimens/samples in the future such that they can be used by all researchers, from sample generation to sample use and understanding. Our group is developing these guidelines through monthly calls and at twice yearly ESIP meetings. We hope to be done by July – but we need the help of the SPNHC community.

In this presentation, we will share our progress to date and solicit feedback on our guidelines. We plan to have our first draft of guidelines available by May and input from the SPNHC community will be crucial in ensuring that these guidelines are broadly applicable. We are working with the American Geophysical Union (AGU) as the first adopter and model for these guidelines but hope they will be of use to other communities. We are reaching out to the SPNHC community to learn more about your concerns and priorities related to biodiversity specimen citation which might be incorporated into the guidelines or community specific variations.

Devising and analysing a catalogue of the Sloane herbarium at the Natural History Museum, London

Mr Brad Scott^{1,2}

¹*Queen Mary University of London, , UK,* ²*Natural History Museum, London, UK*

The vast collection of Sir Hans Sloane (1660-1753) formed the foundation of the British Museum, and is now located across three London sites: the British Library, the Natural History Museum, and the founding institution itself in Bloomsbury. Over the course of his long life, Sloane accumulated an extraordinary collection of dried plants occupying some 260 volumes, collected and amassed by hundreds of people. It remains one of the most important pre-Linnaean botanical collections in the world. A portion of its material has been studied throughout its history, and the herbarium and its collectors have been the focus of much recent research. Nevertheless, the collection as a whole has only partially been described; James Britten catalogued the volumes from 1908 to 1911, which work was brought to publication by James Dandy in 1958.

This paper will describe the current work to develop a framework for a new, extensible catalogue of the Sloane herbarium that will offer novel opportunities for analysing and understanding its contents and contexts of creation. Drawing on and mobilising the rich data implicit in Britten and Dandy's work, the project uses an XML-based approach to create a folio-centric model of the collection to which additional sources and data can be added over time. To serve the needs of the varied communities who may have an interest in the material, the project must support the data requirements of both biodiversity informatics and digital humanities.

Such work is already enabling the generation of some high-level quantitative data, as well as the analysis and visualisation of the component parts of the collection. As a result, it is possible to identify those collectors and volumes about which little is known, and new research arising from this will focus on understanding the networks of collecting and exchange, and the roles of lesser-known actors in the making of the herbarium. In particular, the work will make visible the gaps and silences in the collection, and indicate the occurrence of indigenous knowledge, and the place of local collectors and enslaved people in the European botanical collecting networks of the seventeenth and eighteenth centuries.

Digi-Leap: Connecting Novel Tools, Machine Learning and Public Participation to Label Digitization Efforts

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G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Over the past two decades, natural history collections have been transformed. Key innovations include emerging data standards and first-generation data mobilization tools which catalyzed cloud-based, open data sharing in consistent formats. Despite this progress, one of the biggest gaps in digitization is converting imaged label information into computable, research-ready data. Outside of imaging, necessary steps in specimen digitization have remained mostly boutique, relying on human effort to assemble digital records. The solution to leaping the digitization gap will require a multifaceted approach that exploits modern advances in Natural Language Processing, Optical Character Recognition (OCR) and Computer Vision through mainstream platforms for public, volunteer transcription. Here we showcase “human-in-the-loop” approaches to automate label digitization focusing on Notes from Nature (NFN), a popular platform for label transcription with tools that can be repurposed to help support these new approaches. We use NFN for a set of key tasks. The first is developing training data via NFN to implement a machine learning based label segmentation model for imaged herbarium specimens. The second and third tasks focus on tools for human-in-the-loop validation of OCR. These tools are critical; while OCR success rates on specimen labels show its high value, the results still need to be verified, and often edited. Our first tool asks volunteers if OCR was successful via a quick scan of output compared to the imaged label. Volunteers are asked to assign a simple scoring, and this information will be fed back to improve the OCR models. The second tool works with labels which were rated as having median errors. These are fed into a bespoke OCR editing workflow that invites volunteers to compare OCR output with the original specimen label and make any necessary edits to the text. The edited text is used to refine the OCR engine and decrease the error rate over time. Blog posts are used at each setup to update the volunteer community on the progression of this new approach. Our presentation is interactive and focused on soliciting input from the community about the current approach and the utility of tools and workflows for automating label digitization.

Digitally connecting the Mollusca types in Britain and Ireland - a project update

Ms Harriet Wood¹, Mr Jon Ablett², Mr Ben Rowson¹, Ms Andreia Salvador², Mr James Turner¹, Mr Graham Oliver¹, Mr Tom White²

¹*Amgueddfa Cymru-National Museum Wales, Cardiff, United Kingdom*, ²*Natural History Museum, London, United Kingdom*

Nomenclatural 'types' are the treasures of any natural history collection and are constantly sought out by researchers. Many UK curators are spread across several natural history disciplines and lack the skills or resources to attend to type research and curation, and such specimens risk being 'lost' to the international scientific community.

In March 2018 the 'Mollusca Types in Great Britain' website went live (<https://gbmolluscatypes.ac.uk>) which was the result of a 2-year Ellerman Foundation funded project led by Amgueddfa Cymru-National Museum Wales and the Natural History Museum, London. It encompassed the researching, imaging and publishing of mollusc types from 7 UK partner museums where the staff were trained to recognise, research and interpret the molluscan type specimens in their collections.

A successful bid for Phase II funding, also from the Ellerman Foundation, has given the project further reach, enabling an additional 12 museums in the UK and Ireland to be included. Since 2019 the team have:

- imported new data on type material from Oxford University Museum of Natural History (c. 660 records), the Linnean Society of London (c. 580 records), Tenby Museum & Art Gallery (8 records), National Museums Scotland (260 records), Amgueddfa Cymru-National Museum Wales (c. 1700 records), plus additional paratypes from Glasgow Museums (31 records)
- undertaken visits to National Museums Northern Ireland, Cambridge University Museum of Zoology, Bristol City Museum & Art Gallery and the Booth Museum of Natural History (a new addition to the project) where potential types have been highlighted
- linked the specimen records to MolluscaBase and GBIF to ensure greater visibility and support worldwide taxonomy
- started undertaking historical research on archives, biographies and handwriting that will form a new strand to the website
- progressed with planning visits to the remaining 5 museums
- carried out essential upgrades to Filemaker Pro software and imaging systems
- continued to support curators from Phase I by responding to enquiries related to their collections

Due to a Covid-19 hiatus the project will now end in 2023 and with the inclusion of Ireland, the web resource will be rebranded – 'Mollusca Types in Britain & Ireland'.

Digitisation of a reference collection of seeds

Dr Helmut Dalitz¹

¹*University Of Hohenheim, Stuttgart, Germany*

Authors:

Dalitz, H., Dalitz, L., Gliniars, R. & Duque-Thüs, R.

University of Hohenheim

The Hohenheim Gardens have databased their reference collection of seeds and published it on their website (http://144.41.33.40/4DAction/W_Init/HG_3_12_de.shtml).

This information about more than 4000 species is a step forward for practical work of gardeners, and delivers a profound source of information for other institutions. However, written label information is important, but may be much more useful with attached high resolution photographs of the seeds.

We want to present a project aiming in the production and publication of digital surrogates of the seed morphology with a workflow that includes high resolution photography, image stacking, CMS based handling of thousands of photographs and free online access for everybody of the photographs (http://144.41.33.40/4DACTION/W_Init/HG_4_5_de?W_arr_MMO_Context=Samen&W_arr_Month=alle&sn=). The database behind is based on the ABCD 2.06 standard.

Digitisation of the National Herbarium of Ireland (DBN)

Dr. Wuu Kuang Soh¹, Ms. Cliona Byrne¹, Dr. Darren Reidy¹, Dr. Matthew Jebb¹, Dr. Colin Kelleher¹

¹*The National Botanic Gardens of Ireland, Glasnevin, Dublin, Ireland*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The National Herbarium (DBN) at the National Botanic Gardens of Ireland houses a growing collection of c. 600,000 specimens of plants and fungi from Ireland and around the world. The collection comprises of historical specimens collected between the early 1800s and the present day. The DBN collection is therefore important from the perspectives of cultural and natural heritage. It is a valuable resource for science and education, and for understanding the natural world. The specimen data provides records of spatial and temporal changes in the Irish flora. In 2021, a herbarium digitisation programme was established at DBN with an initial focus on digitising the Irish collection (c. 100,000 specimens) and specialised collections of historical importance (e.g. the Robert Brown and McNab herbaria). We created a viable digitisation workflow specific for DBN, modified from iDigBio recommendations. Our imaging station consists of a mirrorless interchangeable lens camera mounted on copy stand with LED lighting. This workflow enables specimens to be imaged at an average rate of 50 sheets per hour. Our future plan includes using crowdsourcing to transcribe specimen labels and subsequently making the data and images available online through a web-based collection management system (e.g. BRAHMS).

Digitization of Dehradun (India) Forest Fungarium with Data Mining of Plants Disease

Mr. Neelesh Yadav¹

¹*Himalayan Forest Research Institute Shimla, Dehradun, India*

Fungi are among the most important organisms in the world, not only because of their vital roles in ecosystem functions but also because of their influence on humans and human-related activities. The Forest Research Institute, Dehradun (India) has a plant disease herbarium (largest in south east Asia) which is commonly called “forest fungarium” which holds approx. 12,000 no. of plants fungi and disease specimens were collected from India and other countries of the world. It has collections of forest fungi from all the agro-climatic zones of India. In the year 2012 an online software was developed to digitized the specimen’s digital images and their corresponding taxonomic details. The software was developed in Php/MySQL web technology. The online virtual fungarium thus becomes an important tool in the revision of taxa. The digitization work is aimed for developing the state of art software database as per international biodiversity informatics guidelines and standards. The data set includes the voucher information like phylum, class, order, family, genus, species name, locality, longitude and latitude, collector’s name and accession number, date of collection, and missing fields on the label was entered as “Unknown”. The software has a simple and advanced search panel for searching/retrieving the specimen’s information via an online page. Total 8534 no. of specimens have been digitized alongwith and their taxonomic details. As a result of this development work, an online software system was provided on a public portal to access the pathology herbarium specimens of the institute. Through this application, the identification of any forest pathogens is possible via image similarity search of morphological characteristics of any plants disease. Fungi are essential to such crucial activities as decomposition, nutrient cycling, and nutrient transport and are indispensable for achieving sustainable development. To preserve digitally this fungarium, the need arose to develop an online software system in which all digital images can be stored in a scientific manner. The data of this fungarium database analyzed with data mining tools “rapidminer”. Results generated with plants disease probability in specific species of fungi and results show that some fungi species are more vulnerable to disease attacks.

Digitization of Natural History Collections of Tropical Forest Research Institute Jabalpur (India)

Mr. Neelesh Yadav¹

¹*Himalayan Forest Research Institute, Shimla, India*

The historical collections of the Tropical Forest Research Institute(TFRI) Jabalpur's forest herbarium, forest fungarium, and forest insects reference collections require upkeep and modernization through digitization, barcoding of specimens, and web availability. All of these collections are one-of-a-kind in the context of central India and the surrounding tropical forest region. According to the requirements of the Convention on Biological Diversity (CBD), these natural biodiversity history collections must be digitally preserved for simple access and benefit-sharing. An ICFRE funded project began in April 2019 with the goal of developing an online digitized specimen software system in php/mysql that may also be used for research and education. In most cases, published reports of fungal pathogens from most nations are not backed up by specimens or other evidence. Many common plants, diseases, and insects are underrepresented in major museum collections. As a result, the herbarium becomes an important instrument for taxon revision and monographic research of a particular genus. Herbarium specimens are also useful to land managers and conservationists, as well as the general public. Biological specimens housed in herbaria, museums, and natural history collections are very valuable. It is, however, extremely difficult to obtain until it is made available online. This project addresses this problem and focuses on a specific aspect of biodiversity informatics, namely the publication of plant/fungi specimen data, but the approach used in this project is more general, involving the use of various standards, particularly MySQL-based data schemas and query interfaces, as well as open-source software. There are 1400 herbarium sheets in the Tropical Forest Research Institute Jabalpur herbarium, including 77 families and 575 species. There are 758 recognized insects in the TFRI's insect collection, divided into 10 orders and 105 families. The fungarium/plant disease collections at TFRI contain a total of 4061 specimens from 239 distinct taxa. The web portal for the TFRI's natural history collection is <http://www.tfrinhc.co.in>

Digitized Collections as a Means to Deepen Informal Science Learning: An Argument and Early Findings

Dr Lynne Zummo^{1,2}, Ms. Madlyn Larson²

¹University Of Utah, Salt Lake City, USA, ²Natural History Museum of Utah, Salt Lake City, USA

G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

This presentation explores the potential for leveraging digitized natural history collections to advance and deepen informal science learning. It does so through three means: 1) a research-based argument for why and how digitized collections could support informal science learning; 2) a description of a pilot study investigating a museum-based digital interactive that engages learners with digitized collections, and 3) a summary of our initial design principles, constraints, and opportunities around creating learning experiences that feature digitized collections. First, we present a research-based argument via literature synthesis to show why and how digitized collections could advance and deepen informal science learning. Drawing on extant research from the fields of science education and learning sciences, this argument advances the view that digitized collections could be not only useful for learning but potentially transformative. We argue that digitized collections can mediate the cognitively demanding sensemaking processes that have been identified as critical to effective science learning and, therefore, have potential to deepen the intellectual rigor of museum-based learning experiences, helping to expand the way that learners think. Second, we describe a pilot study of a digital interactive that features digitized collections. We will share our design process, which involved adapting parts of a fully developed inquiry-based learning sequence intended for formal science classrooms into a museum-based experience. Specifically, the design of this digital interactive was oriented towards creating an activity that could strengthen learners' data practices—or the selection, analysis, and interpretation of quantitative data—something with which the public is known to struggle. We share initial findings from the pilot study of this interactive, implemented with visitors at a natural history museum in the western US. In particular, we highlight how certain design features were associated with particular forms of engagement by learners. Finally, we consider how these findings might inform future iterations of informal learning experiences that leverage other digitized collections. We expand upon these ideas by identifying initial design principles, constraints, and opportunities for creating learning experiences that use digitized collections in informal spaces. We identify the collaborators, resources, and further research needed, and we suggest multiple paths forward.

Digitizing Botanical Herstory: Digital Humanities and the Herbarium Curatorship of Dr. Dorothy Swales

Ms Heather Rogers¹

¹*Mcgill University, Montreal, Canada*

Botany and the study of the natural world in the West have long been associated with perceived notions of femininity (George 2007). Despite these links, women's contributions to botanical knowledge have largely been pushed to the margins of history, overshadowed by male figures in the field (Shteir 1996). This thesis project will examine the intersection of women, plants, and botany both in history and the digital sphere. To do so, I will focus on the knowledge creation of Dr. Dorothy Swales, the first female curator of the McGill University Herbarium. My research will adopt a feminist epistemology of situated knowledges (Haraway 1988) to foreground both the life of Dr. Swales and the lives of the preserved plants in her collection. I will also draw on New Materialism (Bennett 2010) and Critical Plant Studies (Meeker and Szabari 2020) to assess the agency and the materiality of botanical specimens and examine how both their physical and digital lives can lead to deeper connections between women, plant life, and the representation of nature. The digital aspect of my research will incorporate digitizing correspondences with international herbaria and undigitized botanical specimen sheets from Dr. Swales' tenure as curator. This will culminate in creating and designing a digital exhibit using Omeka. Thus, an overarching objective of this thesis project is to contribute to the growing field of Digital Environmental Humanities, demonstrating how digital tools can weave together print and born-digital materials to tell nuanced stories and open new avenues for inquiry within environmental humanities research.

Digitizing the Ordovician from Biodiversification to Pandemic: Adapting to complete an Institute of Museum and Library Services (IMLS) funded project through the pandemic

Ms. Patricia Coorough Burke

¹*Milwaukee Public Museum, Milwaukee, United States*

(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The Milwaukee Public Museum (MPM) along with its partners, The Field Museum of Natural History (FMNH) and the University of Wisconsin-Milwaukee (UWM) Greene Geological Museum recently completed an IMLS Museums for America grant to digitize the Ordovician fossil collections held by each institution. The grant began as a three year project and was altered by pandemic shutdowns and limited access to our collections. The Ordovician collections in these institutions document the radiation of animal life that gave rise to the Paleozoic fauna following the Cambrian explosion. The project has converted thousands of paper-based specimen records to electronic form and added the Ordovician collections to a previously created Silurian online database.

MPM's digitization project was split into before and after the pandemic. The first two years of the MPM project had full-time summer interns photographing labels and specimens and entering the data into our collection management system. This followed a workflow developed in a previous digitization project. The dramatic pandemic year restrictions limited access and the process was modified to onsite photography and remote data entry. At MPM, one grant worker was allowed to work 15 hours a week in the building throughout the shutdown. The system became a process of photographing the specimen, uploading images to an MPM server, and working from a home office on data entry.

MPM has added over 5,000 multimedia records, over 10,000 specimen records for 45,000 specimens along with additional taxonomic and collection event records. In addition, machine-readable labels were added to all specimens and all storage locations in anticipation of a collection move to a new building.

DINA - An Open-Source System with an Innovative Data Model for Collection Management

Mr. Falko Glöckler¹, James Macklin², Satpal Bilkhu², Christian Bölling¹, Conor Fahy¹, Falko Fleßner¹, Christian Gendreau², David Shorthouse²

¹Museum für Naturkunde Berlin, Berlin, Germany, ²Agriculture and Agri-Food Canada, Ottawa, Canada

G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

DINA (“Digital information system for NATural history data”, <https://dina-project.net>) is a framework for like-minded practitioners of natural history collections to collaborate on the development of distributed, open-source software that empowers and sustains collections management. Target collections include zoology, botany, mycology, geology, palaeontology, and living collections.

The DINA Consortium focuses on an open source software philosophy and on community-driven open development. Contributors share their development resources and expertise for the benefit of all participants. The DINA system is designed as single-purpose modules that communicate with one another through a standard and consistently structured web-based application layer. Likewise, authentication and authorization of human and machine-based agents are coordinated using modern yet secure approaches. This facilitates data migration, data export, tapping into external resources, round-tripping of new data enhancements, and similar scripted activities that have traditionally been challenging to accommodate. At its core, an innovative data model allows for accommodating different use cases from a sample-centric view point. Considering the challenge of managing different types of collections within one institution, including living specimens and aggregated material samples, the sample-centric model and modular approach helps to meet a diversity of requirements. Thus, one of the overarching reasons to develop the DINA collection management system is the need to better handle complex relationships between collection objects (typically specimens) involving their derivatives, preparations and storage, and to document their provenance.

In our talk we will introduce DINA including the main features of the system and how these benefit daily work within collection management and research. Furthermore, the presentation will highlight next steps for the DINA Consortium collaboration and give a sneak preview of the DINA workshop in which we will present the first release version of the DINA system in more detail to give the audience the opportunity to try out the system in a dedicated demo instance.

DINA and ODK – Useful tools for digitisation and moving of natural history collections

Mr Majid Vafadar¹, Ms. Doreen Breyer¹

¹*Museum Für Naturkunde Berlin, Berlin, Germany*

G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Over a project period of four years, 8,500 skulls of the families Bovidae and Cervidae were digitised and moved to new collection rooms in the mammal collection of the MfN (Museum für Naturkunde) Berlin. The digitisation included both the inventory with the database Specify and the capture of over 18,000 photos using the ODK android app and its central server, within the same process.

To ensure about the sufficiently fast and standardised workflow, labels were printed for the first time using a collection management tool, which is the DINA labels module. In addition to object information, these labels also contained a QR code and the associated link as a NURI (Museum für Naturkunde Berlin URI) which is a primary identifier. NURIs are globally unique links to connect the meta-data of the object between databases and the photos, which were created in a subsequent work step.

The ODK app provides user-friendly forms that are designed previously, to take high quality photos and scan the corresponding QR code of the locations and inventory numbers. The manual and error-prone entry of inventory numbers was therefore eliminated. An offline form on the device was filled out and finalised for each object and then sent through the network to the ODK Central server for further processing of the collected data.

An automated data pipeline handles the post-processing to minimize the digitisation time span. The data is exported from ODK Central API endpoints, to update the new collected information of the objects (e.g. the new storage locations) in the collection management system, which is currently Specify.

The collected data and photos are processed further in batches to control the quality and integrity of the photos and meta-data, which are prepared to be stored in their final destinations in order to be publicly available in the data portal and media repository of the museum, using API endpoints in an established and automated process.

Discovering specimens and collections through the scientific literature at MUSE – Museo delle Scienze (Trento, Italy)

Eugen Behrens¹, [Maria Chiara Deflorian](#)¹, Noemi Dipino¹, Martina Giagio¹

¹MUSE - Museo delle Scienze, Trento, Italy

The quality of natural history collections documentation is closely related to the number and completeness of sources associated with the specimens. The recorded information is often inadequate and the available sources are scarce, especially for historical materials. In many cases, however, not all sources are known or those available have not been carefully analyzed. To improve knowledge of its natural history collections and liberate new data on preserved specimens, in 2019 MUSE has launched a project dedicated to the retrieval and analysis of publications where the preserved materials are cited.

The first phase of the project involved two journals published by MUSE, dedicated to natural sciences studies: a) Studi Trentini di Scienze Naturali, founded in 1920 and still active (1,862 articles); b) Memorie del Museo di Storia Naturale della Venezia Tridentina, published from 1931 to 1979 (135 articles). All articles published in the journals were examined and 244 contributions were found concerning the collections. About 10% of them report only general information, the remaining contain direct reference to the materials and were analyzed to identify the specimens cited and verify their presence in the collections. All the additional information found has been digitized, pdf versions of the contributions have been loaded into the catalogue and linked with the specimen data. The task was completed for 38 publications associated with 2111 specimens.

The second phase of the project concerned the type specimens of zoological collections. In most cases the sources were not available in digital format nor were they employed to complete the documentation. The activity carried out so far allowed to find and digitize 95% of the publications and to detect in the collections 78 type specimens still unknown.

The project will continue on an ongoing basis. The publication of the online collections catalogue, scheduled for 2022, will make the original data and all sources accessible to scientific community and to general public.

Diversifying virtual access: going for 3D

Dr Pierre-Yves Gagnier¹

¹*Muséum National D'histoire Naturelle À Paris, Paris, France*

(VA2) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Virtual access to the collections is today scaling up, not only in times of confinement, but in the form of a fundamental shift towards dematerialized access. The European guidelines also point in this direction. The European Synthesys+ program, as part of the DiSSCo infrastructure, has focused on digitization on demand to enable remote consultation and study.

Prior to virtual access to collections on demand, institutions have had to build up the skills and workflows from production to conservation. A program from the French national research agency (ANR) financed a project to increase innovation and mastering skills for a consortium of French institutions. One success of this project was the digitization of the national herbarium in particular with the digitization of 5.6 million phanerogam specimens. An effort was made to diversify the nature of collections, including paleontological, vegetal and animal, with the 2D digitization (RECOLNAT-ANR-11-INBS-0004). Nowadays, nearly 10% of the 100 million of France's natural history collection specimens are accessible on the Web.

If 2D imaging could resolve some questions or help the selection of which specimen to look at, 3D imaging will give access to new data sets for research fields such as comparative anatomy, locomotion, nutrition, biomechanics or biomimicry. The French national research agency continues to finance projects that will stimulate the dissemination and analysis of collection specimens currently held in various French museums and institutions. The e-COL+ project (ANR-21-ESRE-0053) intends to develop equipment, skills and workflows in various institutions to respond to the scientific demand and produce some 10,000 3D models per year. Models that will be available to the community by an index development with artificial intelligence. This new program is a chance to test new virtual access to collections and prefigure with RECOLNAT the French node to the DiSSCo program.

Documenting the alteration of Georges Deflandre's microscope slides: a way to assess the most durable mounting method?

Dr Alice Gimat¹, Mrs Alice Thelliez^{1,2}, Dr Marie-Béatrice Forel³, Dr Michel Sablier¹, Dr Sophie Cersoy¹, Dr Véronique Rouchon¹

¹Centre de Recherche sur la Conservation (CRC, UAR 3224) - Muséum national d'Histoire naturelle, CNRS, MC, Paris, France, ²Master Museology of Natural and Human Sciences, Muséum National d'Histoire Naturelle, , France, ³Centre de Recherche en Paléontologie – Paris (CR2P, UMR 7207), Muséum National d'Histoire Naturelle, , France

G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The French Museum of Natural History (MNHN, Paris) hosts the valued collection of Georges Deflandre, algologist and father of modern micropaleontology. Built up from 1920, and composed of about 13 000 microscope slides associated with numerous publications, this collection testifies of Deflandre's contribution to the field of micropaleontology. Those slides contain an impressive diversity of mounted specimens (diatoms, radiolarians, flagellates...) in various mounting media (glycerin jelly, synthetic or natural resins...). Nowadays, most of the media display a coloration (yellow, brown), cracks or dryness, which could be damaging for the study (and possibly the exhibition) of the specimens, including types. The objective of the project was to inventory the techniques used by Deflandre (mounting medium, sealant, dyes) and the state of preservation of the slides (mounting medium, sealant, cover glass, slide, labels) to assess the durability of the preparations. First, the recipes and mounting techniques were documented using the available literature. Then, an inventory was done on approximately 900 slides in the collection using a spreadsheet with pre-defined entries, designed to facilitate analysis on the collected information. Well documented labels and some chemical analysis were used to fill in the fields for the mounting media and dyes. The use of more than fifty combination of dyes, nineteen mounting media and four sealants was revealed. Three aspects regarding the media state were particularly documented as they affect the slide visibility or the long-term conservation: the color (on the range from yellow to brown), the mechanical degradation (cracks, breaks) due to ageing and the presence of air related to a defective preparation (bubbles, drying). The possible link between yellowing and mechanical degradation was evaluated, as well as the impact of the sealant degradation on the drying of the mounting medium. The cross-referencing of information between literature and slides allowed us to better understand the mounting practices. Additionally, observing these 50 to 100 years old slides was one of the best ways to assess the conservation of mounting media through time. The methodology developed in this work could be applied to other slides collections.

Unlocking of the German mollusc collection of the MfN Berlin through digitization (DORA for MoBBiDig)

Dr. Nora Lentge-Maaß¹, Erik Trostmann², Margot Belot¹, Michael Schiller², Silvio Sperling², Dr. Andreas Herzog², Dr. Thomas von Rintelen¹, Dr. Frederik Berger¹

¹Museum für Naturkunde Berlin, Leibniz Institute for Evolution and Biodiversity Science, Department of Collection Future, Berlin, Germany, ²Fraunhofer Institute for Factory Operation and Automation IFF, Department of Industrial Metrology and Digital Assistance Systems, Magdeburg, Germany

G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Natural History collections are undergoing a vast digitization process in recent years. This digital transformation addresses mainly digital cataloguing of metadata related to collection objects in central databases. Since most collections struggle to inventorise these objects within a decent amount of time, new ways of fast and effective inventory, as well as semi-automated pictorial digitization need to be brought up to reach this goal. The Museum für Naturkunde Berlin started an action plan in 2020 regarding the full inventory of the approx. 30 million collection objects, creating a complete digital catalogue of its holdings within 10 years. The biggest challenges here are the object rich collections like Mollusca, fossil Invertebrates or insect collections.

One of those new techniques and next generation digitization stations is DORA (named after Dora Godan) jointly created by the Museum für Naturkunde Berlin and the Fraunhofer Institute for Factory Operation and Automation IFF. DORA is a Scanner with three industry cameras used for object digitization that are able to produce sharp pictures with focus stacking. The fourth camera captures the labels and is able to read QR-codes. Those QR-codes have been recently introduced into the collection enabling an automated connection between photos and metadata. The object metadata are stored in Json-files and later automatically included into the MfN-Database. The pictures will be automatically connected with their metadata from DORA's library.

The data about certain species are exceptionally important in time of climate change to compare them with recent patterns and therefore to implement protection measures if needed. Additionally, molluscs are indicators for the turnover of habitats, as well as, for their general status. With this new perspective to unlock the massive metadata from the German main collection at the MfN Berlin, we aim to provide historical information about the distribution patterns of molluscs mainly in the Berlin Brandenburg area. We want to update the Red List for this area to provide an online catalogue of Mollusc species in the Area (Molluskenatlas für Berlin und Brandenburg in digitaler Form = MoBBi Dig). We will provide a dynamic and interactive resource for society and research, with constant updates.

EarthCape - highly configurable and extensible collection management platform for natural history collections.

Mr Evgeniy Meyke¹

¹*EarthCape, Helsinki, Finland*

EarthCape is shipped with a sophisticated configuration tool that can take care of very specialized requirements of large institutional collections. In this demonstration we will include general system overview, collection management scenarios and live system customization.

The platform includes a fully functional Windows client as well as a web application. The data are stored in the cloud or on-premises and can be accessed by users with various access and editing rights. Ease of customization (making changes to user interface and functionality) is critical for most environments that deal with operational research processes. For active researchers and curators, there is rarely time to wait for a cycle of development that follows a change or feature request. In EarthCape, most of the changes to the default setup can be implemented by system administrators or the end users with minimum effort and require no programming skills.

Easing the Transfer of Knowledge: A Herbarium Processing Toolkit for Smaller Collections

Ms Margo Yousse¹

¹*Denver Botanic Gardens, Denver, United States*

Smaller herbaria (ca. 100,000 specimens) often struggle to develop and implement best practices or protocols for processing specimens because of a lack of available resources and time constraints. This can delay specimen processing, creating a backlog of specimens. This additionally delays the associated data with the specimens being made available to researchers. Denver Botanic Gardens has a smaller plant herbarium, consisting of approximately 75,000 specimens. While the herbarium may be on the smaller side, there are considerable staff resources at the Gardens that are not available to many herbaria of similar size, particularly those at universities. Therefore, to aid other smaller herbaria in their specimen processing, Denver Botanic Gardens is developing a herbarium processing “toolkit.” This toolkit will aid smaller herbaria in processing specimens and making the associated label data available on biodiversity portals such as iDigBio, GBIF, and SEINet. As part of the toolkit, videos, workflows, and protocols detailing each processing step will be made available to facilitate best practice implementation. The goal of this resource is to increase the quality of incoming specimens by providing context for each step in the process, even explaining the nuances of how each step needs to be done. By pulling from the wide-ranging experience and expertise of our staff and distilling it down into this toolkit, we can easily train new staff and volunteers as well as protect and share the valuable wisdom of our team. We plan to expand our library to include Spanish versions all training materials and to disseminate the toolkit online to ensure it is freely accessible to anyone. The resulting toolkit will enable anyone curating a smaller herbarium to process specimens in a timely, effective manner.

Elephants in the Attic! The Renovation of the Yale Peabody Museum of Natural History

Mr. Tim White¹

¹*Yale Peabody Museum, New Haven, United States*

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Five years after the announcement of the plan for the renovation of the Yale Peabody Museum of Natural History, work on the 1925 Charles Klauder building on the corner of Whitney Avenue and Sachem Street has been progressing at a rapid pace for the past 24 months. While the renovation of the historic Peabody building is progressing, there is work going on in the adjacent 1963 Phillip Johnson Kline Geology Laboratory (KGL) and the David M. Schwartz Class of 1954 Environmental Science Center, which both house a portion of the Peabody Museum collections as well.

On March 13, 2020 University faculty and staff were sent home because of the spread of Coronavirus-19 in Connecticut and on the Yale University campus. After one month construction resumed and after three months, collection staff returned to campus and resumed the packing and moving of research collections and objects on display. These delays required new timelines, schedules, and a review of scope of activity for both construction and collections evacuation.

Initially a 19,000 square foot collections facility at Yale's West Campus was planned, designed, and built to house Peabody's Anthropology collections that occupied more than 50 percent of the assignable SF for research collections and exhibitions at the Peabody Museum on Central Campus. While the Peabody staff was evacuating collections, Turner Construction commenced site work to build staging spaces, began demolition of accessible spaces within the three-building Peabody complex, and excavation in the Peabody courtyard for a new central building that will provide improved linkages to all three buildings in the complex, increased exhibition space and modern collections storage and management spaces.

On April 15, 2021, the renovated KGL lower level and a new loading pavilion were turned over to the Peabody for occupation. Demolition and initial construction on all four floors of the Peabody building continues and the new five floor structure in the Peabody courtyard continues as well with a goal of completion by December 23, 2022.

Exploring and Evolving: Bringing over a million specimens out of the shadows at the Cambridge University Herbarium

Dr Lauren Gardiner¹

¹*Cambridge University Herbarium, Cambridge, United Kingdom*

Four years ago, I spoke at the NatSCA conference in Leeds, not long after becoming the first Curator of the Cambridge University Herbarium since the early 2010s, full of excitement about the volume of material in the collection and the significance of so many of its specimens (an estimated 50,000 types and 1,000 Darwin specimens turned out to be just the tip of the iceberg), but also some trepidation about the lack of staff or current research, teaching, or public engagement activity using the specimens, and the virtual non-existence of any kind of digital presence for the collection online. Even without the global pandemic, it's not been easy, but a lot of exciting things have been happening behind the scenes...

Exploring and Evolving: Bringing over a million specimens out of the shadows at the Cambridge University Herbarium

Dr Lauren Gardiner¹

¹*Cambridge University Herbarium, Cambridge, United Kingdom*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Four years ago, I spoke at the NatSCA conference in Leeds, not long after becoming the first Curator of the Cambridge University Herbarium since the early 2010s, full of excitement about the volume of material in the collection and the significance of so many of its specimens (an estimated 50,000 types and 1,000 Darwin specimens turned out to be just the tip of the iceberg), but also some trepidation about the lack of staff or current research, teaching, or public engagement activity using the specimens, and the virtual non-existence of any kind of digital presence for the collection online. Even without the global pandemic, it's not been easy, but a lot of exciting things have been happening behind the scenes...

Extant and Extraordinary: The Recent Brachiopod Collection At The Santa Barbara Museum of Natural History

Miss Vanessa Delnavaz¹

¹*Santa Barbara Museum Of Natural History, Santa Barbara, United States*

Museum specimens within phylum Brachiopoda are often fossil specimens and held in paleontological collections. This is due to their significant diversity and abundance throughout the fossil record, with several thousands of species recognized between the Cambrian and the Recent. Today, there are fewer than 500 extant brachiopod species. The recent brachiopod collection at the Santa Barbara Museum of Natural History (SBMNH) is a unique collection with over 1,300 extant brachiopod specimen lots, including both fluid preserved specimens and dried shells collected between 1901 and 2020. With holdings from over 30 countries, the collection is focused on specimens collected in the northeast Pacific. This collection has been recently re-housed and digitized under the National Science Foundation Thematic Collections Network (TCN): Documenting Marine Biodiversity Through Digitization of Invertebrate Collections (DigIn) and is now available on the SBMNH Specify Web Portal (<http://www.sbizcollections.org/iz/>) as well as iDigBio. Uncovered data held within this collection has shed light on updated geographic distributions and depth ranges for particular species along the northeast Pacific.

Extracting expedition log data found in the Biodiversity Heritage Library

Mrs. JJ Dearborn¹, Ms. Katie Mika²

¹Smithsonian Libraries and Archives, Washington, United States of America, ²Harvard University, Cambridge, United States of America

The Biodiversity Heritage Library (BHL) has amassed a substantial collection of digitized field notes and archival material, much of which contains images of tabular data. Most of this data is handwritten, non-machine readable, and unverified. As static, digitized images, these logs are unfindable and unusable and represent a vast body of dark data.

By transforming images of species observations, occurrences, and sampling events into machine-actionable, fungible data we can contribute to humanity's understanding of environmental change over time. Providing access to these data in structured formats allows researchers to leverage computational research methods including statistical analysis, machine learning, text mining, visualization, and network analysis. Furthermore, publishing interoperable data in standard formats makes it easier to compare information across locations, time periods, and other data sources.

Librarians from Harvard University and the Smithsonian Libraries and Archives are piloting a workflow to unlock handwritten tabular data in the BHL corpus via Optical Character Recognition (OCR). Sample outputs show promising results. These outputs will be converted into data tables suitable for transcription crowdsourcing platforms and their communities. Building on earlier transcription programs, the data will be corrected, disambiguated, and verified for accuracy by human volunteers. Final outputs could be ingested back into BHL to support full-text searching and taxonomic name recognition, deposited in Harvard Dataverse and archived as data assets curated for computational research, and contributed to GBIF and other aggregators for wider dissemination and connection to an emergent global biodiversity knowledge graph.

The primary goals of this pilot project include:

1. Identifying whether handwriting recognition algorithms are yet sufficient to translate manuscript images into machine readable text;
2. Developing a pipeline to transform OCR outputs into data tables with accurate rows and columns;
3. Investigating and testing crowdsourcing platforms and communities for correcting OCR output; and
4. Collaborating with aggregators to determine best practices for archiving and disseminating these data.

Current efforts to extract tabular data in the images of historic texts is largely a niche and manual affair. If successful, this workflow could be applied by other libraries and museums to unlock expedition and collection sampling event data.

Facing Extinction: Gorilla Death Masks in Museum Conservation Narratives

Dr Verity Burke¹

¹*Trinity College Dublin, the University of Dublin, Dublin, Ireland*

(EX) Exhibiting Extinction and Endangerment, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

When we consider the preservation of the animal body in natural history displays, we primarily think of techniques such as taxidermy or the mounting of a skeletal anatomy. Animal death masks are, by contrast, almost completely unstudied. Although casting has been predominantly understood as a technique for preserving the human face, non-humans have also had their faces captured by the casting of a death mask, and the resultant plaster used for a variety of purposes, from the creation of an accurate taxidermy mount, to featuring as a display object in its own right.

‘Facing Extinction’ examines exhibits in which animal death masks play an integral role, focussing on male gorillas kept in city zoos who grew to be local celebrities and were preserved for display in their regional museum, and who had a cast taken of their face after death. In particular, this paper will focus on the plaster cast of ‘Alfred’, a western lowland gorilla who spent his life in captivity in Bristol Zoo Gardens. On his death, both the zoo and Alfred’s fans were keen to memorialise him. A death mask was taken, a bronze bust was cast and taxidermy mounted, capturing Alfred’s well-known features, while archives and exhibition interpretation emphasised his personality, suggesting that capturing his character has been key in preserving Alfred beyond mere physical form. Objects representing Alfred have since proliferated across Bristol’s museums, zoo and wider cultural landscape, many of which continue his role as a species ambassador and raise awareness for the plight of gorillas.

However, the death mask’s own historic connection with the preservation of human faces constitutes a cultural heritage which draws in the traditions of portraiture, celebrity and memorialisation. Although these traditions can speak meaningfully to how we conceptualise charismatic megafauna and species ambassadors (especially when these are species visually similar to our own), this paper argues that the display of animal death masks materialises the distorted boundaries present in museum conservation narratives: between individual and species, human and non-human, endangered animal and celebrity.

FAKE MUSE! Were more plant genera really named for nymphs than women who actually lived?

Dr Lauren Gardiner⁶, Dr Sandra Knapp³, Heather L. Lindon⁴, Siobhan Leachman², Carmen Ulloa Ulloa⁵, Sarah Vincent³, **Dr Sabine von Mering**³

²*Independent Researcher, Wellington, New Zealand*, ³*Natural History Museum, London, United Kingdom*, ⁴*Royal Botanic Gardens, Kew, United Kingdom*, ⁵*Missouri Botanical Garden, , United States*, ⁶*University of Cambridge, Cambridge, United Kingdom*

Adansonia, Bonplandia, Dieffenbachia, Goethea, Napoleonaea, Washingtonia, Welwitschia - there are lots of angiosperm genera named for men, for all sorts of reasons, but how many angiosperm genera honour female beings? Do you know which women are commemorated by the plant genera Meriania, Mexianthus, Strelitzia, or Vickia? And how come so many plant genera are named for nymphs and other mythical beings?

This international collaboration is working on answering some of these questions – and more. In our poster, we will take you on a journey into the world of botanical eponymy and open up, analyse, and visualize and open up a newly generated data set that is revealing and celebrating many fascinating women, often not properly recognized for their work nor contributions to art, science and natural history collections.

First we take the earthquake: Moving Bird and Mammal collections of the Croatian Natural History Museum

Dr Irena Grbac¹, Dr Igor Pavlinić¹

¹*Croatian Natural History Museum, Zagreb, Croatia*

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

As if moving natural history collections wasn't enough complicate and arduous task, recent earthquakes hindered progress in many ways and add much more stress and pressure in the whole process. Two heavy earthquakes of 5.5 and 6.4 magnitude (Zagreb and Petrinja, respectively) followed by numerous aftershocks hit Croatia during 2020. Quakes seriously damaged the Croatian Natural History Museum building, aged more than 200 years, exhibition galleries and particular exhibits. Scientific collections placed in the basement were mostly unharmed. Entire Museum inventory was moved within 10 months, to a building repurposed for storing natural history collections. We faced the task of urgently packing and moving bird and mammal specimens from galleries and storerooms in shattered building with limited access. However, entire work was doubled as we first removed and conserved specimen from corrupted cabinets and rooms to less corrupted rooms, documenting and fixing damage. Bird and mammal collections contain eggs, skeletons, bones, mounts, wet specimens and skins, ranking in size from Humming birds to complete Blue Whale skeleton. In this presentation, we discuss packing, moving and storing bird and mammal specimens, while following best museum practice but also applying alternative solutions that could prevent future earthquake damages.

Flexible and scalable label generation workflows in support of collection digitization using persistent and machine-actionable identifiers

Christian Bölling¹, Conor Fahy¹, Falko Glöckler¹, Nora Lentge-Maaß¹, Franziska Schuster¹

¹*Museum Für Naturkunde Berlin - Leibniz Institute for Evolution and Biodiversity Science, Berlin, Germany*

G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Large scale collection digitization projects require scalable processes for generating labels to physically associate identifiers and other information with specimens, object lots, and storage units. We describe standardized, scalable workflows for generating labels to support a variety of digitization projects in different settings with regard to available object information. The workflows aim to balance effectiveness by using pre-configured label designs and automated label generation with flexibility through adaptable label templates and software configuration. They use lightweight, modular software components of the Digital information system for NATural history data (DINA) framework which also enables interfacing with collection management systems to generate labels at scale. A core component in the process is the automated generation of persistent, globally unique identifiers and their use as versatile object identifiers. In addition the workflows rely on streamlined communication and data flows among the participating teams (collection staff, digitization managers, IT and data management) to allow for quick responses and adaptability for new requirements in digitization projects as they emerge.

Florence Nightingale's shells. Finding historical treasure among the collection of mollusc specimens in the University of Nottingham's Zoology Collection.

Ms Beth Scahill, Dr Tom Hartman, Prof Angus Davison

¹*University Of Nottingham, Nottingham, United Kingdom*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

At the University of Nottingham, the School of Life Sciences currently holds a large and diverse collection of animal specimens including skeletons, taxidermy, fluid preserved material, pinned insects, birds eggs and sea shells. Many are in good condition, but others are in various states of disrepair and decay. Many have no data labels. The collections are dispersed within at least five different storage areas within the School of Biology building. Some parts of the collection are of interest due to their age, by being a bequest and few by their association with famous scientists. One section that has not been sorted is the seashell collection consisting of an estimated five thousand extant lamellibranch, gastropod and a few cephalopod specimens. One of the collectors of note is Florence Nightingale whose collection was originally hosted in the eponymous hall of residence, but now is housed in the university of Nottingham manuscripts department. The remainder of the collection requires improvement in storage conditions as specimens are loose and at risk of physical damage or deterioration.

There is no previous exploration into this shell collection and no formal catalogue exists either for the collection as a whole nor for the Nightingale specimens. It is unknown whether the Nightingale collection is complete, but the presence of handwritten specimen labels with similarity to Nightingale's handwriting implies that some specimens in the Life Sciences section should be incorporated into the current Nightingale collection. A formal database for this collection has been created alongside the digitization of specimens (and the fragile paper specimen labels) that aims to improve the longevity of the specimens to preserve the information they hold, both historical and scientific. The curation and classification of this untapped collection offers potential insight into a prominent historical figure and opportunities for future research based on the specimen data generated as part of the database curation.

Focusing on Users and Maximising Opportunities: the Sedgwick Museum Collections Research Centre, University of Cambridge

Dr Liz Hide¹

¹*Sedgwick Museum of Earth Sciences, University Of Cambridge, Cambridge, United Kingdom*

(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

In 2019 the Sedgwick Museum of Earth Sciences, University of Cambridge, opened a new 650-square-metre collections facility located around 4.5 km from the main museum site in central Cambridge. When fully populated it will provide high-quality, environmentally controlled storage for more than 80 per cent of the Sedgwick's rock and fossil collections and its unique historic archive. Specialist storage, workspaces and facilities will enable high quality collections care and access for more than 300,000 petrological specimens and 2000 boxes of archival material

In this case study, we describe how a project conceived to improve storage is now driving a much wider range of strategic initiatives for the Museum, aiming to create a Collections Research Centre that supports and engages with a wide range of audiences, including researchers, students, volunteers, school groups and local community groups. While completion of the collections migration into the new facility has been delayed by the Covid-19 pandemic, this has given the Museum time to carry out a consultation with users and potential users of the building which will inform the provision of facilities and processes to enable us to reach and build relationships with these audiences.

The location of the Collections Research Centre, on the edge of a major new community currently under construction on the north-west outskirts of Cambridge, is enabling the Museum to explore meaningful engagement with a much wider public and university audience, and to explore how these audiences might interact with research users. The Evolving Landscapes programme will enable people to explore the geology of their immediate local landscape, through both bedrock geology and building stone usage in the new developments and, we hope, will enable greater dialogue between research and public audiences.

Fragmented DNA in formalin-preserved specimens and where to find it

Dr Erin Hahn¹, Dr Marina Alexander¹, Dr Alicia Grealy¹, Dr Jiri Stiller², Dr Anna Kearns¹, Dr Clare Holleley¹

¹National Research Collections Australia, CSIRO, Canberra, Australia, ²Agriculture and Food, CSIRO, St Lucia, Australia

(NW2) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Natural history collections house an unparalleled record of historical genomic data. While genomic analysis of frozen, ethanol and dry-preserved specimens has been widely adopted, DNA sequencing of formalin-preserved specimens has largely been regarded as intractable. Notably, for fish, reptiles and amphibians, formalin-fixation was the primary method used to preserve tissues throughout much of the 20th century. Thus, formalin preservation has impeded recovery of genome-wide data from a large proportion of older specimens and some of the world's most biodiverse and environmentally sensitive vertebrate taxa. The Australian National Wildlife Collection has recently developed a reliable method for extracting, sequencing and analysing DNA from formalin-preserved tissues. Using this method, we have recovered whole mitochondrial genomes and low coverage nuclear genomes from a variety of vertebrate specimens preserved as early as 1905. Accompanying this method, we have constructed a strategic specimen vetting system to predict sequencing success prior to destructive sampling. Our vetting system relies on visual specimen inspection and characterisation of the fluid's pH and residual formaldehyde concentration and, thus, is not reliant upon knowledge of the techniques used to prepare the specimen. We will present a summary of our end-to-end genome sequencing method as well as a worked example of our specimen selection guide in action. We will also present results of a large-scale survey of the ANWC spirit vault which we undertook to better understand the range of preservation conditions of our specimens and estimate the proportion of specimens that contain DNA suitable for sequencing.

Freeze it all! An IPM case study of the Angelo State Natural History Collections

Miss Serina Brady¹

¹*Angelo State Natural History Collections, Angelo State University, San Angelo, United States*

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The Angelo State Natural History Collections (ASNHC) at Angelo State University in San Angelo, Texas, consists of five distinct collections totaling over 150,000 specimens. Bird and mammal study skins are stored in the Cavness Science Building, completed in spring 1968. Like many museums, we have faced outbreaks of drugstore beetles (*Stegobium paniceum*) and some webbing clothes moths (*Tineola bisselliella*). IPM deterrents such as sticky and pheromone traps, dichlorvos pesticide strips, and spot-freezing, have been able to pause pest activity but have failed to eliminate them. When a specimen case was deemed unsuitable for skin storage, I got creative and decided to designate it the “IPM case.” I examined every case for evidence of pests, ranked them based on the degree of severity, and then began the freezing cycle. The “IPM case” was removed from the collection, placed on a rolling dolly cart, and was transferred weekly in and out of a walk-in freezer. This process allows us to freeze entire cases at a time and since the specimens are still organized on their trays, it drastically reduces specimen re-installation time. While the specimens are in the freezer, cases are vacuumed and cleaned with a 10% bleach solution. Although seemingly straightforward, I encountered numerous challenges that forced me to think on my feet. Discovering that not all trays are interchangeable within cases, finding a dolly that could withstand multiple freeze/thaw cycles, keeping track of which cases should be frozen next, and controlling current pests during the holiday break, all required me to creatively problem solve.

From bee to bone - theory and praxis of a large scale collection move

Dr. Meta Friese¹, Lukas Kirschey¹, Thomas Schossleitner¹, Dr. Christiane Quaiser¹

¹*Museum fuer Naturkunde Berlin, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany*

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Thanks to the unique investment of the Federal Government of Germany and the State of Berlin, the Museum für Naturkunde Berlin has been given the opportunity to develop a new research campus, including the renovation of existing buildings, construction of new infrastructure, and development and digitization of the collection.

In the upcoming construction phase, a large part of our main building on Invalidenstraße will have to be cleared over several floors starting in summer 2022. Five collections will have to be relocated: two insect collections (Coleoptera, Hymenoptera, holding almost 9 mio objects), part of the fossil vertebrate collection (12.500 specimens), a mammal skin collection (30.000 skins and hides), and the animal voice archive (250 RMT). Whereas these collections can be relocated within the building, the zoological library (2.500 RMT) moves to an interim location outside of Berlin. The physical move will be conducted by an experienced packing and shipping company. In view of the special value and uniqueness of the collection objects, these transportation services must meet high professional standards.

The collection move with all its steps will be integrated in the major project of transforming the whole museum and especially in the development and digitization of the collection. This is not only efficient but also a challenge, when designing processes and developing necessary tools.

There were hardly any basic tools that could be used for a structured approach to decide on when and where certain parts of the collection can and should be relocated. With the help of external expertise, we built up a comprehensive set of data describing the collection including necessary space, conservational requirements, dependencies with labs or other facilities, collection move units etc. In several smaller actions we tested the reliability of the data, adapted them. Now, they are an essential source for all calculations of resources (manpower, time, process design). The collection move will provide a first test case and help us to optimize our approach.

Our presentation will provide insights in our processes, ideas, and thoughts, will stimulate further exchange of experiences and will be a clear plea for the need of proper documentation.

From Extinction Voices to Extinction Silences: exploring how natural history displays can shape narratives and action against future extinctions, using a case study from Bristol Museums

Ms Isla Gladstone¹

¹*Bristol Museums, Bristol, United Kingdom*

(EX) Exhibiting Extinction and Endangerment, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

In August 2019, curators at Bristol Museum & Art Gallery intervened to its World Wildlife Gallery to cover 32 taxidermied animals representing extinct and endangered species with a transparent black veil. This intervention, called Extinction Voices, responded to calls from local children and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) for transformative change in addressing species loss. The intervention aimed to raise visitors' awareness of extinction threat, promote conversation and ideas for action. Its impact spread beyond the museum, to local action and international recognition. Extinction Voices also brought critical friends, who interrogated the mainstream framing of its environmental narratives. In turn, the museum team has explored the colonial origins of its world wildlife collections and the new possibilities for narratives and action against extinction that lie in the silences in its displays. In January 2022 the museum was awarded £90,000 by the UK's Museums Association, on behalf of the Esmée Fairbairn Foundation, for a project called Extinction Silences which will explore these issues in collaboration with Bristol communities.

This presentation will share the practice-based learning gained through this journey about the contemporary relevance of traditional taxidermy displays to engaging audiences with the global extinction crisis. This will include motivations behind the original intervention and visitor responses to it, critical reflections on narratives used and the positionality of the institution, and the new possibilities which may lie in open and collaborative exploration of colonial legacies that the museum is now actively exploring.

From pyrite decay to amber breakage: the power of qualified storage and conservation to preserve and disseminate cultural and scientific heritage

MSc João Muchagata¹

¹*Museu De História Natural E Da Ciência Da Universidade Do Porto (MHNC-UP), Porto, Portugal*

Like many other century old institutions of its kind, the Natural History and Science Museum of the University of Porto (MHNC-UP), has experienced many and deep transformations both in its collections and main building itself. In recent years, a new team of curators and preventive conservationists have been revisiting and rehabilitating its heritage collections. Every collection presents its own challenges, and the geological and paleontological collections are no exception.

The MHNC-UP geological collection is currently being subject to considerable conservation efforts, with priority work focusing, for instance, on pyrite disease affecting some of the specimens. This present conservation will, in due time, be presented in the form of an updated mineral catalog for the museum. As for the paleontology collection, it is being preserved and restructured, with part of the curatorship work currently focusing on the repackaging and relabeling of the type specimens (mostly from the Portuguese Carboniferous). This work involves around 85 holotypes, paratypes, syntypes and lectotypes, some of which have only been recently identified and incorporated. By repurposing entomology boxes, it was possible to highlight these important specimens: boxes with glass lids allow for the observation of the specimens with minimal handling. In addition, using an anoxia controlled environment is essential to ensure pest control that may destroy older specimen labels or boxes.

Here, we offer a first-person insight into the daily life of a curator, shedding some light on essential procedures to ensure the up-keep of the geological and paleontological collections, and making them promptly accessible to the widest possible audience for research, education, cultural and engagement purposes.

From Unknown Unknowns to Known Unknowns: A product of digitisation is a better understanding of the causes of collection loss

Dr Rachel Walcott¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

(CT) Collection Theft and Security Monitoring of Collections, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

The Earth System collection of the National Museums Scotland has been gathered over the course of 250 years and now comprises nearly 50,000 minerals and 20,000 rocks, meteorites, hydrocarbons and various other items. As with most old and large collections, we have known that several specimens could not be located and were probably lost. More challenging has been to find the 'probable unknowns' (e.g., "It is probably in collection somewhere but I haven't seen it for decades").

The early collection was once the working collection for University students. It has experienced two world wars, several moves and periods where it was managed by people who were not geological specialists or were distracted for other reasons. These are just some of the known events that could have potentially contributed to the loss of specimens. For the first time, we are starting to be able to quantify the relationship between substantial collection loss and known historical events and situations.

Digital data capture of our collection along with transcription of registers has galvanized our attempt to move from guessing the extent of specimen loss ('probably unknowns') to knowing specifically what is lost ('known unknowns'). Rather than focus on discrete specimens and events, this presentation will reveal in a more general fashion how much of the collection described in historical texts and registers is missing. I will conclude with a discussion about some of the potential causes of inadvertent collection loss.

Georeferencing and Mapping Fossil Vertebrate Localities into the Bureau of Land Management's Colorado Statewide Locality Database

Vertebrate Paleontology Collections Manager Jacob Van Veldhuizen¹, Museum and Field Studies Graduate Student Chelsea Trenbeath¹, GIS Specialist Chelsea Herbertson²

¹University of Colorado Museum of Natural History, Boulder, United States, ²Bureau of Land Management Colorado State Office, Lakewood, United States

The University of Colorado Museum of Natural History (CUMNH) is collaborating with the Bureau of Land Management (BLM) Colorado State Office to georeference and map 615 BLM Colorado fossil vertebrate localities at the CUMNH that occur on or near BLM Colorado land and migrate the locality data to a newly-created statewide paleontology locality database. The BLM is in the process of developing several statewide paleontology locality databases because locality records are scattered throughout many different museums and BLM offices across the United States. Statewide paleontology locality databases centralize and standardize BLM locality data, helping BLM make more informed decisions on the care, management, and conservation of paleontological resources found on their lands. First, localities were georeferenced to provide a consistent and standard set of geographic coordinates. Different georeferencing procedures were followed depending on the data type of the locality (e.g., geographic coordinates, Public Land Survey System, locality description). Once georeferenced, the localities were mapped into an ArcGIS Pro geodatabase structured using BLM's statewide paleontology locality database schema. Using various land ownership GIS layers and websites, the current and historic land ownership of the locality was researched to verify BLM or other owner's land ownership through time. Any localities that were collected when BLM did not manage the land were excluded from the ArcGIS Pro geodatabase. A PDF of the physical locality form and a specimen list were attached to a locality's ArcGIS Pro record, which then serves as a single place for the original and georeferenced locality data, specimens collected, and other data not part of BLM's statewide paleontology locality database schema. The locality data and attachments were then shared with the BLM Colorado State Office via ArcGIS Pro and ArcGIS Online. Issues encountered primarily related to paucity of data for old localities, but we remedied this by shelving the locality until more data for the locality is found. None of the issues slowed down the process. Eventually, the locality data shared with the BLM Colorado State Office will become a part of a national localities database for a project effort called RAPTOR (Recreation and Permit Tracking Online Reporting).

Global Names Architecture tools for verification, normalization, and detection of scientific names.

Dr Dmitry Mozzherin¹

¹*University Of Illinois at Champaign/Urbana, Champaign, United States*

(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Global Names Architecture (<https://globalnames.org>) provides tools for taxonomists, collection managers, curators, ecologists -- anyone working with scientific names. These tools allow people to detect scientific names in texts, normalize scientific names from different sources (making them comparable to each other), verify scientific names and check them against many biodiversity databases, and register zoological names in Zoobank. Global Names is used by such projects as Biodiversity Heritage Library, Encyclopedia of Life, GloBI, Arctos, Taxon Works and DINA.

The purpose of this presentation is a demonstration of how Global Names tools can help Natural History Collections to manage their resources. We will show how a list of scientific names can be verified and updated, how to find names in PDFs, and how to bring names from different databases to a comparable format.

All these tools are available on the web.

Name normalization: <https://parser.globalnames.org>.

Name verification: <https://verifier.globalnames.org>.

Name finder: <https://finder.globalnames.org>.

GRSciColl: How the Registry of Scientific Collection can help improve system interoperability and link data from different sources

Ms Marie Grosjean¹, M. Tim Robertson¹, M. Morten Høfft¹, M. Marcos Lopez Gonzalez¹, Ms. Andrea Hahn¹
¹GBIF Secretariat, , Denmark

GRSciColl (<https://www.gbif.org/grscicoll>), the Registry of Scientific Collections, is a global, comprehensive, community-curated clearinghouse of collections information originally developed by the Consortium of the Barcode of Life (CBOL) and was hosted by the Smithsonian Institution until 2019. It is now hosted and maintained as a component within the Global Biodiversity Information Facility (GBIF) registry.

One of the initial goals of GRSciColl was to improve interoperability among databases by providing codes and machine-readable identifiers for institutions and collections.

Today, GRSciColl contains more than 8,000 institutions and 6,000 collections and around 15,000 codes and 48,000 identifiers referencing these institutions and collections. Some of the identifiers available on GRSciColl refer to other systems such as ROR (<https://ror.org/>) and Index Herbariorum (<http://sweetgum.nybg.org/science/ih/>) which facilitates interoperability and cross-referencing.

In 2020, GRSciColl was enhanced with the Collection API Lookup service (<https://www.gbif.org/developer/registry#lookup>). This service enables users to find collections and institutions based on codes and identifiers. The Lookup service is now used to link specimen-related occurrence records within GBIF.org to GRSciColl entries when possible, making use of the various identifiers associated with records, such as collection identifiers and codes. This allows institutions to aggregate metrics for their digitized specimens regardless of how they were published on GBIF. There are currently more than 100 million specimen-related occurrences linked to GRSciColl entries.

GRSciColl is actively maintained and enhanced with new features. In 2022, we are focusing our efforts on improving the registry content. Longer-term, we would like to explore how best to integrate DOI assignment to GRSciColl entries and whether to expand the GBIF literature tracking system (<https://www.gbif.org/literature-tracking>) to credit institutions and collections.

This presentation will introduce some of the challenges experienced when building this global registry, with a focus on issues relating to different identifier formats used with the relevant data objects.

Gryposaurus monumentensis: the holotype fossil that brings people together

Miss Bailey Jorgensen¹

¹*Raymond M. Alf Museum Of Paleontology, Rancho Cucamonga, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Gryposaurus monumentensis, a hadrosaur from the Late Cretaceous Kaiparowits Formation in Southern Utah, tells an amazing story of collaboration in the pursuit of curation and science. During the 2002 field season with the Raymond M. Alf Museum of Paleontology, the massive skull of this hadrosaur was discovered by Duncan Everhart, a long-term museum volunteer. The skull was excavated by high school students in 2004 as part of their summer paleo trip organized by the Alf Museum. This specimen was found and excavated in Grand Staircase Escalante National Monument, a national park where paleontologists have been involved in restoring the protected land's boundaries. The specimen was temporarily housed at the University of Utah, where researchers discovered the hadrosaur was a new species, making the specimen a holotype. A cast of the skull was made, and is currently a key piece in the Alf Museum's Hall of Life tour given to countless 2nd and 3rd graders from the greater Los Angeles area. The skull was returned to the Alf Museum in 2006, and was recently found to be in need of better long-term housing. However, the complicated nature of the skull meant that the preparator, Jared Heuck, wanted some help from other local experts. Alan Zdinak, preparator at the Natural History Museum of Los Angeles, agreed to assist. Together, alongside preparation lab volunteer Liz Smith, they were able to create a clamshell Smithsonian mount that would allow both sides of the skull to be viewed without endangering the delicate and heavy specimen. Without contributions from volunteers, students, and colleagues from other institutions, no part of this fossil's story could have been fulfilled. In addition, collaboration with local and national governments helps preserve the lands on which amazing fossils like G. monumentensis can be found.

Harbor Porpoise Time Machine: mounting a small cetacean to gain insights into how old specimens were prepared.

Ms Becky Desjardins¹, Director Mickel van Leeuwen

¹*Naturalis Museum, Leiden, Netherlands*

G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Though dolphin and whale specimens are found in many natural history collections, they are primarily preserved as skeletons. Naturalis Museum is home to a handful of mounted small whales and dolphins skins, all of which are well over 100 years old, and in some cases are in dire need of repair. Though there are many resources regarding repair and conservation of land mammal skins, there is a dearth of information about preserved cetacean skins. Biologically the two are very different. The two layers of skin in most land mammals are the epidermis and the dermis, and these layers are interlocked using dermal papillae. On cetaceans, the two layers are the epidermis and the blubber, and instead of interlocking they lay parallel, with the epidermis layer constantly peeling off and being replaced (Bruno and Huggenberger 2017). The lower layer, the blubber, consists of thick fat. In mounts of land mammals, all fat must be removed or risk problems with fat burn and insect pests. This would appear to make dolphin and whale specimens quite challenging to prepare. To see for ourselves, we decided to tan and mount a recently stranded Harbor porpoise. We used chemicals and methods similar to what might have been used in the past including shaving the skin by hand and using salt and alum for tanning. The resulting specimen has some of the same characteristics that we see in the historical specimens such as distinctive cracks from stretching the skin over the body form. Mounting this specimen has given us insight into how specimens were prepared in the past and helps guide our decisions for treatment of our mounted cetaceans.

Cozzi, Bruno; Huggenberger, Stefan; Oelschläger, Helmut (2017). *Anatomy of Dolphins: Insights into Body Structure and Function*. Elsevier Inc. p. 23. ISBN 978-0124072299.

Harnessing the Goldilocks Effect: What is the best way to share digitisation workflows?

Lisa French¹, Robyn Drinkwater², Michael Jardine¹, Laurence Livermore¹

¹Natural History Museum, London, , United Kingdom, ²Royal Botanic Garden Edinburgh, , United Kingdom

G1: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Digitisation of natural history collections can help unlock important data to new audiences and create opportunities for researchers to understand the natural world, developing solutions from and for nature. The efficiency and accuracy of digitisation workflows can be improved through institutions sharing knowledge and best practice methods, providing institutions with an opportunity to identify process improvements. Standard Operating Procedures (SOPs) are a good consistent way to share these workflows. Collections and their supporting technical infrastructure (e.g. collections management systems, local file management) differ between institutions, making it difficult to generalise workflows - SOPs allow for some comparability, albeit with a level of simplification.

The Distributed System of Scientific Collections (DiSSCo) is a new European Research Infrastructure for natural science collections, and aims to digitally unify all European natural science assets. Within this project, members from DiSSCo partner institutions have utilised a business process modelling methodology to create a template for digitisation SOPs. This approach has been piloted with several workflows, all of which have been included on a community digitisation guide website. We will give an example of a herbarium sheet mass digitisation workflow from the Royal Botanic Garden Edinburgh. This approach has provided a useful starting point for sharing SOPs between institutions, and we will share the latest developments in response to user feedback.

Harnessing the power of community science to digitize, transcribe and import preparation information into a collections management database system

Ms. Carolyn Levitt-Bussian¹, Ms. Alyson Wilkins¹, Mrs. Ann Johnson¹, Ms. Teresa Mareck¹

¹*Natural History Museum Of Utah (UMNH), Salt Lake City, United States*

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Museums with fossil preparation labs historically have handwritten, sometimes barely legible, fossil preparation sheets (prep sheets). The digitization initiative at the Natural History Museum of Utah (UMNH), as well as the “Stay at Home” orders of the pandemic, allowed UMNH to scan the handwritten prep sheets, put these scans onto DIGIVOL, a platform created by the Atlas of Living Australia, and have citizen scientists worldwide transcribe these data. Since September 2019, UMNH has digitized 12,000 pages of documents, including 3,140 pages of prep sheets. These prep sheets were transcribed by citizen scientists and validated by UMNH volunteers. DIGIVOL generated an Excel spreadsheet with the transcribed prep sheet data which was then analyzed, massaged, and coded in a way that could be imported into EMu, our Collection Management System. When UMNH bought EMu, our Paleontology Department knew that customizing our Conservation Module in order to best record fossil preparation data was essential. In collaboration with our Preparation Lab Manager, we determined essential data to be recorded, then created customized fields for these data. These fields included drop down menus for consolidants, adhesives, solvents, and techniques, as well as open notes fields for comments such as preparator’s remarks, specimen’s condition upon receipt, handling concerns, among others. A conservation number is assigned to each Preparation Record. Each record is linked to the Catalog Record of the specimen to which it is referring, the Party Record of the preparator, as well as any Multimedia Record i.e. scanned prep sheet, preparation photos, etc. In moving forward with our current and future preparation records, we are creating a digital prep sheet using Sapphire, a browser-based tool for EMu. By formatting the form in Sapphire, we can add only the fields needed to create accurate preparation records. Photos can also be added directly into the form and annotated with notes. All this can happen via a mobile device. This information feeds directly into EMu and, if needed, can feed into a report to be printed. Bringing preparation records into the 21st century will create fewer errors, more details recorded, and make for easier importation into EMu.

Hello old friend- *Plantago ovata*

Mrs Mandeep Matharu¹

¹Royal Horticultural Society Gardens, Surrey, United Kingdom

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

I never thought I would see a herbarium specimen of a plant I researched during my Masters in India, before moving to the other side of the world. The husk of the plant was a necessary staple in our kitchen when I was growing up in Punjab and it has fascinated me since childhood. So, when I saw this plant as part of the herbarium collection at Wisley, it leapt out at me as the perfect specimen to present for the SPNHC Conference.

Plantago ovata is a soft, stemless, hairy annual herb in the Plantaginaceae that is native to Asia, the Mediterranean region and North Africa. Isabgol, also known as Psyllium husk, is derived from the seeds of this plant. The name has its roots in the Sanskrit words “asp” and “ghol,” which together mean "horse flower" alluding to the shape of its seed. The plant grows to a height of 30–45 cm with long and narrow leaves and contains around 70% soluble fibre and 30% insoluble fibre. In India, it is known as a common remedy for effective weight loss and clearing out the toxins from the digestive tract. Isabgol has a myriad of health benefits including lowering plasma cholesterol levels in humans because of its hygroscopic properties. The whole grain of *Plantago* compares favourably in quality with cereals & legumes. The seed and husk of this plant are used in medicine as demulcent and highly valued for treating constipation & dysentery. A widely used drug in the US called ‘metamucil’ is isabgol husk combined with dextrose and mineral salts. In addition to its medicinal value, it is also used in dyeing, calico printing, setting lotions and in the food industry for manufacturing ice creams and sauces.

A.J Huxley collected this particular specimen in Syria in April 1964. Huxley was a famous botanist and author, vice president of the RHS, and son of the very well-known evolutionary biologist, Julian Huxley. The speaker cannot take any responsibility for any adverse effects from the use of plants. Always seek advice from a professional before using a plant medicinally.

Herbarium as an object for conservation. Ethical background to decision making on conservation treatments

Dr Magdalena Grenda-Kurmanow¹

¹*Academy of Fine Arts in Warsaw, Warsaw, Poland*

G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

As stated by the authors of *Herbarium Practices and Ethics, III* (Rabeler et al.), herbaria are “archives of plant biodiversity through space and time”. From a conservator’s perspective, herbarium is a multi-technological object, consisting of dried plants, paper support, a variety of mounting materials, such as adhesives, threads, pins etc., combined with materials used for bindings, fascicles, folders and so on. Each element has its own structure and different pattern of degradation, but combined, all elements interact with one another.

Many historical items document not only the plant resources but are also fascinating evidence of past practices of professional and amateur botanists. They convey a much wider perspective of historical and aesthetic values, than we can expect from a basic herbarium definition. They can therefore be considered as a combination of scientific tools, archives, art objects, carriers of aesthetic values and elements of the natural heritage.

By placing herbaria between so many categories, we create a wide scope for interpretation of their role, which in turn influences decisions related to their preservation and conservation.

This may cause differences between the perception of herbaria by curators, conservators, and other users. Conservation codes of ethics emphasise the issue of the integrity of the artefact and the need to preserve it during the conservation process.

In addition to referring to different codes of ethics that allow different ways of interpreting what herbaria are, I will show the effects of conservation decisions regarding the reintegration of specimens during a conservation project. The solution was agreed upon with the owner of the object but is not a typical step in the case of herbaria. The presentation is an invitation to discuss the conservation methodology related to herbaria, what we actually preserve in herbaria, and what integrity is in their case.

*Richard K. Rabeler, Harlan T. Svoboda, Barbara Thiers, L. Alan Prather, James A. Macklin, Laura P. Lagomarsino, Lucas C. Majure, and Carolyn J. Ferguson "Herbarium Practices and Ethics, III," *Systematic Botany* 44(1), 7-13, (5 February 2019). <https://doi.org/10.1600/036364419X697840>

Herbarium backlogs: Challenge or opportunity?

Ms Hannah Bendull^{1,2}, Undergraduate Student Gabriel McColleston^{2,4}, Assistant Professor of Ecology and Evolutionary Biology and Herbarium Director (TENN) Jessica M. Budke³, Independent Scholar Robin A. Lewis²
¹New York University, New York City, United States, ²Hobart and William Smith Colleges, Geneva, United States,
³University of Tennessee - Knoxville, Knoxville, United States, ⁴Boston College, Newton, United States

G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

In order to fulfill its role in the botanical community, an herbarium must have its specimens processed, identified, and cataloged so that botanists can consult these materials during their research. Many herbaria, however, struggle to keep up with the influx of specimens. As a result, specimens may accumulate while awaiting further processing, leaving the institutions with what is known as a 'backlog'; yet we know little about the content and origins of such backlogs. In this study, we aimed to quantify the number of backlogged specimens at herbaria around the world and identify the obstacles herbarium staff face when working with these materials. We also sought to better understand the relationship between donations/gifts and backlog at herbaria, focusing on bryophytes, which are nonvascular plants including (mosses, liverworts, and hornworts). In order to address these aims, we surveyed herbarium staff about their backlog of unaccessioned specimens. Eighty-seven staff members responded to our survey. Approximately 93.0% of staff indicated that their herbarium had a backlog with an average of approximately 67,500 unaccessioned specimens per herbarium. Based on Index Herbariorum there are 3,426 active herbaria in the world, and thus we estimate that 231 million specimens may be present in herbarium backlogs. According to our staff respondents, unaccessioned bryophyte specimens comprised approximately 15.0% of this backlog with half of these specimens being stored in field packets without labels. Herbarium staff also reported that more than half of the bryophyte specimens in their backlog are not identified to species. In addition to describing the challenges associated with the integration of partially curated materials into an herbarium, staff also discussed other limitations. These obstacles included the sheer volume of backlogged specimens, competing demands on staff time, and/or a lack of resources (e.g., herbarium staff having limited or no bryological expertise). With these findings in mind, we hope to assist the herbarium community in determining how to efficiently accession specimens currently in backlog and explore avenues for decreasing the number of donated/gifted specimens that may ultimately become backlog.

Herbarium Life: Shipping Cryptogamic Specimens

Ms. Genevieve E. Tocci

¹*Harvard University Herbaria, Cambridge, United States*

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Packing and shipping non-vascular cryptogamic botany specimens requires a different set of techniques and materials than their vascular counterparts do. Keeping these boxes, bags, packets, and microscope slides safe and secure for shipment requires versatility in approaches. Cryptogams often require stabilization, extra packing supplies, and some ingenuity. This talk demonstrates how the Farlow Herbarium packs things like fungi, lichens, and bryophytes with confidence while still tying things up with the classic herbarium knot. It will not cover the myriad of permits an institution needs to house or ship these specimens.

Herbarium sheets: applications and impact on science, ways of preventive conservation and importance of voucher specimens

Dr. Ivan Pérez-Lorenzo^{1,2}, Dr. Neus Nualart¹, **Dr. Neus Ibáñez¹**

¹*Botanic Institute of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain,* ²*Facultat de Farmàcia, Universitat de Barcelona, Barcelona, Spain*

The methods of collecting and pressing plants have undergone little changes in recent centuries. However, the applications that have been given to plant material from herbaria, as well as to the information associated with the specimens, have increased significantly, giving rise to different applications in ecology, genetics or phylogeography, among other topics. The growth in recent decades of the number of herbarium sheets, as well as the number of institutions dedicated to their conservation, has allowed an exponential increase in publications, being available around 390 million specimens preserved in the world.

This makes the herbarium sheet an important tool to obtain a holistic vision in the study of plants. Research on herbarium material requires its good conservation; for this reason, the physicochemical conditions of the environment (temperature, relative humidity, exposure to light...) and of the support of the material itself (pH of the paper, chemical composition...) are controlled. In this poster, two additional forms of preventive conservation are highlighted: (1) increasing the availability of the specimens to the scientific community without having to subject them to mechanical and physicochemical effects due to their manipulation and (2) increasing the exchanges of duplicate material between different institutions to ensure the preservation of samples and associated data in case of destruction of the original material. Finally, we stand out the importance of preserving sheets of taxa whose identification is problematic or specimens difficult to collect (because they grow in inaccessible places). Also we highlight the importance of conserving reference material, being available for taxonomical comparison and for reducing the collecting effort in the field.

Herpetological collections for the 21st century: the impact of regional collections to understand the diversity in a threatened hotspot.

Dr Juan M. Daza¹, Dr Wilmar Bolivar², MSc Elson Meneses-Pelayo³, Dr Fernando Vargas-Salinas⁴

¹*Biology Institute, Universidad de Antioquia, Medellin, Colombia,* ²*Biology Institute, Universidad del Valle, Cali, Colombia,*

³*Biology Department, Universidad Industrial de Santander, Bucaramanga, Colombia,* ⁴*Biology Programme, Universidad del Quindío, Armenia, Colombia*

(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

In the last decade there has been a large increment in the number of descriptions of new amphibian and reptile species across the northwestern corner of South America. This trend, is in part due to the integration of different lines of evidence leading to a better delimitation of taxonomic units. But most importantly, in a highly diverse region, local and small biological collections are becoming critical to uncover this enormous richness. Here, we show the impact of several regional collections in Colombia in terms of student training, species description, checklists and taxonomic reviews. Together, four regional collections represent less than 30% of the specimens harbored by the main national collections. We demonstrate the significance of these local collections where more than 40 taxa await for formal species descriptions. In addition, these collections are harbored by academic institutions where they are contributing to biology students in different areas such as taxonomy, biogeography, ecology and conservation. Lack of funding, faculty dynamics, and museum's perceptions by young scientists are the main challenges for the long-term persistence of these regional collections. We highlight the importance of satellite collections and stress the need for implementing a national network of regional collections that combined with the main national collections will improve our understanding of the enormous diversity in this part of South America, and will definitively impact different areas of biology ranging from systematics and ecology to conservation and public outreach.

How a green tooth and a global pandemic inspired change

Ms Danielle Serratos¹

¹*Fundy Geological Museum, Parrsboro, Canada*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Museums are increasingly encouraged and expected to provide hands-on learning opportunities for youth and adults to better explore the world around them. Unfortunately, the global pandemic has altered how many museums engage with guests and some hands-on activities, such as "fossil" dig pits, are unable to be sanitized from one family/group to the next. The Fundy Geological Museum found itself in this predicament and needed to replace a large exhibit that featured a full-sized *Coelophysis* skeleton that encouraged guests to discover the fossil bone cast under rubberized pellets, thus mimicking the field work that paleontologists do when excavating fossils. Around the same time as this exhibit was flagged for replacement, a social media post about a neotheropod tooth from the Museum's collections generated a lot of social discourse and excitement. The tooth in question is unique, even for fossil material, in that it is entirely green in color, indicating it was permineralized with trace amounts of copper. We seized this chance to create an exhibit about early theropod dinosaurs, their lifestyle, and the environment they lived in 200 million years ago. This brief presentation will cover the fossil tooth, two skeletal casts, and three early theropod footprints from Nova Scotia that the new exhibit was built around. The new display also incorporates a hands-on component that can be regularly sanitized to help prevent the spread of COVID-19 thus retaining some of the original exhibit's features while adding experiential value without removing integral factors for tactile learners.

How are we imaging our collections? A survey of standards, guidelines and protocols.

Dr Elspeth Haston¹, Dr Arnald Marcer², Mr Joaquim Santos³, Dr Austin Mast⁴, Dr Elizabeth Ellwood⁵, Dr Gil Nelson⁴

¹Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom, ²Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain, ³Universidade de Coimbra, Coimbra, Portugal, ⁴Florida State University, Gainesville, United States of America, ⁵iDigBio, Los Angeles, United States of America

The rapid development of processes for digitising Natural History Collections around the world has resulted in a wide range of equipment, protocols and standards for capturing images of the diverse range of specimen objects in the collections. An international survey was undertaken to build a comprehensive overview of awareness and implementation of standards, guidelines and protocols for imaging natural history specimens and to identify impediments that institutions face when applying existing standards and making the images available online. The survey covers all kinds of curated natural history specimens held in institutions (museums, botanical gardens, universities, research institutes, biological stations) across the world. The results of the survey will be presented.

How dangerous is the oldest stuffed tuna in the world?

Mr Mike Rutherford¹

¹*The Hunterian, University Of Glasgow, Glasgow, United Kingdom*

The Atlantic Bluefin Tuna in the Hunterian Zoology Museum at the University of Glasgow has long been an iconic object for staff, students and visitors. It was bought from a Glasgow fish market in 1830 by John Scouler, mounted and displayed at the Andersonian Museum before being acquired by the University and becoming a regular fixture on display ever since. From the mid 1970s it has been hanging in its current position above the steps into the main gallery where many a year group has posed for a class photo. Research by Geoff Hancock and Maggie Reilly revealed its provenance and history but no detailed analysis of the chemicals used in its preservation have been undertaken. A hand-held XRF analyzer was used to examine the tuna and ascertain if arsenic and mercury are present. This lightning talk will reveal if the tuna has been slowly poisoning generations of zoology students and if it's too dangerous to have on open display...

How museum specimens and community science data are used to revise the conservation status of a rattlesnake in Utah, USA.

Dr Drew Dittmer¹, Collections Manager of Vertebrates Katrina Derieg², Derek Halm³, Curator of Vertebrate Zoology Eric Rickart²

¹Utah Division of Wildlife Resources, Salt Lake City, United States, ²Natural History Museum of Utah, Salt Lake City, United States, ³University of Utah Department of Philosophy, Salt Lake City, United States

MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

To receive the federal funds called State Wildlife Grants (SWG) every state and territory of the USA is required to develop, maintain, and implement a Wildlife Action Plan (WAP). A required element of WAPs is that state agencies must include a list of species of greatest conservation need (SGCN). This talk will focus on the reptiles and amphibians listed as SGCN in the state of Utah. The state of Utah is currently working from the second revision of its 2015-2025 WAP. Since 2018 I have been focusing on revising the list of reptiles and amphibians that qualify as SGCN. I will present how the state of Utah developed its list of SGCN and document how specimen data from natural history collections were overlooked when developing the 2015 version of the SGCN list. I will describe how I have taken on the task of revising the list of reptile and amphibian SGCN by sourcing data from natural history collections and community scientists. The approach I have used depends heavily on using the data available from natural history collections and community science applications like iNaturalist. Essential to this approach is the availability of well curated voucher specimens and digitally accessible locality and temporal data. These data help capture the short and long term trends that are an important component of developing Utah's SGCN list. I will present an example of how data from natural history collections and community science efforts aided in revising the conservation status of a species of rattlesnake.

How not to – damages in fluid-preserved collections caused by renovation works

Mr Dirk Neumann^{1,2}

¹*Bavarian Natural History Collections (SNSB), Munich, Germany,* ²*Leibniz Institute for the Analysis of Biodiversity Change, Centre of Natural History of the University of Hamburg (LIB-CeNak), Hamburg, Germany*

(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Renovation works in Fluid Collections should be well planned, especially in case of major revisions or replacement of climate control systems, and when this unit is essential to safeguard stable climate conditions in the storage space.

Ideally, the relative humidity in fluid-preserved collections is kept between 35-55 %, while the temperature should not fall below 15°C (59°F) or rise above 25°C (77°F). When climate control systems are shut down or not operating for shorter or longer time intervals, but also when new climate control systems are initially launched for the first time and need to be calibrated, key parameters ensuring a stable climate inside the storage space may fluctuate.

To prevent damages in the collections, it is essential to control both, the relative humidity, and the temperature. While relative humidity can easily be stabilised with mobile humidifiers and dehumidifiers, stabilising the temperature is much more complex, especially if the climate control system has been the only source to provide heating for the storage space.

Depending on the magnitude, frequency and period of time fluid-preserved collections are exposed to adverse temperatures, different damages, such as glass deterioration, unwanted secondary chemical reactions, container seals to be compromised, or damage to the collection furniture, may occur.

The required costs to reverse these damages, i.e. the staff time and direct replacement costs, can be substantial. This presentation gives an overview on damages likely to occur, key criteria that should be considered early in the planning of renovation works in Fluid Collections, and shows what happens, if things go wrong.

How to CT scan “the gorilla in the room” without going ape

Mr Gregory Watkins-Colwell¹, Dr. Gary Aronsen²

¹*Yale Peabody Museum Of Natural History, New Haven, United States*, ²*Yale University, Department of Anthropology, New Haven, USA*

(NW2) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

In 2017 the oVert (Open Exploration of Vertebrate Diversity in 3D) initiated a program using computerized tomography (CT scanning) to image fluid-preserved specimens in collections held in the United States with the goal of providing image data to researchers and educators for every genus of Vertebrata. To further this goal, we scanned two gorillas and one chimpanzee utilizing medical scanners. Here, we describe the process (obstacles included) required for scanning large, heavy, fluid-preserved specimens. We will discuss the challenges of removing the specimens from their storage tanks through transportation, loading into sensitive instruments and even the basics of navigating through buildings where humans conduct “normal” daily activities that do not involve gorillas.

How to make a low-quality mount useful. Increasing the institutional value of taxidermy mounts by balancing object conservation ideals and economy in mount restoration and modification.

Director Steven Sullivan¹, Assistant Curator of Vertebrates Wesley "Skip" Skidmore²

¹*Hefner Museum of Natural History, Miami University, Oxford, United States*, ²*Monte L. Bean Life Science Museum, Brigham Young University, Provo, United States*

G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Taxidermy mounts are an important part of most natural history exhibits. For a wide range of reasons, these mounts may deteriorate over time, become anachronistic, or contextually inadequate. Specimens that don't meet exhibition or archival standards are often relegated to storage or discarded. Worse, they may remain on display, resulting in problematic or inaccurate messaging to the public. In recent decades, significant advances in the materials and methods of object restoration are providing new life for old mounts through repair and alteration. Object conservators are specialists who are best equipped to determine the most useful restoration materials. Sometimes though, the cost of such "best practices" can exceed the other values of the specimen, leaving it to languish, unrestored and unused. While common taxidermy materials are often avoided because they may be irreversible, invasive, or unstable over the long term, they may equal or exceed the conservation quality of the original materials and be more economical than conservation treatments. Therefore, using these traditional or non-conservation materials-- after careful evaluation of specific circumstances and applied by qualified personnel--can revitalize a specimen and make it a usable part of the collections again. We discuss how to resolve some of the most common restoration challenges and how to deal with deficient specimens in ways that achieve the sometimes-conflicting goals of economy and archival preservation ideals.

How to transform 22 meter long skeleton of fin whale into augmented reality using simultaneous localization and mapping method - National Museum, Czech Republic

Mgr. Adam Cironis¹, Dr. Jiri Frank¹, Dr. Ivo Macek¹, Bc. Frantisek Sion¹

¹*National Museum, Prague, Czech Republic*

One of the biggest highlights of the National Museum's collections (Czech Republic) is the skeleton of the fin whale. This more than a 130-year-old specimen is unique both in historical terms and in its dimensions. The skeleton was one of the few collection items that remained in the NM Historical Building during its complete reconstruction (2014-2019) and now became the dominant of the newly opened permanent natural history exhibitions again.

The Covid-19 pandemic accelerated our vision of a new visual presentation of this historical specimen. A complete 3D digitization of the skeleton using photogrammetry was performed. A detailed 3D model of the skeleton was created for various usage, as well as a 3D model of the live specimen. Then a project of data transformation into augmented reality began. The idea was to showcase a model of a whale on its own skeleton. There were many challenges, e.g. the reduced lighting conditions in the room, the limit on the use of visible markers, and to project the specimen model precisely to the skeleton even when the user is moving around. For these reasons, we chose Simultaneous Localization and Mapping method for the implementation. Unlike other methods, it allows us to work only with virtual anchors and the digitized object is placed precisely in the scanned space.

The image is sent to the Google ARCore Cloud Anchor environment and evaluated in real-time using a standard camera on mobile device. When a match is found, the 3D model is positioned relative to the virtual anchors and absolutely to the room, and it is visualized into the frame. Thanks to this, we can provide not only a view of an otherwise hard-to-see whale to the visitor but also using the info points to show the attractions of this exceptional species directly on the model. At the same time, the visitor can freely move around the skeleton and view the hyper-realistic whale model in a detail.

The final AR application was subsequently integrated into the new native application of the National Museum, which also serves as a digital guide.

How well is the world's biodiversity represented in collections?

Mr Pieter Huybrechts¹, Maarten Trekels¹, Quentin Groom¹

¹*Meise Botanic Garden, Meise, Belgium*

(MI) MIDS - A digitisation standard for natural history collections, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

One might assume that at least one specimen will have been deposited in a collection when a species was named, so that global collections should hold specimens of all known species. However, we do not know if this is correct and due to losses we might have considerably fewer. Furthermore, it would be useful to know what proportion of biodiversity is held within collections in a single country or a continent. These numbers can then be compared to estimates of the total number of species and the total number of named species. With such information we can evaluate the real value of collections and also inform collecting policy through knowing where our collections are lacking. As all biological research, conservation and biodiversity policy is dependent on being able to name and catalogue biological diversity, getting an answer to these questions is critical (Meineke et al. 2019).

To answer these questions we have used innovative Big Data analytic tools to conduct calculations on digitized collection datasets and have compared different algorithms for estimating the number of species hidden in undigitized specimens. However, these are not simple questions to answer. Collections use different taxonomies, they have not been digitised randomly and the volume of data is enormous. There are an estimated 8.7 million eukaryotic species, between 1.2 and 2.1 billion (109) specimens are held in collections globally (Ariño 2010, Sweetlove 2011) and the Global Biodiversity Information Facility holds data on 198 million specimens (as of January 2022). That amounts to 122 GB of data compressed. In this presentation we present our methods and our preliminary results of our analysis.

Ariño, A. H. (2010). Approaches to estimating the universe of natural history collections data. *Biodiversity Informatics*, 7(2), 81–92. <https://doi.org/10.17161/bi.v7i2.3991>

Meineke, Emily K., et al. (2019). Biological collections for understanding biodiversity in the Anthropocene. *Philosophical Transactions of the Royal Society B* 374.1763: 20170386. <https://doi.org/10.1098/rstb.2017.0386>

Sweetlove, L. (2011). Number of species on Earth tagged at 8.7 million. *Nature*. <https://doi.org/10.1038/news.2011.498>

'I didn't know we had that!' - Bringing insight and order into a herbarium backlog when moving to a new depot

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(MC2) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

A largely invisible but no less important part of any herbarium is the backlog. These are unmounted, undigitised specimens not yet ready to go into the main collection. They can be separated into hundreds of individual projects.

When the over six million specimens of the Dutch Naturalis herbarium, consisting of L, U, WAG and AMD, were moved from two temporary buildings to a new permanent one, we had to move this backlog as well. The projects were smeared throughout these two buildings, stored away wherever there was space for them. One toilet was even made inaccessible due to the amount of boxes stored inside.

One half depot of the thirteen new depots designated for the herbarium was assigned to the backlog. We created a list where we described and cataloged every project (be that one herbarium box or several hundred) and their location. Each project was assigned a number, and the boxes were labelled accordingly. Next, we loaded these boxes onto pallets based on four categories of process: not yet mounted, digitised or scanned, or requiring other kinds of attention from the collection manager. As we could only fit 8.000 of the 12.000 boxes into the new depot, we selected projects which we would not soon be able to work on (mostly duplicate specimens) and had those stored on pallets off-site. Some spaces were left empty for planned acquisitions. Finally, the new locations were updated in our list.

The backlog depot has now been in use for over two years. We can search and filter details in our digital list, then find the exact location of each project, greatly increasing the accessibility of an otherwise invisible collection, and making it easier to process and accession into the main collection.

Identifiers and labels for everyone: recent developments in Symbiota

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(ID1) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Different biological collections can adopt a variety of specimen identifiers that must be tracked, reconciled, and be visible on printed labels of physical specimens. Recent biodiversity informatics developments have advanced our capability to connect multiple sources of information via one or more identifiers, thus helping data users to decipher the complex network of digital biological occurrences. Symbiota is a leading digital content management platform for biological collections. In 2021, a network of nearly 40 portal communities, 1,800 collections, and 3,000 active users joined iDigBio as a new domain, constituting the Symbiota Support Hub. However, until recently, Symbiota provided limited support for tracking multiple identifiers per record, and only a few options to generate well-designed specimen labels using digitized occurrence data. We report on the development of new features that link multiple identifiers, generate persistent identifiers (PIDs) via external services, and fully customize the appearance and data contained in printed labels, including custom barcodes. We demonstrate these new features – which can be implemented in any active Symbiota portal – through select use cases.

Images on glass: Recovering hidden treasures of the University of Vienna's Zoological Collection

Mag. Simon Engelberger¹, Mag. Lisa M. Liska¹

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Aside from actual natural history specimens, the University of Vienna's Zoological Collection (UVZC) houses a large collection of early twentieth century lantern slides. The majority of the lantern slide collection was created to serve as teaching aid in various lectures of the zoology curricula in the last century. Prior to the relocation of the whole UVZC to a new biology building in 2021, the lantern slides were digitally catalogued. The lantern slide collection contains, in addition to the slides themselves, handwritten inventory ledgers listing each slide, and a comprehensive, thematically arranged file card catalogue. The digital cataloguing process comprised the assembly of lantern slide scans with the digitized file cards and inventory books, as well as the transcription of the originally handwritten content on the file cards. Linking these data allowed for a comprehensive analysis of the content and the origin of the illustrated subjects for the first time. Surprisingly, more than one third of hitherto ~5000 analyzed images are originals rather than reproductions of published illustrations from textbooks, papers, and the like. Among these originals are over 150 early microphotographs taken by the histologists Heinrich Joseph (1875-1941) and Walter Kolmer (1879-1931). Other lantern slides associated with famous zoologists are series of ~50 photographs by the ethnologist Konrad Lorenz (1903-1989) depicting various behaviours of birds, ~40 herpetological photographs and illustrations by the experimental zoologist Paul Kammerer (1880-1926), and ~60 microphotographs and illustrations by Otto Storch (1886-1951), illustrating his research on crustacean locomotion. In addition, the lantern slide collection contains some 400 photographs or illustrations of physical collection objects before and/or after preparation. Some of the imaged objects were actually found among the specimens of the UVZC, presenting a unique opportunity to compare the photographic or graphical presentation of collection objects in university lectures with the actual specimens. As the lantern slide collection was used as a teaching tool during the greater part of the last century, it represents a valuable resource for future studies on the institutional history of the zoological institute in Vienna, teaching practices, media transformation and the development of the UVZC over the course of time.

Implementing 'Science Up Close': an innovative researcher-curated exhibition at the Florida Museum of Natural History

Miss Rachel Narducci¹, Exhibit Developer Jonnie Dietz¹, Curator of Vertebrate Paleontology Jonathan Bloch¹

¹*Florida Museum of Natural History, Gainesville, United States*

(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

A limited proportion of Florida Museum of Natural History (FLMNH) objects can be displayed in our publicly accessible exhibits, and many have not yet been digitized or associated research published. To better connect our museum visitors and community with the processes of scientific research, we have developed an innovative researcher-curated space titled 'Science Up Close.' The paleontology divisions designed the first theme in this rotational series. Our thematic goal was for visitors to leave with a better understanding of the scientific process behind paleontology, emphasizing how fossils reveal secrets about ancient life and what those findings might mean for the future of the planet. These concepts are delivered through 6-8 months of flexible researcher-led workshops and full-time visitor engagement with the paleontology labs operating daily on display, in the exhibit. For a broader perspective on paleontology, fossil-themed pop-up exhibits are hosted external to the museum, content is shared via social media, and live streaming interactive events are regularly scheduled from offsite collections and fossil excavation sites (e.g., Florida, Wyoming). Most of the local live streaming highlights the contributions made by our volunteer base of community paleontologists.

To aid this dynamic exhibit content, fossils and associated stories are delivered through 360-degree interactive exploration tours of an excavation site and paleontology collections paired with virtual reality headsets and a touchscreen TV. Also included is a microscope work area for researcher-led hands-on activities, theater showcasing interviews from a diversity of fossil enthusiasts, touch table interactive, light table for artistic exploration, multiple iPad stations, and a library. This all-encompassing style of exhibition requires an 'all hands-on deck' approach, with museum volunteers, students, staff, educators, and faculty taking part in the space and associated events, daily. This exhibit allows museum visitors and community members to experience what goes on behind the scenes and understand the vastness of the FLMNH collections. It also provides any number of our 700 plus community volunteers an avenue to showcase their experiences and expertise, demonstrating that anyone can be a paleontologist. 'Science up Close' brings objects and their stories to the surface for public engagement with ongoing scientific research.

Improving the Smithsonian National Museum of Natural History Collections Data Quality

Ms Ducky Nguyen¹

¹*Smithsonian National Museum Of Natural History, Washington, United States*

As part of our pandemic adjustments to staff being offsite, NMNH decided to focus on a large scale data quality project to improve discoverability and use for better alignment with FAIR data principles. In early 2020, the NMNH received internal funding for this deep dive to discover areas of improvement for the data and the infrastructure of our Collections Information System, plus updated guidelines for continued efforts to increase digitization and data migration of our collections. This initiative starts at the ground up with departmental data verification and cleanup projects, occurring in parallel with a top down pan-department data analysis and data standards working groups. This brief talk will discuss the successes and failures of the initiative and future plans to address deficiencies.

In with the Old, In with the New: Interdigitating Museum Collections and Equipment

Ms Lynn Jones¹, Mrs. Maureen DaRos White

¹*Yale Peabody Museum Of Natural History, West Haven, CT, United States*

(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The Yale Peabody Museum of Natural History renovated collection spaces for the Anthropology and History of Science and Technology Divisions at the Yale West Campus, Collection Studies Center throughout 2018 and 2019. Over 19,000 square feet of building was renovated resulting in an open office, two work rooms, and a combined collection storage space. The state-of-the-art facility incorporated building upgrades, enhancing sustainability, and maximizing efficiency for housing collections. During equipment installation both existing and new equipment were combined into a new mobile configuration resulting in unique issues that required the coordination of object installation concurrent with equipment. Space planning with extensive collections knowledge was required to strategically move objects into permanent locations. We will discuss the processes, strategies, and challenges of renovating a 50-year-old building, old and new equipment installation, and planning the coordination of object installation coming from multiple swing spaces.

Increasing knowledge across collections by example of the Valdivia Expedition

Ms Edda Aßel¹, Ms Christine Zorn¹

¹*Museum Für Naturkunde Berlin, Berlin, Germany*

In 1898, the research ship “SS Valdivia” set out on a 9-month long journey to explore the deep sea of the Atlantic, Indian and Arctic Ocean in search of new species. The documentation, dissection and if possible determination of the collected material took place immediately on board of the ship. At the end of the expedition a large part of the collected specimens were passed on to experts of the Zoological Museum Berlin for further research. Today we house “Valdivia”-material in not only in the marine invertebrate, ichthyology and mollusk collections but also in the ornithology, herpetology and entomology collections as well as in the museum’s archives, were historical record, correspondences, travel logs and original drawings relating to the Valdivia expedition are stored. Its’ distribution across different sections of our institution evoked the need for close cooperation between the various collections to utilize the full potential of this scientifically and historically outstanding material.

Institution Codes, Collection Codes, and Specimen Identifiers: linking voucher specimen to Tissues, DNA Samples, and Sequence Data.

Dr Daniel Mulcahy¹

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ID2) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Nearly all disciplines of biology now have some form of molecular genetic analyses incorporated into areas of their research, from systematics, ecology, and behavior, to physiology and conservation. In order for science to be transparent and verifiable, the source and provenance of the genetic material used must be easily identifiable and traceable. Natural history collections are ever-increasingly facilitating the use of genetic components from collection objects, and in some cases increasing the number and types of collection objects under their care (i.e. tissue/DNA-only, e.g., blood, feather, skin- fin-clips, environmental samples, etc.). Most natural history collections are now making their holdings available online, either on their own platforms or via aggregate search engines like the Global Biodiversity Information Facility (GBIF) and the Global Genome Biodiversity Network (GGBN). Genetic resources are often sought out by researchers external to the holding natural history collection, and molecular sequence data are then generated and deposited in public repositories, such as GenBank and the Barcode of Life Database (BOLD). Making genomic material digitally discoverable to researchers, and linking published data to voucher specimens (and/or genomic samples) is an increasing challenge for natural history collections. As natural history collections digital management systems, digital identifiers (DOIs, URIs, etc.) are assigned to objects in collections, including multiple objects derived from the same individual organism (e.g., voucher specimen and genomic samples), which need to receive different digital identifiers to be uniquely identifiable in digital management systems. The National Center for Biotechnology Information (NCBI), which hosts GenBank, has created a BioCollections Database to curate metadata for natural history collections and link sequence data to voucher specimens. Institution and collection codes are linked to create a “structured voucher” annotation (following the Darwin Core Triplet) to standardize usage across interconnected databases (e.g., GenBank, European Nucleotide Archive, and the DNA Databank of Japan). In this discussion, these issues are presented and recommendations are given for natural history collections to make their genomic resources discoverable and accessible in aggregate databases (such as GGBN) and how to instruct borrowers of their genomic materials on proper publication and citation using institution codes, collection codes, and digital identifiers.

Integrated Pest Management: Holistic Approaches to Managing Pests in Herbarium Collections

Ms Erin Berkowitz¹, Administrative Curator Mare Nazaire¹, Volunteer Deb Woo¹

¹*California Botanic Garden, Claremont, United States*

The Herbarium at California Botanic Garden (RSA) holds over 1.25 million vascular plant specimens, making it the 3rd largest herbarium in California. With over 850 cabinets, a collection of this size creates an often-overwhelming challenge to prevent, mitigate, and manage pest infestations. Further, pest management at this scale requires dedicated personnel and time, which was significantly hindered due to the COVID-19 pandemic. Prior to 2018, the RSA Herbarium's Integrated Pest Management (IPM) practices were primarily word of mouth protocols. Additionally, the database used at that time for monitoring pest activity was inefficient and difficult to interpret, which presented challenges with data analyses. In 2018 the Herbarium experienced a surge in *Lasioderma serricorne* (cigarette beetle) populations within the collection, which served as the catalyst to our IPM reform. Staff reviewed current IPM literature and techniques and implemented several best practice methods in conjunction with the already established quarterly check method to better track and manage pests within the collection. With the help of a skilled volunteer, we developed a database to track pest activity more accurately and to better inform our pest management strategies. We also produced a detailed written protocol and implemented this as part of our routine training for all curatorial staff. Other pest management measures included installing additional pheromone traps in all areas of the building containing herbarium cabinets, eliminating environments hospitable to pests, and implementing a routine freezing treatment on specimen pressing supplies and cabinets in areas with inadequate climate control. The overhaul of RSA's integrated pest management program over the past four years has helped us to holistically and effectively manage pests in our collection.

Keywords: IPM, database, protocols, cigarette beetles, monitoring

Integrating African Natural History specimen data; current progress and future needs

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(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

With around 23 million out of 1.3 billion occurrence records in GBIF (1.7%), Africa lags behind in basic species occurrence data, fundamental to sustainable development. Much data has historically been hidden on labels in drawers and jars in natural history museums globally. Concurrent with the global trend for online data accessibility, there is a strong drive for digitisation of such specimen-associated information across museums in South Africa, with the outputs being centralised at the South African National Biodiversity Institute (SANBI). In addition, much data about African species diversity lies in museums in the northern hemisphere, and this too is becoming increasingly available due to recent digitisation drives, such as the SYNTHESYS initiative. This essential baseline data from historic collections allows future comparison of freshly collected material to do time trend analysis in a changing world. However, in certain museums in remote parts of Africa, natural history collections remain inaccessible, uncatalogued or lost due to civil war or infrastructure collapse, though in some cases the original specimens still exist. Such historic specimen collections need assessment and proper curation, and the associated data needs to be accessed and shared through online portals to get a sound knowledge of historic species distributions. Much still needs to be done to access the information in museums in Africa, as well as ongoing survey work in understudied areas to build up specimen collections to get a better representation of species diversity of all taxa across the continent. With this, teaching of species-level identification for target taxa is imperative to overcome the existing taxonomic impediment. In parallel to the need to release the data associated with African species in global museums, modern DNA-based methods, in particular environmental DNA (eDNA) has the power to provide occurrence data across all taxonomic groups at an unprecedented scale. However, the accuracy and utility of this DNA-based data relies on the construction of robust reference libraries – expertly identified specimens and their associated DNA data. Much baseline taxonomic work, across all fields of the life sciences, including palaeontology, still needs to be done in Africa to contribute sound information for reliable databases.

Integrating Zoo and Museum Collections Databases: A Case Study

Miss Serina Brady¹, Mariel Campbell²

¹Angelo State Natural History Collections, Angelo State University, San Angelo, United States, ²Museum of Southwestern Biology, University of New Mexico, Albuquerque, United States

ID2) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Natural history museums have often been a repository for specimens from zoological parks and aquaria. Captive animals have an abundantly documented biological history, including known parental and offspring lineages, global animal numbers (GAN), growth charts, blood and serum samples, and transportation or transportation histories. When the animal is deposited into a museum, often that information is not transferred with the specimen, and therefore its museum record is lacking important life-history details. Museums strive to create the most holistic specimen voucher possible to maximize extension and use. Components such as tissues, parasites, blood slides, media, field notes, and handling histories should all be linked to the source voucher specimen and to their shared data. This case study describes efforts to integrate zoo data from the Species 360 Zoological Information Management Software (ZIMS) database with museum specimen records in the Arctos Collection Management Database (Arctos). The ZIMS database hosts data for over 1,100 zoos, aquariums, and wildlife institutions spanning 96 countries. The Arctos online multi-institutional museum database and data portal hosts over 4.2 million records from ~250 collections. This case study involves two zoo/museum collaborations between the Albuquerque Biopark and the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM) and between the Angelo State Natural History Collections (ASNHC) at Angelo State University and the San Antonio Zoo. We developed a baseline protocol to include essential information from the animals ZIMs record to incorporate into its publicly available, web-accessible Arctos record. This information includes its global animal number (GAN), local identifiers, sex, weight, birth/hatch and death date, age at death, and relationships, including sire, dam, siblings, and offspring. These data were in turn made available online through the Arctos web URL at <https://arctos.database.museum/>, with each specimen URL serving as an accessible globally unique identifier. Arctos provides tracking of these organisms and their data through time through linked documentation of accessions, loans, permits, publications, and projects. This case study illuminates the challenges but also the power of creating extended specimen records through the integration of zoo and museum databases.

Introducing the “IUGS Geocollection Subcommission” – the new international body to represent geological collections.

Dr Rachel Walcott¹, Dr Marcela Gómez Pérez, Ms Leslie Hale

¹*National Museums Scotland, Edinburgh, United Kingdom*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The International Union of Geological Sciences (IUGS) has played an important role in the promotion and professional development of the geosciences – from providing formal definitions of geological time periods (IUGS - International Commission on Stratigraphy), and development of international data standards (IUGS Geoscience Information), to helping to develop the UNESCO led Global Geoparks Network scheme among many other activities. However, until recently there was little representation of geological collections, despite their great geoheritage, scientific, and cultural importance.

This gap in representation was closed in early 2022 with the formal launch of the IUGS Geocollection Subcommission. I will introduce the key objectives of this subcommission. This includes: 1) setting up a road map for the development of a collection designation scheme that will acknowledge the important geoheritage of specific specimens and collections, 2) developing a centralised resource for information on geocollections; and 3) developing a network to acquire and disseminate knowledge about geocollections.

Introducing the 'civically engaged natural history museums: transforming public programmes to address societal challenges' symposium.

Ms Liz Hide¹ Dean Veall,

¹*University Of Bath, Bristol, United Kingdom*

(CE) Civically engaged natural history museums: transforming public programmes to address societal challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

How can natural history museums respond to societal issues to make a positive impact for both people and the natural world?

This is the challenge natural history institutions face as the awareness of the impact of social inequalities and the climate and ecological crisis increases in society. Across the cultural sector in the UK a number of museums have innovated in their learning, engagement and participation practice to respond to issues their local communities and society as a whole are facing. This civic or socially engaged practice has resulted in people and audiences becoming central to the decision-making of these organisations.

My talk will introduce the theme of the symposium. We will draw on thinking and examples from the UK of how natural history institutions could 'activate' their spaces, collections and people (scientists and curators), creating public programmes that convene discussion around how we respond to climate change and biodiversity loss, are focused on creating positive outcomes for people such as improving individual health outcomes and become more representative of historically marginalised voices and underserved audiences.

It takes a village to fill a herbarium: how a small team can accomplish big things

Mrs Clare Booth-downs¹

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(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The Royal Horticultural Society Herbarium (RHS), which holds approximately 150,000 specimens and associated collections, had outgrown its original storage space. This necessitated a move to a new larger herbarium, located in the Hilltop building, which opened at RHS Garden Wisley in June 2021.

Despite Brexit and Covid-19, a small team of herbarium staff worked alongside a specialist removals company to ensure the collections arrived intact into the new facility. The new building not only provided the room to expand the collection, but also to expand the team to include a tremendous group of volunteers, who were generously sponsored by the National Lottery Heritage Fund.

The addition of the volunteers has generated new workflows and enthusiasm across the team, as it will help the RHS to achieve ambitious growth of the collection in a way unachievable in the original building. For the initial phase of the project five plant collectors and 10 specimen preparation volunteers were coached in collecting, colour charting, pressing and mounting of specimens. So successful has the project been over the past few months the RHS now have the impetus to expand the programme to two of our other gardens.

As one of the Herbarium Curators at the RHS' newly named 1851 Royal Commission Herbarium, the last 18 months have included the re-curation of the collection, packing and unpacking of boxes, testing for the migration to a new collections management database and looking for the specimen stories that would engage the public in the new exhibitions spaces.

Whilst working in a herbarium during a pandemic has certainly had its challenges, the camaraderie and commitment of the staff and volunteers has been an unexpected highlight. This talk is less about the safe relocation of the plants, as it is about the people who facilitated the move and how we are looking to the future with renewed vigour together.

Jars are made for „networking“

Miss Anja Friederichs¹

¹*Museum Für Naturkunde Berlin, Germany, Lübben, Germany*

Jars - many questions - many wishes - worries - and where do you find answers and solutions.

FAQs for jars are mostly like the same: what is a good jar; how to open jars, sealants, where I can buy good jars (with a price I can pay for it) e.g.. There were projects like the KUR project in 2008-12 at the MfN Berlin, Germany or the PFC meeting in Paris 2019 (Preservation of natural history wet collections: feedbacks and future prospects), many workshops in the last years.

Through the topic of jars in wet collections I have come to ask around where solutions for “my problems” are – first asking around in your immediate circle of colleagues, then one or the other colleague is recommended and gradually a small network develops. Through SPNHC meetings, this expands to contacts worldwide.

We exchange ideas, and many new questions and ideas are raised, from digitization and reorganization to best practice examples.

This gave rise to the idea at our museum to offer lectures from the collections for interested people. What is common practice among scientists, namely to present one's knowledge, is much less common among colleagues within the collections.

Through the idea of collection lectures, I approached colleagues from other institutions for guest lectures and the response was surprisingly good, as was offering them this network for exchange.

The guest speakers also expressed the wish to open this up beyond our museum. Especially for smaller collections, not just the well-known large institutions in Europe.

Therefore, what can be the future idea of sharing knowledge in a good way?

We can use the covid pandemic as an opportunity because meeting virtually is much more common now and easier to organize than a face-to-face meeting or talks. In addition, it means less cost and less time for traveling.

So should we use the new working methods as chance to share knowledge in an easier and better way than before the pandemic?

Just how bad are NFTs?

Dr. Todd Clardy¹

¹*Natural History Museum Of Los Angeles County, Los Angeles, United States*

There is a general perception among many in the public that non-fungible tokens (NFTs) and blockchain technology are inherently bad. I was a harsh skeptic of NFTs when the Natural History Museum of Los Angeles County began investigating collections-based NFTs. This skepticism stemmed mainly from the environmental costs associated with some of the more common blockchains and cryptocurrencies, such as Bitcoin and Ethereum. Mining for these popular cryptocurrencies consumes as much energy as some nations. The constant upgrading of high-performance crypto-mining rigs generates an enormous amount of electronic waste. However, in discussions with our museum staff, it became clear that there are emerging blockchains that are more energy efficient and avoid some of these core issues. There is potential to generate revenue for natural history museums by selling NFTs of collection artifacts. Given the economic hardships of many museums, the use of NFTs as a possible fundraising opportunity cannot be discounted out of hand. The task ahead is to find an approach that benefits museums while avoiding many of the pitfalls of the technology.

“Keep it secret, keep it safe”: Lessons learned from mineral collection security

Ms. Erika Anderson¹

¹*Laboratories Canada, Ottawa, Canada*

(CT) Collection Theft and Security Monitoring of Collections, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

With a thriving market, minerals are among the most valuable specimens in natural history collections. While some specimens are commonly perceived to be of high monetary value (e.g. gems and gold), other mineral specimens can hold an even higher monetary appraisal value for a variety of reasons (e.g. rarity, colour, crystal form) and/or hold considerable non-monetary value (e.g. historical, scientific, etc.). Institutions with no dedicated staff for their mineral collection or with only a small number of mineral specimens in their care may be unaware of their high value. As it is the duty of public institutions to store, curate, conserve, research, and safeguard these specimens for the public, security of them is therefore imperative. Lessons learned from mineral collection security can be readily used to inform and implement security strategies for other types of collections and high value specimens. In addition to institutional security programs, there are many low to no cost strategies to help keep specimens secure, many which can even be performed at the individual level. For example, knowledge of the physical location of valuable specimens can be limited to a select few on a need-to-know basis, with related signage to a minimum. Keeping current with trends in valuation of natural history specimens by monitoring public sales and auctions can aid in informing which specimens require higher-level security measures for storage or exhibit, can be used for outreach, or sent out on loan. Knowledge of current standards and best practices in acquisition and disposition can deter specimen loss due to opportunistic individuals. Sharing collection work and museum specimens on social media has become an important tool for public outreach, but leaving key pieces of information off the web can keep specimens more secure. By implementing these security measures from the realm of mineral collection management to other natural history collections, we can mitigate the likelihood of further theft of sought-after natural history collection objects.

Keeping the doors open (Virtually) – Natural Science events during lockdown. Changing the way we deliver public outreach events at Amgueddfa Cymru National Museum Wales.

Mr Andrew Haycock¹

¹*Amgueddfa Cymru - National Museum Wales, Cardiff, United Kingdom*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The Department of Natural Sciences at Amgueddfa Cymru National Museum Wales (AC NMW) has run a very successful program of curator-led public outreach events for a number of years, on and off museum sites. This has included meet the curator events, hands-on displays, behind the scenes collection tours, museum sleepovers and late opening events in partnership with local artists and musicians.

When Wales went into the first of several lockdowns during 2020 and 2021, our museum sites were closed, events cancelled, and most curators worked from home. As a result, it was impossible to deliver public outreach in the same way as we had before.

This talk will look at the work we did with our Events Department to continue delivering public outreach. Going online, we were able to deliver fantastic virtual events like 'Amazing Astronomy', 'Museum Sleepover - Outer Space from Home' and 'Nature on your doorstep'.

Lessons learned from fifteen years of “The Collections Course” at the University of Connecticut

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(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The University of Connecticut's Biodiversity Research Collections (BRC) reflect the richness of the world's biodiversity through space and time. The vertebrate holdings consist of fish, bird, reptile, and mammal collections, with a particularly strong emphasis on South American mammals. The invertebrate holdings focus on insects of New England, army ant “guests,” parasites of Connecticut vertebrates, and tapeworms from sharks and rays from around the world. In combination, the George Safford Torrey Herbarium and the Plant Biodiversity Conservatory and Research Core maintain remarkable fossil, preserved, and living plant collections with special concentrations in native New England plants and the region's imperiled and invasive species. Altogether, these collections include over a million specimens. When the collections moved to a brand-new, single shared facility in 2003, they became much more visible via external display spaces and the implementation of tours for all introductory biology students. As a result, student interest in learning about and working in the collections increased significantly. The staff of the preserved collections conceived of an introductory course that could both enhance awareness and understanding of the operation and mission of natural history collections and provide the required training for students to be eligible to work in the BRC. Since 2005, the staff of the preserved collections have taught an Introduction to Natural History Collections course for graduate and undergraduate students. Course content includes the history and importance of natural history collections, legal and ethical considerations and practices, research uses of collections, threats to specimens, the importance of vouchers and type specimens, and an exploration of potential academic and non-academic career paths. Hands-on activities that train students in specimen preparation are especially popular and memorable, fostering community and camaraderie among students from various levels and academic programs (e.g., evolutionary biology, ecology, anthropology, and art). This deep instructional history has yielded many insights on what works (and what does not) to encourage student engagement with the material, impart critical information about working in collections, and empower students to pursue creative specimen-based projects.

Leveraging collaborations to increase digitization efforts in small museums

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Maximizing the value, utility, and visibility of biodiversity collections through digitization is a major focus of natural history museums. However, small museums with limited staff and resources often struggle to participate in such modernization efforts. Collaborations, such as multi-departmental partnerships within a university and undergraduate internship programs, may provide opportunities for smaller museums to tackle collection digitization initiatives. The University of Nevada Reno (UNR) Museum of Natural History partnered with the University Libraries at UNR to produce 3-D scans of skulls cataloged in our mammal collection and store them on a digital database. With the effort of undergraduate interns both in the Museum and in the Library Makerspace, some of which were funded through university work-study programs, we have increased our digitization efforts and connected students and faculty with biological specimens in the Museum's collections. This partnership also provided students hands-on experience with new technology that is used across a variety of industries, supporting general professional skills. Inter-university community access to these 3-D scans is available both through an Arctos Project and the UNR Digital Archives Library Page. The initial intent of this project for our museum was to increase virtual educational resources for use by K-12 science educators. We aim to expand the initiative and allow these scans to also be available for scientific research-based use. This project is an example of how interdisciplinary collaboration across an institution can effectively allow small museums to implement cutting edge digitization efforts despite limited resources.

Like Baseball Cards: Distributing Specimens through the Curriculum

Dr. Maura Flannery¹

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(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

I spent my career teaching biology to nonscience majors in my university's college that provided career-oriented programs. Just as my parents had presented information as a source of wonder, I tried to do the same. One approach I found useful was to link biology to other disciplines and interests. In this presentation I want to do the same with herbarium specimens, using as a visual guide a reworking of the Extended Specimen Network diagram that was published in the 2019 Biodiversity Collections Network report, "Extending U.S. Biodiversity Collections to Promote Research and Education." As in the original, the specimen is at the core of the diagram. In the ring surrounding it are circles labeled with familiar college subjects: history, art, economics, philosophy, etc. On the outer ring are career programs offered in my college: criminal justice, communications, data management, sports management, hospitality management, etc.

When I became involved with herbaria, they fit nicely into a biology curriculum dealing with evolution and biodiversity, but how would they fit into the interests of my career-oriented students? I will present a few strategies and argue that specimens can be linked to many parts of the curriculum, even to career fields. In one class, I explained how a plant collection can hold specimens from many different eras and geographic areas. They end up in one place through collectors donating and trading specimens. One student raised his hand and said: "They're like baseball cards." Suddenly a dry plant wasn't so dull. Needless to say, he was a sports management major. I see making such connects one more way to broaden the community of those interested in plants. Many students in underrepresented groups are attracted to career programs for economic reasons. This should not put them at a disadvantage in learning about biodiversity, environmental issues, and the wonderful stories linked to so many specimens. It is up to biologists to find the connections: plants in forensic science, horticulture and the hospitality industry, and a very obvious one: big data and bioinformatics.

Little Brown Bugs: Machine Learning on Challenging Collections

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G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Machine learning is already being used by citizen scientists to contribute to our knowledge of biodiversity. Records of which species have been observed where and when is becoming increasingly critical to understanding our changing world. But image libraries that are the raw material of machine learning applications are unevenly available across taxa, with smaller bodied, more diverse, and less distinctive and colorful groups lagging behind; we refer to such groups collectively as Little Brown Bugs. Effective machine learning applications require a large though unspecific number of images for each data class (species). The world's museum collections are archives of specimens, containing large series of common species and often the only accessible examples of many lesser known species. Our objective is to understand how image libraries based on museum collections material can fill gaps in image libraries suitable for machine learning, and what level of determination power we can anticipate from such systems. We report on a pilot dataset based on seven species in the staphylinid beetle genus *Stenus*. These species were selected to represent a gradient of taxonomic challenges. Beetle specimens were photographed both individually using a high resolution extended focus composite system and with multiple individuals together in a unit tray. This allowed us to explore tradeoffs in time, effort, and performance. In addition, images of unmounted specimens from recent field work were identified with and combined with image libraries based on mounted museum specimens. Images from various online sources were identified based on the combined image library. Machine learning on museum collections of Little Brown Bugs shows promise. Caution is urged when making determinations based on images from novel sources. But libraries based on multiple image types improves performance for some applications.

Lockdown voyage: wherein Dr Hugh Scott, our most prolific curator of entomology, does not discover an Insect

Mr Russell Stebbings¹

¹*University Museum Of Zoology, Cambridge, Cambridge, United Kingdom*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

During Lockdown, I took the opportunity to transcribe an expedition diary authored by Dr Hugh Scott, one of the University Museum of Zoology's Insect Collection's most prolific curators. His contribution to the order and richness of our collections is very considerable, so it seemed the perfect opportunity to 'meet' this omnipresent grand-father of our collections as he voyaged to Abyssinia, during the 1920s. He undertook several journeys, observing the lands, life and styles of worship of the Abyssinian people, and occasionally managed to collect natural history specimens. This culminated in an unanticipated discovery by Dr Scott, and subsequently by myself.

Looking into the future: A systematic way of collection space planning.

Lukas Kirschey¹, Mr Thomas Schossleitner¹, Joachim Huber², Dr. Christiane Quaisser¹

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(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Thanks to the unique investment of the Federal Government of Germany and the State of Berlin the Museum für Naturkunde Berlin (MfN) has the opportunity to develop a new research campus, including renovation of the existing buildings, construction of new infrastructures and the digitization of the collection. In a museums-wide planning process, requirements for storage facilities and working spaces are discussed as well as new concepts for opening up the collection leading to new ways in collection management and access, interdependencies with other research infrastructures and interactions with the public.

To address this challenge we needed to gather the actual state of our collection in particular the volume and conservation status. With these data, we were able to define future needs and target state of the collection space. The StorageScan database (developed by Joachim Huber, PrevArt GmbH) provided a useful tool not just to capture the current status in a systematic and reliable way, but also to derive the target state of these parameters. The database provided us a solid overview of the volume of our collection and a better understanding of the space that will be required in the future. The results can easily be transferred in square meters and adapted to specific circumstances (e.g. storage height, cover load). To allow for handling and growth additional storage space and parameters can be included. This compiled dataset enabled us to derive future space requirements and spatial dependencies to optimize our collection storage space. In a next step, the obtained data were connected with conservational needs (e.g. temperature, relative humidity, light, biocides), collection management related areas (collection care labs, preparation labs, quarantine, registration, packing station), interdependencies with other research infrastructure (e.g. molecular and ct-labs) and the possible use of collections for or within future exhibitions. Hopefully we will be able to encourage colleagues facing the same challenges to strive for a systematic approach and to allow time for participation and conceptual planning.

Making Nature: Preventive Conservation and Sustainability Challenges in Contemporary Diorama Construction

Dr Claire Dean^{1,2}

¹*Tullie House Museum & Art Gallery, Carlisle, United Kingdom*, ²*Northumbria University, Newcastle, United Kingdom*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

As part of a recent refit of the Natural History Dome at Tullie House, we aimed to construct elements for a series of habitat dioramas from low-cost, conservation safe and sustainable materials. In this 5-minute talk, I'll share some insights from the making process, tips on using limited construction materials, and stress the importance of a consideration of preventive conservation in natural science displays.

Making the most out of your collection data to assess the extinction risk of endemic plant species

Dr. Wesley Tack¹, Dr. Henry Engledow¹, Dr. Marc Sosef¹

¹*Meise Botanic Garden, Meise, Belgium*

MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The alarming rate of biodiversity loss worldwide has increased the need for high-quality occurrence data to support conservation assessments for the IUCN Red List of Threatened Species. Plants, in particular, are underrepresented on the Red List. Narrow-ranged endemic plant species from tropical forests, which are vulnerable to climate change and anthropogenic activities, require immediate attention but often lack data. Many of these species are often only known from a handful of preserved specimens in herbaria, where efforts need to be made to complete and correct data to increase their usefulness for research and conservation. Two spatial metrics form the basis for most plant risk assessments: the extent of occurrence (EOO) and the area of occupancy (AOO). Combined with information on habitat, elevation and local threats, a species can be assigned to a particular risk category when these two quantitative measurements fall within the relevant thresholds. When the geographic coordinates of specimens are missing, they should be georeferenced before calculating their range statistics. This is particularly true for species with few occurrence records, as the inclusion of newly georeferenced specimen data may easily cause the calculated EOO or the number of threat-defined locations to exceed one of the IUCN thresholds, thus altering the conservation status. Improving the data quality is equally important for the completeness and accuracy of a species' distribution. As the EOO is particularly sensitive to geographic outliers, taxonomic and spatial errors could lead to a miscalculation of the extinction risk, especially for threatened taxa. We will illustrate some of the issues and the level of data cleaning needed when using natural history collections for Red Listing poorly-sampled endemic and range-restricted species. This study used a specimen-based occurrence dataset compiled for the Conservation of Endemic Central African Trees (ECAT) project. Red List assessments were done for 347 tree taxa endemic or sub-endemic to the Central African region comprising the Democratic Republic of the Congo, Rwanda and Burundi.

Managing Long-Term Sustainability in an Uncertain Future

Mr John Simmons¹

¹*Museologica, Bellefonte, US*

(ML1) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Scientific collections are increasingly being used in new and innovative ways, yet many administrators and scientists fail to recognize the strategic importance of collections for research, teaching, and public education. As a result, most collections care professionals are left trying to cope with ever-growing collections and increased collection use using limited collections care resources, all while facing an uncertain future due to climate change. In this session, through the presentation of innovative ideas and critical case studies, we will initiate a long overdue and thoughtful discussion of how we can cope with these challenges while still providing quality collections care by approaching sustainability through strategic reduction of concerns. Collection growth is rarely linked to resource availability (time, space, and personnel), which often results in poor resource allocation, and the high costs of coping with growth and change can only be reduced through careful long-range planning and changes in specimen storage configurations. Although densely packing specimens in storage furniture may solve temporary space issues, it negatively impacts our ability to monitor specimen condition, particularly when using collection storage furniture designed for old organizational schemes—how can we better configure collection storage arrays for better access, care, and retrieval of specimens and objects? What parameters should be recommended to maintain a sustainable collection storage environment as collections worldwide confront the uncertainties of climate change? How might the concepts and guidelines generated by the “active collections” initiative be applied to natural history collections? All of the currently available collection databases were designed to make collections more accessible to users, not to improve collection management—a new generation of databases must be designed for comprehensive collection management, not just for dispensing collection information.

Marine biodiversity advances using the natural collections and open data

Dr Hanieh Saeedi¹

¹*Senckenberg Research Institute And Natural History Museum, Frankfurt am Main, Germany*

MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

The transmission of data and information is not always a transparent process. It depends on a series of assumptions about a shared understanding of words and concepts. The wider the user communities of data are, the less likely that those assumptions will be fully met, and the greater the need to work to ensure that understanding is met. One example of this could be the language barrier. Information and data generation could also create storage problems for many organizations and sometimes is difficult to allocate funding for maintaining that storage. All aspects of the availability and transfer of data, information, and knowledge, entail costs of some sort for someone, and this can become a real issue when resources are limited. Meanwhile, the lack of strategies for addressing the demands of stakeholder communities for fit-for-use biodiversity data, in particular, is an issue.

To address some of the challenges mentioned above, digital data (or Digital Specimens) aim to create digital-only workflows that facilitate digitization, curation, and data links, thus returning value back to physical specimens by creating new layers of annotation and developing automated approaches to advance marine biodiversity discoveries and conservations.

Mass-digitization and data sharing efforts will not only facilitate the large-scale biodiversity studies, but also the fundamental questions of what are the main drivers of biodiversity patterns and how climate change might shift the distribution ranges of deep-sea species in the future. These are fundamental knowledge and the essential information to provide any science-policy reports in order to inform the decision-makers towards establishing management and sustainable solutions.

Marine Biological Collections: their importance and value.

A review of the Marine Biological Collections in Spain.

Dr. Elena Guerrero¹, Lourdes Fernández-Peralta², Isabel Muñoz³, Iván Casañas⁴, Francisca Salmerón², Ramón García-Cancela², Eva García-Isarch³, Pedro Pascual Alayón⁴, Ricardo Santos-Bethencourt¹, Roger Villanueva¹, Pere Abelló¹, Antoni Lombarte¹

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G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Marine biological collections are key to scientific research and to assess the still poorly known biodiversity of our seas and oceans. The value of their specimens is, in many cases, incalculable or priceless e.g. deep-sea specimens, whose fieldwork costs are immense and/or specimens from areas that will probably never be sampled again. Samplings in the ocean are mostly unrepeatable or irreproducible, beside the fact that the marine environment is difficult and very expensive to access, especially in deeper waters, which make marine collections exceptional. Having marine specimens available for research and biodiversity studies in a collection's room is therefore a luxury.

Despite their importance and value, marine collections are usually underfunded, for periods of time with no employees, there is a lack of specific qualification for curators and managers and fewer and fewer specialists in taxonomy, illustrators or photographers. Marine collections are not sufficiently recognized in the field of collections and receive little attention in the discussions associated with global biodiversity. The proper conservation of the marine scientific samples and the access to the specimens and their associated data is key to our collective understanding of biological diversity, especially now in the Decade of the Oceans. A correct management is urgent in light of increasing environmental change and the need for more effective conservation measures.

In Spain we recognize four collections dedicated entirely to marine fauna: Biological Reference Collections of the Marine Sciences Institute of Barcelona, Marine Fauna Collection of Oceanographic Center of Canarias, Marine Fauna of Oceanographic Center of Málaga, Crustacean Collection of Oceanographic Center of Cadiz. In which catalogued specimens are well preserved, identified by expert taxonomists, available for research and loans, and their data publicly available at international biodiversity portals (e.g. GBIF). To address the aforementioned deficiencies, we propose a network of Marine Biological Collections in Spain to build cooperation, strength collaborations and promoting scientific best practices for the management of these collections. It's necessary to join forces for raising awareness of marine collections and their benefits to science, promoting sustainable funding mechanisms to support collections and international collaborations among marine collections, their staff and researchers.

Mass digitisation of freshwater bioindicators: The NHM's Ephemeroptera, Plecoptera and Trichoptera Collections

Ms Robyn Crowther¹, Mrs Kate Holub-Young¹

¹*Natural History Museum London, London, United Kingdom*

(VA2) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Natural History Museum, London (NHM) has recently completed the SYNTHESYS+ Virtual Access project to mobilise data on key bioindicator insect species, informing Red Listing assessments for the International Union for Conservation of Nature (IUCN). By mobilising the data held within these collections, the requesting community research group aims to gather vital occurrence data to further understand distribution of Ephemeroptera, Plecoptera and Trichoptera (EPT) species, and assess their vulnerability to extinction. Despite having limited previous IUCN assessments owing to lack of data, EPT have long been considered bioindicators for water quality, and their populations can give us vital information about habitat fragmentation and degradation of freshwater ecosystems.

At the NHM, there are ~75,000 EPT specimens within the collections, including slide and spirit material. The majority (~65,000) are dry-pinned, most of which have labels that include collection location, date, acquisition numbers and collector names. However, many of these pinned specimens are decades old and were housed in over-crowded, cork-lined drawers. In addition to digitisation and data capture, this project required significant curatorial work to rehouse the specimens.

This presentation will cover the main phases and digitisation rates of the project, including the rehousing (pre-digitisation); high-throughput imaging using the prototype Angled Label Image Capture (affectionately known as ALICE); and transcription required for creating research data. We describe some of the unique challenges faced during the project including: the lack of existing collection standardisation and its effect on digitisation rates, lockdowns due to Covid-19, and optimal scheduling of a growing digitisation team.

Mass Imaging and Transcription of Zoology Trait Data: Using Low Cost Tools and Community Science

Collections Digitization Coordinator Alyson Wilkins, Collections Manager Katrina Derieg

¹*Natural History Museum Of Utah, Salt Lake City, United States*

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

In 2019 the Natural History Museum of Utah digitized over 20,000 field notes and catalogs associated with the vertebrate zoology collection. Many of these documents included mammal trait data, which were ingested into the Arctos database following imaging and transcription. The next step is capturing any data that are not listed in notes. This was accomplished by utilizing a combination of traditional and new methods of 2D document digitization to capture mammal trait data on individual specimen tags by imaging them in large batches.

Alterations were made to the 2D imaging setup to assist in the automation of image processing for upload into the citizen science tool DigiVol. We imaged entire unit trays of mammal study skins twice to capture data on the front and back of specimen tags. We then used Image Magick, an open-source coding tool for automating image editing and processing, to split and combine photos. After image processing was complete the images were uploaded into DigiVol for transcription. After transcription and validation, the data get prepared to be ingested into Arctos. Supplementing digitization with a few opensource tools for digital image editing and harnessing citizen science can transform data capture of historic trait data. Since implementing this workflow in October 2021, we have imaged and transcribed data from over 10,000 small mammals and linked the associated data to the specimens.

Measuring the economic impacts of digitised collections

Mrs Helen Hardy¹, Mr Laurence Livermore¹

¹*The Natural History Museum, London, London,*

G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Making the case for investment in digitising natural science collections is more important than ever. Over time, a range of approaches have been used including case studies of impact, and metrics such as downloads and citations of digital collections data.

In 2021, the Natural History Museum, London collaborated with Frontier Economics to carry out an analysis of the economic benefits to the UK of digitising the Museum's collections in full. This used different approaches - not only estimates based on cost inputs and standard figures for returns on investment in scientific research, but examination of five key sectors in which benefits might be expected to accrue: conservation; invasive species; medicines discovery; agricultural research & development; and mineral extraction.

Overall, this report identified around a seven to tenfold return on investment, with benefits of £2 billion over 30 years. This presentation will share the approaches and findings of this report; how it is being used to make the case for digitisation in the UK; and discuss its wider implications and next stages.

Meet the Mighty Mite: Amerodectes ischyros

Mr. Kevin Krajcir¹, Ms. Alix Matthews¹, Dr. Than Boves¹

¹*Arkansas State University, Jonesboro, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Here we will discuss the extreme generalist feather mite (Arachnida: Acariformes: Analgoidea) species, *Amerodectes ischyros*. This mite was first described in a 2018 paper in *Systematic and Applied Acarology* by F. A. Hernandez, A. E. Matthews, and T. J. Boves. The holotype specimen was collected from a Black-throated Blue Warbler (*Setophaga caerulea*) from Pennsylvania. Since the discovery and description of this species, our lab has documented new associations between this mite and multiple New World warbler hosts, which inspired the species epithet *ischyros* from the Greek word for “mighty,” “powerful,” or “influential”. This mite’s uniquely generalist nature has allowed us to develop a wide variety of field and lab experiments that explore and compare mite evolution, life history, and host specificity. Come hear more about all that we have been able to learn from this “mighty” mite!

Misidentifications of herbarium specimens are a great problem for distribution studies: Kalanchoe as a case study

Mrs. Mònica Utjés¹, Dr. Neus Nualart¹, Dr. Jordi López-Pujol¹

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(MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Natural history collections (museum specimens and herbarium sheets) are extremely useful for delimit species distribution areas. There are two type of errors in herbarium specimens that can produce, however, substantial biases when defining geographic ranges: (1) spatial errors (i.e., wrong georeferencing), and (2) taxonomic errors (i.e., incorrect species identification). The latter ones are very common for groups that show similar morphology, as occurs in many species complexes (e.g. *Achillea millefolium*) or in hybrids and their parental species. To illustrate how taxonomic errors may compromise the usefulness of herbarium specimens in delimiting species ranges in hybrid–parental species pairs, we have chosen the genus *Kalanchoe* (Crassulaceae) as a case study. By gathering all herbarium specimens of the hybrid *Kalanchoe ×houghtonii* and their parental species, *Kalanchoe daigremontiana* and *K. tubiflora* (both endemic to Madagascar), we demonstrate that the misidentification rates can be alarmingly high (particularly between the hybrid and the maternal species, *K. daigremontiana*) and these produce very significant (artificial) changes of the geographic ranges, with (erroneous) locations that could be situated hundreds of kilometres outside the actual range. Therefore, validating the identification of specimens by expert scientists in taxonomically complex species is essential to improve the quality of natural history collections.

Mobilising data in the Natural History Museum's historical botanical collection: digitally uniting objects and creating accessible and searchable tools in the SloaneLab

Dr Victoria Pickering¹, Dr Mark Carine¹, Dr Julianne Nyhan², Dr Andreas Vlachidis², Dr Andrew Flinn², Dr Nina Pearlman², Dr Jeremy Hill³, Dr Kim Sloan³, Dr Sushma Jansari³, Dr Foteini Valeonti², Mr Marco Hummel²

¹Natural History Museum, London, United Kingdom, ²University College London, London, United Kingdom, ³The British Museum, London, United Kingdom

The botanical historical collections room at the Natural History Museum (NHM) houses a historical collection formed between the 1680s and 1750s. This collection includes over 200 bound herbarium volumes containing over 120,000 specimens, which were brought together by the physician and Royal Society President, Sir Hans Sloane (1660-1753). For decades, it has been used for research across disciplines and yet there remains no digital way of accessing or searching the collection as a whole. In order to find specimens by taxon, a user must physically look inside Sloane's personal copy of John Ray's *Historia Plantarum* (1686-1704) to find handwritten notations that link Ray's polynomial plant names with herbarium folios. Similarly, there exists no way of connecting these herbarium specimens to the rest of Sloane's vast collection found across the British Museum and the British Library. These separated objects include over 30,000 coins and medals, hundreds of albums of prints and drawings, a library containing over 50,000 books and manuscripts, as well as scientific instruments, antiquities, ethnographic artefacts, fossils, shells, corals and animal parts. As part of an AHRC-funded project, the SloaneLab (and the wider Towards a National Collection initiative), the NHM is working with University College London's Digital Humanities department, the British Museum and project partners to mobilise data across Sloane's botanical catalogues and surviving objects so that the Sloane Herbarium can become digitally searchable for the first time. This paper will introduce the SloaneLab project and reflect on the questions and challenges that have shaped our consideration of how museums can connect their historical catalogues with present-day cataloguing systems, link to other digital collections, and better support the "curious or interested person" in searching and using Sloane's diverse collection of natural history specimens and other objects. Such challenges of supporting the ability to unite and search the UK's national collection in innovative and contextual ways, serve as a microcosm of those faced in bringing together other UK collections to help audiences use, learn, and benefit from them.

Modular Solutions in Image digitization

Dr Frederik Berger¹, Mr. Bernhard Schurian¹

¹*Museum Für Naturkunde Berlin, Berlin, Germany*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

With the Future Plan of Berlin's natural history museum, all 30 Mio objects are planned to be digitized. Insects with 15 Mio and mollusks with estimated 7 mio specimens will be digitized with automated solutions. For smaller collections, automation doesn't work. The handling of the objects take too much time. For this we have developed a modular system of Camera – equipment with lights and tripods gives most likely flexibility with variability of the object, can be obtained comparably easy, also with updates and support and can be used by all staff. Except libraries there's no established closed system with natural history objects.

We grouped collections into 4 classes:

- Objects less than 6cm
- Object between 10 – 60 cm
- Objects bigger than 60 cm
- Flat objects

For all groups we used consumer-made hardware with the same components plus special items for specific needs – like stack rails. The idea has been that all images come out with a constant quality in color, resolution, focus, illumination, contrast,...

But equipment by itself doesn't lead to good results only – it needs skilled staff, who do have an expertise with imaging.

Mollusca Types in Britain & Ireland: Founding a Union database

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G8: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Digitisation of natural history objects has allowed global access to specimens and their associated data without physical access. Due to the historical reach of the British Empire and the UK's global position in trade and industry, many regional/national museums in the UK and Ireland hold specimens not just of national but also of international importance. Nomenclatural 'types' are often the most sought after and studied group within natural history collections. They are objects of permanent and global value, the fundamental basis of scientific naming and biodiversity inventories, and hence vital to biological research. However, due to the decline in natural history specialists and funding cuts to curatorial posts many institutions no longer have the expertise in-house to locate and verify nomenclatural type specimens.

The Mollusca Types of Britain & Ireland website (<https://gbmolluscatypes.ac.uk>) was set up by staff from the Natural History Museum, London and Amgueddfa Cymru-National Museum, Wales and was funded by an Ellerman Foundation to help solve this issue. It aims to digitally unite the Molluscan type specimens housed in UK and Irish collections and to provide access to resources and expertise to assist researching such collections.

The first phase of our project encompassed researching, imaging and digitally publishing mollusc types from 7 UK partner museums where the staff were trained to recognise, research and interpret such specimens within their collections. We are currently in the second phase of the project, verifying and cataloguing an additional 12 museums across the UK and Ireland. When complete we estimate that we will have captured over 95% of the molluscan type material housed in UK institutions.

Taxonomy and systematics is, however, not the only beneficiary of such digitisation projects. When researched, understood, and documented, types can become the stars in stories of historic, global exploration and discovery by local pioneering naturalists. They offer continuity between the fervor of museums' founding years and contemporary scientific research, allowing institutions to engage with audiences in new and exciting ways.

Monitoring of temperature and relative humidity in the biological collections of the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” in Buenos Aires city

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G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN) holds some of the largest and most diverse biological collections in Argentina, accounting for >2 million specimens. Its 23 biological collections are constantly consulted by scientists, naturalists and artists from all over the world, contributing to the consolidation of its immeasurable value. This museum is located in Buenos Aires city, central-eastern Argentina. The climate in this city is humid temperate, with a mean annual temperature of 17.9 °C (64.22° F) and a mean annual precipitation of 1236 mm. Museum environments require meticulous attention in order to ensure proper temperature (T) and relative humidity (RH) conditions; however, most collections at MACN lacks of air conditioning systems for collections. In this contribution, we analyse the conditions of T and RH in seven collection’s storage rooms of the MACN between September 2015 and December 2021, with the aim of evaluating environmental conditions presented by them. Our results show that T and HR fluctuates according to the seasonal conditions taking place outside the building. The collection rooms reveal T and RH conditions less extreme than outside, suggesting some buffer effect of the building. Different allocations have diverse conditions and some collections are placed in a secondary store building, which is less effective for isolation from outdoors conditions. In the cases where measurements were taken inside the cabinets (wooden and metal), T and RH were even more temperate; in fact, RH fluctuations were reduced significantly inside the wooden cabinets. Neither the cabinets nor the drawers were much effective to moderate T fluctuations; still, wooden cabinets show to be of some affectivity. Specimens located in open shelves without any physical barrier moderating the fluctuations represent in general the main concern in the collection’s conservation. Even when current T and RH conditions are not ideal, the MACN has no budget to install any kind of air conditioning systems in collections rooms, so implementation of several levels of control using cabinets, drawers, polyethylene zip lock bags, etc., shows to be the best choice for protecting the specimens against RH and T fluctuations, as well as for other deterioration agents.

More than a “mineral museum”: refocusing, reinterpreting, and striving to remain relevant on a college campus

Dr Julianne Snider¹

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(YS) Year of the Student: Attracting College Students to Campus Museums, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Earth and Mineral Sciences Museum & Art Gallery (EMS Museum) has been part of an earth materials sciences, engineering, and energy-focused college within a large university for more than 125 years. The EMS Museum’s collections reflect the research and teaching that has been conducted within the college since 1896. Over time, as the college’s foci have shifted away from traditional natural science object-based research and teaching the museum has had to shift its use and interpretation of its collections to remain relevant.

Refocusing the museums’ mission and rethinking how the museum’s geologically-based collections are categorized and utilized enables us to be more strategic in setting priorities to ensure the collections retain their relevance as objects that embody knowledge, foster learning, and promote new pathways of engagement with science, technology, engineering, and art for students from across the university. Concerted efforts to maintain the health of the collections and uphold standards of collections care have been balanced with bringing diverse audiences into the museum and getting collections out to researchers and educators. This balancing act has resulted in a series of thematic collections-based exhibits that reflect the history of research and education in the college. Although targeted at college students, these exhibits have also become the basis of programs designed for K-12 teachers, middle and high school girls interested in science, life-long learners enrolled in university outreach programs, LGBTQ college student groups, and undergraduate courses in history, art, writing, contemporary culture, geosciences, and material sciences. The outcomes and success of these programs are dependent upon not only the content provided by the museum but on creating and maintaining relationships with individuals and student groups that are able to connect the museum with new audiences across the university. Steps that the EMS Museum have taken are transferrable to other museums wanting to promote their collections, broaden science communications, and provide more diverse opportunities for informal learning within a formal education institution.

Most fairies fly, but this one digs: The Florida Museum of Natural History Mammals Collection's elusive, subterranean pink fairy armadillo specimen

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(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

In the Mammals collection at the Florida Museum of Natural History (FLMNH), a small box that has long inhabited the shelves states: "Specimen is not to be removed from this box under any circumstances" with no reason provided, which, of course, invites curiosity about its contents. Inside the box is a mounted specimen of the even more curious *Chlamyphorus truncatus*, or the pink fairy armadillo.

The pink fairy armadillo is the smallest living member of the Mammalian order Xenarthra, which includes the sloths, armadillos, and anteaters. The species is endemic to the dry shrublands of central Argentina and spend nearly their entire lives underground in burrows efficiently dug by massive (relatively, considering the entire critter is about 13 cm in length) front limbs. Both the ecology and natural history of the pink fairy armadillo remain largely mysterious – enough so that its International Union for Conservation status is listed as "Data Deficient." These armadillos are rarely encountered in the wild due to their nocturnal, subterranean lifestyle. Additionally, they do not survive for months or even days in captivity, so both the population health and behaviors are difficult for researchers to observe. Pink fairies are also rare specimens: a search of museum databases returned only 45 total results. For context, the same databases had 89 specimen results for the famously elusive giant squid.

Recently, ancient DNA extracted from a 12,000-year-old glyptodont, an extinct armadillo-like xenarthran, not only classified the glyptodonts as nested within armadillos rather than as a sister-group, but also identified the pink fairy as one of their closest living relatives. This is especially fascinating considering the largest glyptodonts outweighed pink fairies by two metric tons.

An X-ray computed tomography scan of our specimen (still in the box) revealed a skull and other skeletal elements. These findings allow for anatomical and comparative study that could add to the limited information known about pink fairy armadillo morphology and the evolutionary history of armadillos large and small. Altogether, this makes our spotlight specimen a distinct and impactful member of the Mammals collection at the FLMNH.

Moving around living collection in Meise Botanic Garden: the Green Ark project.

Mr. Marc Reynders¹, Mrs. Elke Bellefroid,¹ Dr. Patricia Mergen^{1,2}, Dr. Steven Dessein¹

¹*Meise Botanic Garden, Meise, Belgium*, ²*Royal Museum for Central Africa, Tervuren, Belgium*

(MC2) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Meise Botanic Garden houses around 18000 plant taxa of which more than 50% grow under a total surface of 1.5 ha of glasshouses. About 40 smaller conservatories date back from the 1930's and 150's and are now being replaced by a modern glasshouse complex named the Green Ark. In contrast to the old conservatories, where plants were grouped according to taxonomic or geographic units, the new glasshouses are designed to regroup the collections based on their ecological needs, resulting in less but larger climatic zones under one roof. This also enhances the energy efficiency dramatically in comparison with the old design and curation. To be able to calculate the required surface of the different climate zones, a detailed and thorough analysis of the ecological needs of the collection was performed in advance. As the Garden lies within a protected landscape, the available spots for building new glasshouses were rather limited. This implicated reuse of a terrain where half of the old houses were located, however still completely filled with plant collections. To cope with this we are building the new complex in two phases making it possible to start up the first phase, move around the collections on our own site and subsequently remove the emptied old conservatories to continue building the new complex. The short timeframe between both phases where plants could be moved around, necessarily in a period with suitable outdoor temperatures and multiple delays, implied continuous planning and preparation.

Moving Collections in a Pandemic? No Problem! How Planning and Preparation Saved the Day

Ms Margo Yousse¹

¹*Denver Botanic Gardens, Denver, United States*

(MC2) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

In May 2020, Denver Botanic Gardens successfully moved approximately 100,000 plant, fungi, and arthropod specimens into the newly constructed Freyer - Newman Center for Science, Art, and Education. Early planning and preparation allowed us to adapt our detailed move plan to accommodate new pandemic restrictions.

With funding from the U.S. Institute of Museum and Library Services, we had detailed a 3-stage move plan to juggle the timing of new cabinet installations and the moving of old cabinets into the new collection space. The entire move was anticipated to take six people over one month including wait times for the new cabinet manufacturer to transfer and install cabinets. Two months before the move was scheduled to begin, Colorado was issued a stay-at-home order due to the COVID-19 pandemic. While we worked at home, construction proceeded and when we returned to the Gardens in May of 2020, it was to pack and move the collection as our former space needed to be vacated within four weeks. All the pre-planning we had done allowed us to make quick adaptations and cut our move team in half to account for reduced indoor capacity. COVID restrictions taught us that having a lean, focused team with a well-organized plan was efficient and we were able to completely transfer all the collections and cabinets within the tight timeline. I will share my experience and lessons learned to provide guidance for future moves for collections around the world.

Moving collections: Curse, Blessing or Opportunity?

Populating the New Collections Store at the Sedgwick Museum of Earth Sciences, University of Cambridge

Mr Dan Pemberton¹, Catherine Craston¹, Helen Devereux¹

¹*Sedgwick Museum of Earth Sciences, University of Cambridge, Cambridge,, United Kingdom*

(MC2) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The collections of the Sedgwick Museum of Earth Sciences, University of Cambridge comprise approximately 1.5 to 2 million rocks, fossils and minerals. They are an important resource for research, teaching and public engagement. Like many institutions the majority of the collections are stored off-site, at some distance from the public Museum. The Sedgwick has two such repositories the A.G. Brighton Building, a modern structure with climate controlled stores and conservation laboratory and the Atlas Building, an unsuitable, deteriorating wartime structure, rapidly approaching the end of its life. The Atlas Building houses the University's main research collection of rocks and other similar collections, which are at serious risk of deterioration.

2019 saw the completion of a new extension to the A.G. Brighton Building, specially designed to accommodate the rock collection and create a new collections research centre. Around 12,000 drawers containing an estimated 360,000 rock specimens with a total estimated weight of 120 tonnes are being migrated to the new building. Whilst detailed information exists for many objects in the form of catalogues and field notebooks, only about 10% of objects have a record on the Museum's Collections Management System.

In this presentation we explore the question 'Moving collections: curse, blessing or opportunity?' We introduce the background, scale and rationale for our project and describe some of our procedures for mitigating hazards, capturing condition and basic collections information and managing the transportation of drawers of objects between sites. We discuss some of the opportunities and benefits that have arisen beyond the improvements in collections care and documentation usually associated with such projects. We show that such projects offer important early career opportunities for staff and although the roles created are temporary ones, they bring fresh ideas into the team, and can be considered as important career 'stepping stones'. Consultation with new and potential users will inform development of the new collections research centre and management of the collections beyond the end of the project. The skills, experience and lessons learned from the project will form a valuable contribution to the Museum's emergency and salvage planning process.

Moving Forward and Fitting In: designing storage and relocating the museum collections at College of the Atlantic

Ms Carrie Graham¹, Dr. Stephen Ressel¹, Ronald Harvey²

¹College of the Atlantic, Bar Harbor, United States, ²Tuckerbrook Conservation LLC, Lincolnville, United States

College of the Atlantic (COA), an interdisciplinary college of approximately 350 undergraduate students in Bar Harbor, Maine, established the George B. Dorr Museum of Natural History in 1982 to deepen public understanding of Maine's natural history via student work. The museum holds more than 3,000 specimens among its dioramas, mammal, bird, herpetology, entomology, oology, and skeletal collections, all of which have been prepared by COA students as part of their academic experience. The museum is fully integrated into COA's curriculum through courses, independent studies, and work-study assignments. Students, in turn, receive hands-on training in museum education, exhibition preparation, and collections care and management.

Over the past 20 years, COA faculty and students have worked to improve our collections care practices, using recommendations from a Conservation Assessment Program report. Efforts to do so had inherent constraints because of a lack of dedicated collections storage space. In 2019, the opportunity arose to design dedicated spaces for our natural history collections in a new campus building within the context of a collections care course. The ensuing course project, which received funding from IMLS and the Dorr Foundation, was a collaboration among the 14 students in the course, additional work-study students, faculty, staff, and a conservator. In this presentation, we will outline our steps taken to move our collections towards alignment with best practices, maximize opportunities for student learning, and make the most of limited resources.

Multiplying the value of collections data through sharing and citation

Mr Tim Hirsch¹

¹*GBIF Secretariat, Copenhagen, Denmark*

MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Thirteen hundred peer-reviewed studies cited use of GBIF as a source of data in 2021, enhancing knowledge across a wide range of scientific disciplines and policy-relevant applications, including support for conservation, targeting invasive alien species, adapting to climate change, protecting food security and assessing human health risks. A pro-active effort to monitor onward use of shared data in the scientific literature, including promotion of Digital Object Identifiers (DOIs) to cite user downloads and derived datasets, enables increasingly precise links to be drawn between the data shared by natural history collections and the research it has informed. Tools provided by GBIF help collections to discover and communicate the research enabled by its published datasets, and thus the value both of the collections themselves and the investments made in digitization and mobilization of the data using common standards and open licences. The talk will provide examples of high-value research in which the contribution of collections data to addressing key societal challenges can be clearly illustrated. It will also highlight new tools and developments including a hosted portal service, through which collections can provide a showcase for their holdings making use of GBIF's central services to provide backend services such as mapping, filtering, image display and data downloads.

Museums – the missing link for conservation?

Dr Rebecca Johnson¹

¹*Smithsonian Institution, Washington, United States*

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

From climate change to wildfires to floods –we are in a time of unprecedented global change largely attributed to human activity. At the Smithsonian’s National Museum of Natural History, we are custodians of the world’s largest biological collections. The collections support foundational discovery science and collectively represent a substantial baseline of biodiversity and ecosystem knowledge, including how these have changed over time.

Critical to detecting and understanding change is the baseline knowledge of accessible natural history collections. With examples ranging from cockatoos to koalas – this presentation will explore the rich source of data in museum collections and how it can be translated into actionable conservation information. While NMNH holds the world’s largest natural history collections, much of the information about these specimens is dark data – meaning that the data may not be discoverable or accessible. This presentation will share some of our future plans to create accessible collections records using new technologies. This is urgent, not just to illuminate our collections but to share data that may facilitate our understanding and mitigation of increasing changes to the Earth’s biodiversity and ecosystems.

Museums, Health and Wellbeing

Dr Miranda Stearn¹

¹*The Fitzwilliam Museum, University Of Cambridge Museums, Trumpington Street, United Kingdom*

(CE) Civically engaged natural history museums: transforming public programmes to address societal challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

In the UK and internationally, recent years have seen an increasing recognition of the role cultural organizations, including museums, might play in contributing to the health and wellbeing of individuals and communities. No longer just a sometimes-acknowledged by-product of our engagement with culture for education or leisure, health and wellbeing outcomes have become something to be planned for, measured, evaluated and, on occasion, commissioned or prescribed. Policy makers, funders, the health and social care sectors, museum workers and individual museum goers are all showing an interest in understanding how museum experiences might relate to our health and wellbeing, helping respond to key societal challenges such as mental ill health, social isolation and ageing well.

Unhelpfully for natural history collections however, the conversation about the difference museums and their collections might hope to make has often been subsumed into wider discussion around 'culture and health' or more frequently, 'arts and health', making it more difficult to make the connection. This is a shame, especially when one considers the parallel growing recognition of the importance of access to nature for our health and wellbeing, and the potential of natural history collections to bridge both these agendas - potential that some collections are actively engaged in, but which remains un-tapped elsewhere. This paper offers an overview of current evidence, policy and practice, considers how Natural History collections are responding or might respond, and shares the experience of developing and adapting health and wellbeing programmes within an interdisciplinary museum consortium at the University of Cambridge Museums.

Museums, Students, Zoology and the Public: Bringing Them All Together

Mr Jack Ashby¹, Ms Tannis Davidson²

¹University Museum of Zoology, Cambridge, United Kingdom, ²Grant Museum of Zoology, UCL, London, United Kingdom

(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Teaching with museum objects is a powerful format for experiential learning in life sciences.

Many natural history museums, particularly those in universities, were originally founded as resources for comparative anatomy. However, in recent decades one could argue that this foundational topic has become less visible in public galleries. At the same time, the teaching of 'traditional' morphology and whole organismal biology was diminished in many university curricula.

Happily, this latter trend is on the reverse. This presentation will explore examples from university museums which have sought to thoroughly embed student learning within museum collections, spaces and public programmes.

Providing access to extensive and comprehensive museum collections can be transformative for undergraduate students, who typically arrive from school thoroughly naïve of the discipline. Teaching in museums can act as the key informative step in understanding difficult scientific concepts and in preparing students for postgraduate research. This presentation will share some of the key pedagogical benefits of object-based learning.

Using examples of courses taught at University College London, we will explore how students' comparative anatomy skills are built through problem-based learning. The incorporation of assessed real-world public engagement in undergraduate biology teaching in museums will also be discussed. The integration of public engagement, based on the students' own collections-based research, provides opportunities for museums' public audiences to understand the science behind the collections. It also introduces students to the responsibility that museums and researchers have to working with the public, and the science communication skills required to do so. Uses of technological innovations for object-based learning driven by the need to teach remotely during the covid-19 pandemic will also be explored.

Finally, we will discuss a new course at the University of Cambridge which seeks to help students understand the role of natural history museums in tackling key global questions such as climate change and biodiversity loss. Students at the start of their academic careers are typically unaware of the scientific value of collections behind the scenes.

Musings of a paleontology community of practice at the Museum of Comparative Zoology

Ms Christina Byrd¹, Curatorial Associate, Entomology Crystal Maier¹, Curatorial Associate, Invertebrate Paleontology Jessica Cundiff¹

¹*Museum Of Comparative Zoology, Harvard University, Cambridge, United States*

Paleontology collections at Harvard University's Museum of Comparative Zoology (MCZ) are spread across three departments and have historically been managed in various ways. We established the All-Paleontology Working Group in June 2020 with the purpose of standardizing practices and strengthening collaboration across the Entomology (Fossil Insect), Invertebrate Paleontology, and Vertebrate Paleontology departments. Inspired by the Paleo Data Working Group (an interinstitutional community of practice associated with iDigBio), the Curatorial Associates of each department decided that the best way to make improvements to the database records was through the formation of an institutional community of practice. A community of practice consists of people who engage in a process of collective learning who share a concern or a passion for something they do and learn how to do it better as they interact (Wenger-Trayner, 2015). This group was formed from a need to clean and georeference specimen collecting locality data, to share knowledge and resources, and to build connections with departments who can contribute to the goals of the group.

Curatorial staff from the three departments, along with staff from the Collections Operations Departments, meet monthly. Initial discussions revolved around georeferencing of shared localities. As work progressed, working group members identified areas for improvement and invited subject-matter experts to the meetings for their knowledge and implementation expertise. Later discussions focused on standardizing geologic data capture and database structure updates to capture data efficiently. We used Zoom for synchronous communication, email and Slack for asynchronous communication, and Microsoft SharePoint for collaborative spreadsheets and documents.

As solutions are developed at the institutional level, we can then communicate what we have learned to the interinstitutional communities of practice and professional societies, including the Paleo Data Working Group, the Society for the Preservation of Natural History Collections (SPNHC), and Biodiversity Information Standards (TDWG).

Referenced Literature:

Wenger-Trayner, E. and B. 2015, Introduction to communities of practice: A brief overview of the concept and its uses.

Mussel memory: Digitization of the Unionida at the Buffalo Museum of Science

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With historic roots dating back to the mid-1800's, the Buffalo Society of Natural Sciences (BSNS) has had an eventful and rich journey into the present scientific era. The Conchology Collection is of notable historic significance because it is the oldest section of the Museum's research collections. Not only does the collection extensively document the Niagara River Region, but it also holds representatives from other parts of the U.S. and from around the world, spanning freshwater, marine, and terrestrial habitats. The most comprehensive publication of this collection is *The Mollusca of the Niagara Frontier Region and Adjacent Territory* published in 1948, by Imogene C. Strickler Robertson and Clifford L. Blakeslee. Shortly after the publication of this resource, conchology fell out of Buffalo's popular culture, and the collection has remained hidden. The recent resurgence of the city of Buffalo, NY has prompted ecological efforts that will be directly enhanced by better access to this collection, especially because both endangered and extinct unionid species are well represented. Supported by IMLS Museums for America funding, the Buffalo Museum of Science has sought to re-curate and digitize the Conchology Collection, starting with the order Unionida, while increasing the current care and management of this historic material. The collection holds over 2,200 lots, containing over 6,000 individual dry specimens across the families Hyriidae, Iridinidae, Margaritiferidae, Mycetopodidae, and Unionidae, including a number of Type specimens. Efforts to re-curate, photograph, and digitize this collection to reflect advancements in archival practices and unionid taxonomy are nearing completion, and they will produce a usable collection catalog accessible through aggregators such as iDigBio and GBIF. Improved accessibility to this collection will support current scientific inquiry pertaining to these important organisms. Additionally, the Museum has begun a science studio expansion to highlight freshwater mussels, promoting public awareness of their ecological and evolutionary importance as well as their conservation challenges as one of the most imperiled organisms of North America.

Natural history collections and social impact in the context of the climate and ecological crises

Ms Isla Gladstone¹

¹*Bristol Museums, Bristol, United Kingdom*

(CE) Civically engaged natural history museums: transforming public programmes to address societal challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

How are museums innovating in their public programmes to respond to and engage public audiences with the climate and ecological crises? This talk will draw examples from across different types of museum collection to provide wider scene setting. It will then focus in on natural history collections within this context to consider examples of best practice and opportunities for increased social impact and relevance.

Natural History Collections Research Design: A discussion course for research applications using collections and differentiating hypotheses from predictions

Dr. Travis Marsico¹

¹*Arkansas State University, State University, United States*

(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Differentiating scientific hypotheses from statistical hypotheses and predictions is confused by pressure from the scientific community to frame everything through the lens of mechanistic understanding. Yet, documenting biologically meaningful patterns is an important aspect of science, and it is in this area where natural history collections are most helpful. Collections are the foundation of much biological knowledge including references for species descriptions and place-based and time-stamped records of species distributions. One way to introduce students to effective understanding of pattern vs. process is through a course focused on the discussion of research publications using natural history collections to answer important questions in science. I developed and have thrice taught Natural History Collections Research Design as a cross-listed undergraduate and graduate course. The course is structured with daily paper discussions (26 papers in a semester), four paper content and application quizzes, a written publication critique, and a written justification for a testable hypothesis. This course follows a hands-on skills course called Curation of Collections in a two-course series. It aims to develop the skill of interpretation of scientific writing and findings, increase understanding of important elements of hypothesis testing (scientific and statistical), increase comfort and ability in oral and written science communication, and immerse students in 11 topical areas for which natural history collections are used to answer scientific questions: species descriptions, taxonomic revisions, phylogeny, biotic impacts from climate change, species invasions, ecology, biogeography, biodiversity inventory, ecological restorations, population genetics, and ancient DNA. Students have reported enjoying the course content and benefiting from the readings and discussions. Graduate students noted that experience leading a discussion session helped them.

Networking specimen data across collections and disciplines: the CETAF Botany Pilot

Mr Anton Güntsch¹, Dr. Quentin Groom², Mr Marcus Ernst¹, Mr Jörg Holetschek¹, Dr. Andreas Plank¹, Mr Dominik Röpert¹, Mr David Fichtmüller¹, Dr. David Peter Shorthouse³, Dr. Roger Hyam⁴, Mr Mathias Dillen², Mr Maarten Trekels², Dr. Elspeth Haston⁴, Mr Heimo Rainer⁵

¹*Botanic Garden Berlin, Berlin, Germany*, ²*Meise Botanic Garden, Meise, Belgium*, ³*Agriculture and Agri-Food Canada, Ottawa, Canada*, ⁴*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*, ⁵*Naturhistorisches Museum Wien, Wien, Austria*

(ID1) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

By using common data standards (e.g. Darwin Core and ABCD) and access protocols (IPT and BioCAsE), it has been possible to build a network of international biological collection databases and make them freely accessible. Whilst this makes it theoretically possible to connect specimens from different databases through common properties such as collection locations or names of collectors, standardised access alone does not generally ensure that the data can be linked across collections. These properties are usually transmitted as free text strings, which generally cannot be assigned to common entities.

Herbaria of the Consortium for European Taxonomic Facilities (CETAF) and beyond have developed a system using the example of collector names as anchor points to link specimens across collections (Güntsch et al. 2021). The basis of this "Botany Pilot" is the semantic annotation of collector names, by associating these names with Wikidata IDs (so called "Q IDs"). The annotations were then used to dynamically pull together and display information on collectors from different information systems in a web portal (<https://services.bgbm.org/botany-pilot/>). This includes specimens from the participating institutions, multimedia objects from EUROPEANA, literature from the Biodiversity Heritage Library (BHL) and biographical information from Wikidata.

The portal can be accessed with any Wikidata ID for a collector. In addition to the presentation as a website, we have started to build a service that can be queried by machines. In future, this service could be used to dynamically enrich data in collector records in any information system or collection management system. The activities will now be extended to other data types. A special focus will be on the topics of geography (e.g. by annotating collection locations with GeoNames IDs) and scientific names.

Reference

Güntsch A, Groom Q, Ernst M, Holetschek J, Plank A, Röpert D, et al. (2021) A botanical demonstration of the potential of linking data using unique identifiers for people. PLoS ONE 16(12): e0261130. <https://doi.org/10.1371/journal.pone.0261130>

Neurodiverse communities as crucial contributors to paleontology exhibits and collections perspectives, using inclusive museum design and self-advocacy

Mx Taormina Lepore¹, Ms Katrina Lepore

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(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Paleontology is well received and often a topic of intense interest within the neurodiverse and autism spectrum communities, and a growing body of knowledge recognizes and supports the benefits of inclusion of these communities in paleontological education and outreach. Museum fossil collections can be excellent resources for outreach to these communities, but are often inaccessible to neurodiverse day program learners. Here we describe a project that underscores the importance of neurodiverse perspectives in paleontology exhibit design, especially when directly involving fossil specimens. This project was co-led by adult neurodiverse learners in a day program work environment, where the team developed a portable paleontology exhibit using real and virtual fossil samples. These adult learners participated in an informal outreach session at their day program work site in 2018, where the expertise and interest of the attendees was instrumental in drafting and completing the project. Beginning in 2019, with the aid of program staff and the leadership of selected adult participants, the practitioners wrote and designed materials on deep time, described fossils, and produced multimedia materials to aid in science communication to their verbal and non-verbal colleagues. Augmented reality technology was also utilized to assist in the development and communication of paleontological materials within the exhibit. In 2020 and 2021, virtual Zoom classes utilizing the in-house museum allowed the project to expand its reach. Future work includes implementing direct feedback from neurodiverse populations in local miniature museums at other adult day programs outside of the project site. Sharing these inclusive methodologies and neurodiverse planning perspectives can allow day programs, and museums at large, to increase science offerings with direct input from neurodiverse populations and further recognize the value of such input to scientific work. Through direct inclusion of neurodiverse learners in the development of paleontological learning tools and materials, the paleontological natural history collection community can help support self-advocacy and awareness within the natural history collections sciences in a mutually beneficial way.

New digitization technologies at the service of science and society – do virtual nature museums have a future?

Dr Wioletta Wawer¹, Prof. Marcin J. Kamiński¹, Dr Marcin Raś¹, Dominika Mierzwa-Szymkowiak¹, Prof. Dariusz Iwan¹

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G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

We live in an age of rapidly developing technologies that have become part of our everyday lives. Facilitations related to digitization also apply to scientific collections. A dozen or so years ago, it was the curator's dream to implement projects related to the digitization of specimen – e.g. taking high definition photos, scanning manuscripts, implementation of modern inventory systems (QR codes). Digitization saves specimens from the destructive effects of time, and enables information to be shared non-invasively, e.g. reducing the risks associated with transport. Most often, digitized specimens are used for taxonomic research using morphology-based methods, but some techniques can also be helpful in broadly understood education.

The Museum and Institute of Zoology, Polish Academy of Sciences (MIZ PAS) has been collecting specimens from all over the world for 200 years. Currently, about 7 million specimens are stored here. The collections are mainly used by researchers, academics and students. New technologies offer different opportunities to digitize the specimens and make them available to scientists who cannot visit us in person. As part of various projects we first digitize the most valuable specimens, i.e. types. We use different methods depending on the group of organisms. We use the scanning electron microscope to study the key structures of an insect and obtain information about the content of elements; with a high-resolution digital microscope, in addition to photos of the specimen, we use the entire integrated slope recording system. We digitize birds by combining a series of photos which gives the effect of a 3D image; obtaining 3D models using computer microtomography techniques enables the specimen to be non-invasively cut and for full insight into the structure of the insects or shells to be obtained.

Currently, more and more museums have specialized methods to record information about the specimen in digital form. The more modern the techniques, the better the data quality and the ability to mass-produce perfect copies. The present challenge is how to make large-format digital data available and where to store digitized information so that it serves us not only today, but also for decades to come.

New focus and new audiences for the engagement programme at the Museum of Zoology during the pandemic and into the future

Dr Rosalyn Wade¹

¹*Museum Of Zoology, University Of Cambridge, Cambridge, United Kingdom*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

As for all Museums, the Covid-19 lockdowns completely changed the way we could interact and engage with our audiences. In response, we shifted the focus of our work to engaging with the zoology on the doorstep, exploring how we could use online platforms to support our audiences in spending time in nature for its wellbeing benefits as well as providing safe learning opportunities during this difficult time. We developed a mix of livestreams and online resources, and strengthened relationships with other local organisations to plan and deliver outdoor activities. Even with a focus on local wildlife, our online activities extended our reach to a global audience, and the use of green spaces has given us new perspectives on how we use our collections in learning programmes. As we move back to more Museum-based activities, we are now working to keep this outdoor and online learning as a permanent aspect of our programming. In this talk, I will give a brief overview of our programming for the past two years, what we found worked well, and how we plan to incorporate this way of working into our upcoming work.

New professional development offerings from the iDigBio Digitization Academy.

Ms Lauren Cohen¹, Digitization Resources Coordinator Erica Krimmel¹, PI - Digitization and Workforce Training Austin Mast²

¹Institute for Digital Information and Scientific Communication, College of Communication and Information, Shores Building, Florida State University, Tallahassee, United States, ²Department of Biological Science, 319 Stadium Drive, Florida State University, Tallahassee, United States

iDigBio (the US National Science Foundation's National Resource for Advancing Digitization of Biodiversity Collections) is working towards a sustainable Digitization Academy that offers a set of complementary professional development courses on the topic of biodiversity specimen digitization. The offerings began in 2021 with two 4-day courses: (i) Introduction to Biodiversity Specimen Digitization and (ii) Public Participation in Digitization of Biodiversity Collections. In post-course surveys, 100% of responding participants agreed that they would recommend the respective course to others if it was offered again in the future. With this poster, we will introduce the 2022 course offerings and other Digitization Academy resources for the community. Stop by to meet iDigBio's new Workforce Development Manager, Lauren Cohen.

New Symbiota Features to Support Digital and Extended Specimen Data

Katie Pearson^{1,2}, Dr. Nico Franz¹, Ed Gilbert¹, Samanta Orellana¹, Greg Post¹, Dr. Laura Rocha Prado¹, Dr. Jenn Yost²

¹Arizona State University, Tempe, United States, ²California Polytechnic State University, San Luis Obispo, United States

(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The Symbiota software platform (<https://symbiota.org/>) has supported curation, digitization, and publishing of biodiversity data for nearly 20 years. At present, more than 1,800 collections and 3,000 active users use this platform to manage occurrence data in over 40 thematic portals. Symbiota is continually evolving to support new types of information, including products aligned with the increasingly community-prioritized Digital Specimen and Extended Specimen concepts. Here we will demonstrate new features developed to facilitate occurrence data integration and enrichments within and across Symbiota portals, specifically: (1) scoring and searching of custom occurrence traits (e.g., phenological traits), (2) linking of associated occurrences (e.g., subsamples, hosts and other ecological relationships, associated taxa), and (3) managing of occurrence datasets (e.g., private versus public datasets). These features have been developed in the core Symbiota software code (<https://github.com/BioKIC/Symbiota>) managed by the Symbiota Support Hub team, which joined iDigBio as a new sixth domain in 2021. They are therefore available for integration into all active Symbiota portals. Leveraging these novel developments will amplify the research potential for digitized, extended biodiversity specimens by improving connectivity to different disciplines and types of data.

Nitrogen Hypoxia Treatment of Animal Specimen Infested with Cigarette Beetles - An Example of a European Mouflon at CHIMEI Museum

Mr Wei-an Wu

¹*Chimei Museum, Tainan City, Taiwan*

Taiwan's CHIMEI Museum is a comprehensive museum with collections of Western art, musical instruments, weaponry, and natural history. In December 2019, a staff member from the collection department found powder dust underneath a European mouflon (Collection No.0003072) in the storage room. Upon inspection, the specimen was moved to the museum's quarantine room for isolation and observation. Common pest treatments in museums are freezing, heating, anoxia treatment, and fumigation. CHIMEI Museum once designed a nitrogen hypoxia deworming chamber that successfully treated a batch of oil paintings infested with drugstore beetles [*Stegobium paniceum*], therefore the same anoxic treatment was applied to treat the mouflon specimen.

During the observation period, live adults and larvae of cigarette beetles [*Lasioderma serricorne*] were found in the chamber. After the infestation was confirmed, a nitrogen treatment was imposed on May 22, 2020. The low-oxygen level inside the chamber gradually dropped and reached below 0.2% one week later, and remained in such environment for 39 days. The number of cigarette beetles in the observation chamber continued to rise to 19 and stopped increasing by June 8 until a cigarette beetle was found again on August 25. Since then, every time a new cigarette beetle was found, it would be removed from the nitrogen chamber. By the end of 2021, a total of 114 adult cigarette beetles and 26 larvae were retrieved, with an average of one to four beetles per week.

After two years of observation, we found it difficult to effectively eradicate insect pests concerning three-dimensional objects with the nitrogen hypoxia method. In addition, we have also observed that cigarette beetles are not as good at flying as documented in the literature. During the two-year period, cigarette beetles were found only 6 times on the wall at 0.9-1.9 meters height, while the rest were found on the ground. The crawling larvae is another possible reason that causes the spread of cigarette beetles. In the future, the CHIMEI team will apply freezing methods to solve the problem of cigarette beetles in the specimen.

Nothing in (taxonomic) publishing makes sense except in the light of treatments

president Donat Agosti¹

¹*Plazi, Bern, Switzerland*

(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The goal of taxonomic literature is to describe taxonomic diversity as a result of charting the Earth's biological diversity. As research adds to our knowledge, our understanding of taxa increases with additional published results. This is how it has happened since the standard publications by Linnaeus in 1753 and 1758 in the format of taxonomic treatments, clearly delimited sections of text about a particular taxon. Later, material citations were added, providing an explicit link to the material that led to the published research result. Each treatment has a nomenclatural section including the referenced taxonomic name representing the usage of a specific citable name. Thus, the taxonomic name *Apis mellifera* L, 1758 refers to the taxonomic treatment published by Linnaeus 1758 on page 576. Later usage of the name cites this treatment thereby adding new research to the scientific corpus.

From a semantic point of view, a treatment and a material citation provide context to the content. For example, a geo-coordinate or specimen code in a material citation are references to a specimen which is a reference to the taxon of the treatment in which the material citation is in the text of a publication.

While this can be easily perceived by a human, machines depend on the treatment, treatment citation, material citation and taxonomic name annotations for recognizing this relationship.

These elements are in most cases distinct entities discoverable and annotatable by machines, can support human curation, but even better, the annotations can be embedded in prospective publications like those championed by Pensoft and the European Journal of Taxonomy.

Over the last 15 years, Plazi has been spearheading efforts to develop TaxPub, a schema modeling the taxonomic treatments, as well as material citations. Plazi has developed a processing workflow to discover these elements, make them open and citable using TreatmentBank and the Biodiversity Literature Repository and reused in collaboration with the Global Biodiversity Information Facility. Currently 730,000 treatments and over 1M material citations have been liberated from 51,000 publications. They have also been made reusable by GBIF, including over 80,000 taxa that are in GBIF only because of Plazi-provided treatments.

Nummulites: The Largest Single-Celled Organism, World Fair Collection, Building Blocks of the Pyramids, and the "Nummulosphere"

Mr Paul Mayer¹

¹*The Field Museum, Chicago, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Specimen lot P 3811 in the Fossil Invertebrate collection at the Field Museum is a box of Nummulites gizehensis, Eocene fossil tests of a single-celled, amoeboid protists belonging to the subphylum Foraminifera. These specimens were part of the Ward's Natural Science Establishment fossil collection that was on display on the second floor of the Anthropology Building in the World's Columbian Exposition (the 1893 Chicago World's Fair). This collection was purchased by Marshall Field to help establish a natural history museum in Chicago and is the core of the Field Museum's Fossil Invertebrate collection. These specimens are from the Eocene (~40 million years old) of Egypt. The species was described in 1775 by Peter Forsskåhl, a Finnish naturalist and student of Linnaeus and Carsten Niebuhr, a German explorer and cartographer. However, older accounts of these fossils are known including one from the 5th century BCE Greek historian Herodotus. He noted flat shells in the limestone blocks of the Pyramids at Giza. Some of the blocks that the pyramids are built from are nummulitic limestone (a fossiliferous limestone whose major component are fossil nummulites). While in some areas nummulites are very common a paleontologist, Randolph Kirkpatrick, took things a step too far. He began seeing evidence of nummulites in every rock he examined (even igneous rocks) leading him to eventually propose the term 'Nummulosphere' for an accumulation of nummulites that once covered the world and from which all of Earth's rocks were derived from. Obviously this idea was not accepted, but nummulites are an abundant fossil and used as index fossils by geologists to correlating rock layers.

"One Specimen Many Stories", encouraging new visions and seldom heard voices about natural history specimens.

Dr Christopher Marshall¹

¹*Oregon State University, Corvallis, United States*

(CC1) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Natural History collections are critical foundational components for descriptive biological science, especially for the specimen-based fields of taxonomy, biogeography and comparative/phylogenetic studies. As such, it is not surprising that much of the storytelling surrounding these collections, and the specimens that fill their shelves and cabinets, originates from the vantage point and value systems associated with people actively engaged in these fields. The displays we create, the language we use, and the people, places and context we present both in person and online emanate from particular perspectives — perspectives that can, and do, directly and indirectly influence whether various communities are more, or less, likely to find value in our facilities and/or core missions.

The profound racial and gender disparities in the sciences together with other forms of social and cultural bias negatively impact the profession, the body of work generated by it, and the ability to share scientific discoveries into society at large. Natural History Collections are a product of the people and cultures that created them, and as such reflect these social and cultural inequities. This talk presents ongoing work at the Oregon State University's entomological collection (Oregon State Arthropod Collection: OSAC) in which we reflect on social inequities in the context of our specific collection, seek to acknowledge the deficiencies, and actively move forward to encourage perspectives that have not been a significant part of our representation. Our goals in doing so are to inspire greater participation and sense of belonging to the professions associated with biodiversity science by individuals from underrepresented groups, and to explore the use of novel storytelling formats (e.g., artwork, graphic novels, poetry, etc) about our collection and its holdings, so as to better connect the collection to a wider audience.

Osteoscribing: writing on bones

Illustrator Jacki Whisenant¹

¹University of Wisconsin - Madison Zoological Museum, Madison, United States, ²Wisconsin Insect Research Collection, Madison, United States

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Osteoscribing, or labeling bones, is part of the general practice of any vertebrate collection, and this presentation gives an overview of the processes and pen options. Skeletons need to be properly cleaned and rested before committing ink to bone, or risk the label degrading on a coating of grease. A wide variety of archival pens are now available, and it is important to consider pen efficacy, longevity, cost, and ease of use. Waterproofing the mark prevents damage to the label as bones shift.

There is no one single answer for pen preference - each collection can ultimately decide what is best for their own practices. This presentation expands on a previous 2019 poster of osteological pen comparisons.

Outside the box; Specimens of the Malacology Department, at Harvard's Museum of Comparative Zoology

Mrs. Jennifer Trimble¹

¹*Harvard Mcz, Cambridge, United States*

The Department of Malacology at Harvard's Museum of Comparative Zoology (MCZ) dates back to 1860, with the purchase of land and freshwater snail specimens from J.G. Anthony, who later joined the staff of the MCZ in 1865 as its first curator. Today, with our newest curator, Gonzalo Giribet, the department continues to grow and integrate new methodologies of specimen curation.

The MCZ's publicly available database, MCZbase, archives specimen data through the use of unique catalog numbers which correspond to our physical collection of over 500,000 specimen lots. We increasingly strive to capture, and make publicly available the many pieces of specimen data that relates to a cataloged lot. Each record, and thereby each specimen, extends beyond the information contained within a single box on a single shelf in the museum. Examples of this extended data include, but are not limited to: digital specimen data, morphological data, field images, associated microbial communities, and biotic interactions. These extensions, including the physical specimen and it's related pieces of data comprise the extended specimen. Through the use of our customizable database, MCZbase and it's collaborators have been able to integrate iterative levels of extensions through interconnected resources. Thinking broadly about what the future holds for the mollusk collection in the Museum of Comparative Zoology will ensure that we are able to continue to integrate unique specimen attributes.

Partnering with scholars in the digital humanities to link an historic regional herbarium with its original collection and accession records.

Dr Andrea Weeks¹, Dr. Wendy Mann², Dr. Alyssa Fahringer²

¹*George Mason University, Ted R. Bradley Herbarium (GMUF/LFCC) and Department of Biology, Fairfax, United States,*

²*George Mason University, Fenwick Library Digital Scholarship Center, Fairfax, United States*

(ID1) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

A challenge set forth by the Extended Specimen concept is the development of the curatorial practices and data integration techniques that can retain and build connections between natural history specimens and their diverse metadata. Here we report an ongoing collaboration that meets this challenge in the restoration and digitization of an historic US regional herbarium, its collection notebooks and accession records. In 2019, the George Mason University herbarium (GMUF) incorporated the orphaned Lord Fairfax Community College herbarium (LFCC) and began to restore this collection as a research resource. LFCC comprises ca. 12,000 herbarium specimens and over 4000 pages of collection notes and accession records that record textual and illustrative metadata about the specimens beyond that reported on the herbarium labels. In order to connect the herbarium specimens with their original written records, we collaborated with our university's digital humanities librarians in customizing Omeka S, a next-generation web publishing platform that is designed to interpret digital cultural heritage collections, for herbarium collections. We discuss how we modified Omeka S software using DarwinCore vocabulary to support advanced queries, created ARK identifiers for the notebook images, and integrated LFCC specimen and notebook datasets. We report challenges encountered in creating reciprocal linkages between Symbiota and Omeka S platforms and our discoveries about this collection, which are at the intersection of regional floristics and the history of science, that were uncovered as a consequence using this new web-based tool.

Past and Present Teaching: Returning to the Cole Museum of Zoology's original function as a university-level teaching resource, by developing a new museum space and enabling undergraduate students to safely undertake remedial conservation work within our fluid-preserved collections.

Mrs Claire Smith¹, Miss Caitlin Walton¹

¹*Cole Museum Of Zoology, University Of Reading, Reading, United Kingdom*

(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Francis J. Cole became Professor of Zoology at the University of Reading in 1907 and began collecting natural history specimens for teaching in 1909. The focus of what became the Cole Museum of Zoology has always been on comparative anatomy, and undergraduate teaching. During the past few years, the collection has become increasingly inaccessible due to relocation of teaching, building work, and of course the Covid-19 lockdowns. Having recently moved into a brand-new Health and Life Sciences building with a dedicated museum space, The Cole Museum's Curator, Amanda Callaghan, has designed the new displays specifically to support the teaching of undergraduate zoology courses.

As well as being able to study relevant specimens from the collections both in the museum and in the lab, undergraduate students can also choose to work as volunteers for the Cole Museum – including with the fluid-preserved specimens. As it is unusual for students to be permitted to work with wet collections, we have developed a guided training programme to ensure that this work can be carried out safely. The training addresses the broad range of skills that they will need to undertake collections care and remedial conservation work.

The training of undergraduate students in working with fluid-preserved specimens has benefits for both the students and the museum. As a small team with limited working hours, having additional expertise on hand allows us to undertake a great deal more work than we otherwise could. For the students, they gain not only expertise in practical skills which would be extremely difficult to acquire elsewhere, but also a greater depth of awareness of the kinds of roles in which they could employ these skills in their future careers, whether in museums directly, or in scientific work which makes use of fluid-preserved specimens.

Our focus will be on the Cole Museum's many and varied functions as an undergraduate teaching resource. This includes the development of our successful fluid-preservation volunteering opportunity, in particular its benefits both to the health of our collection, and also to our students' potential, thanks to the structured training and support we are able to offer.

Pathologies associated with the Osteological Collection of the Natural History and Science Museum of the University of Porto

Miss Sofia Perestrelo^{1,2}, Miss Mariana Costa^{1,2}, Dr. Joana Salgueiro¹, Dr. Eduarda Vieira³, Dr. Luis Ceríaco¹

¹Museu De História Natural Do Porto, Porto, Portugal, ²Universidade Católica Portuguesa, School of Arts, Porto, Portugal,

³Universidade Católica Portuguesa, Research Centre in Science and Technology of Arts, Porto, Portugal

G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

In the context of Conservation and Restoration in Portugal, studies related to specimens and collections of Natural History are scarce. Currently, no inventory norms or definition of pathologies for specimens of these collections are available, contrasting to the vast literature on inventory norms, glossaries of pathologies and common damages in other types of heritage such as ceramics, paintings, archaeology, etc. Within the diversity of specimens in Natural History collections, osteological specimens stand among some of the most iconic and universally known parts of these collections.

Here we present a case study carried out in the Natural History and Science Museum of the University of Porto (MHNC-UP). MHNC-UP houses approximately 850,000 specimens, collected from the mid-nineteenth century to the present day. The historical collection of zoological osteology has about 300 specimens, most of them collected and assembled from mid-nineteenth century to the mid twentieth century. These belong to the different groups of vertebrates – mammals, birds, reptiles, amphibians and fishes – and prepared and mounted for different types of uses (education, exhibition, research), such as articulated skeletons, anatomical preparations, skulls and skeletons (either loose or supported on wooden bases), as well as the traditional skulls mounted as hunting trophies. Using this collection as a case study, we will highlight in this communication the most common pathologies associated to these type of collections and a tentative relationship between the pathology and the different characteristics of the specimens.

Persistent identifiers for specimens/samples are way more than yet another label

Dr Lesley Wyborn¹, Dr Kerstin Lehnert², Dr Jens Klump³, Dr Sarah Ramdeen², Dr Kirsten Elger⁴, Dr Anusuriya Devaraju⁵

¹Australian National Data Service, Acton, Australia, ²Lamont-Doherty Earth Observatory, Palisades, United States of America, ³CSIRO Minerals, Kensington, Australia, ⁴Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany, ⁵Terrestrial Ecosystem Research Network (TERN), Brisbane, Australia

ID2) Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Since 2011, the IGSN (International Generic Sample Number) has provided a central registration system for users to apply a globally unique, persistent, resolvable identifier (GUPRI) to any physical specimen/sampling feature related to any sampling procedure. But IGSN is not simply about assigning a persistent identifier to a single object. Its core purpose is to enable transparent and traceable connections between the specimen and its sampling context to any related data, publications, people, organizations, instruments, and grants. This places critical requirements on its data model.

The IGSN data model is based on ISO 19156:2011 (Observations and Measurements, O&M), which includes the concept for 'Specimen' with minimum attributes such as materialClass, samplingLocation, samplingTime, procedure, instrument/method used for collection or creation. In the O&M model, a 'Specimen' is treated as a specialization of a 'SamplingFeature' that is further classified into various spatial sampling features such as cross-sections, transects and boreholes. In addition, the W3C/OGC Sensor, Observation, Sample, and Actuator (SOSA) ontology can be used to provide the required constructs for representing sampling information including the relation between a 'Specimen' and the larger physical feature of interest it was sampled from. An IGSN can also be assigned to the 'SamplingFeature', treated as the parent, and the 'Specimen', as well as any subsamples taken from that specimen, linked back to it through parent-child relationships.

Multiple procedures can subsequently be undertaken on a specimen by different researchers, organizations, laboratories, etc. IGSN plays a critical role in maintaining its unique identification as it passes between systems and organizations. As IGSNs are GUPRIs, they cannot be duplicated by other researchers, laboratories or repositories: any derived uniquely identified resource (analytical data, images, physical measurements, annotations, etc) can be linked with confidence.

Best practice is to assign the IGSN to the specimen when it becomes a standalone identifiable 'thing'. This identifier then anchors the specimen through the progressive stages of its subsequent 'life-cycle' including laboratory analysis, generation of further data, images, publication, and ultimately curation and preservation. Where any subsamples are derived, they, and any data generated on them, can also be linked back to the parent identifier.

Perspectives and challenges of creating a new museum in 21st century Brazil

Perspectives and challenges of creating a new museum in 21st century Brazil Bruna Toscano¹

¹*Museum of Biology, Brasilia, Brazil*

G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

This work aims to discuss the challenges of creating a natural history museum in Brazil in the 21st century. The project of the Museum of Biology (MB) of the University of Brasilia (UnB) is currently under development at the Institute of Biology. The MB results from the union of 13 collections that together amount to nearly 4.5 million organisms. Those collections have been under constant growth and renovation since the 1980s, adding to scientific knowledge by Brazilian and international researchers, especially regarding the Cerrado biome. The diffuse effort to keep those collections makes an even more significant challenge to preserve and research because the curators depend on funds external to University. Therefore, the MB intends to unify the collections to improve preservation conditions, facilitate public access to scientific knowledge, facilitate money raising, and increase awareness among the local public about the Cerrado biome to protect its biodiversity. As a young capital created in the 1960s, Brasilia still lacks a Museum of Natural History, and as a young city provides fertile ground for its creation in a country without long tradition in the field. In addition, developing the project of MB in the 21st century implies its presence in the virtual world and social media since its conception. This scenario demands that the public's experience not only be restricted to the visit but englobes their engagement through virtual interaction tools.

Physicochemical analysis of sealants from Anatomic collection in fluid of the MNHN: evolution of historical recipes.

Mr. Baptiste Zuber¹, Dr. Sophie Cersoy¹, Pr. Veronique Rouchon¹, Dr. Michel Sablier¹, Dr. Marc Herbin^{2,3}

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(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Materials used to seal jars are key elements of the preservation of wet collections since they prevent evaporation of conservative fluid and inflow of atmospheric oxygen, thus limiting the alteration of specimens. Visiting historical fluid collections allows one to notice the wide variety of materials and sealing techniques used since the 17th century throughout the setting up of these collections. Reports of travelers, naturalists and scientists account for the attention they paid to the hermetic sealing of their jars sometimes brought back from distant expeditions. Different recipes, more or less precise are mentioned in this literature. They were used by contemporary collection keepers, and probably adapted according to local preferences, know-how or possible supplies.

This project aims to gain knowledge on past sealing practices and focuses on physicochemical analyses of about 100 historical sealants coming from the Comparative Anatomy Collection of the Museum National d'Histoire Naturelle, Paris (MNHN). Pyrolysis Gas chromatography coupled with Mass Spectrometry, Fourier Transform Infrared spectroscopy and colorimetry were performed on these historical sealants and on model samples made of pure products or according to known recipes. Assessment of minor components remained difficult because of their limited impact on analyses. Moreover, the visual aspect of the samples (texture, color) were poorly correlated to their compositions. Despite these difficulties, the chemometric analysis of collected data enabled to gather samples of similar compositions, and to propose a classification according to the type of binders and additives. These results, cross-checked with available historical data, allowed to propose a typology of the sealants present in the collection and to trace the chronology of their use.

As long as historical data are available and micro-sampling feasible, the methodology developed here can be extended to other historical collection and, if necessary, using other analytical techniques. Finally, we took advantage of the characterization of the most commonly used sealants to set up an experimental protocol for the evaluation of their performance in terms of permeability and durability. This second aspect will be of great use to improve preservation and restoration of historical and/or endangered artifacts.

Planning a new collection space for the Royal Horticultural Society's specialist herbarium of ornamental plants

Ms Yvette Harvey¹

¹*Royal Horticultural Society, Woking, United Kingdom*

(CS1) Collection space in the 21st century and beyond, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

On Thursday 24th June 2021 the newly named 1851 Royal Commission herbarium opened its windows to the public from a new location, 'RHS Hilltop – The Home of Gardening Science', c. 400 metres from the Laboratory where it had been housed since the early 1900s. This presentation focusses on planning, funding, negotiating, involving, collaborating and a little compromise.

Severe space constraints, water ingress issues, predation by pests, and limited opportunity to show our collections to the public, together with the urgent requirement to upgrade our scientific research capability, necessitated the move to a new fit-for-purpose building. Although looking primarily at just the herbarium, planning for the move included Library and Entomology collections and had a wonderful outcome in bringing curatorial and research colleagues together, sharing ideas for collections spaces, solutions to challenges, kitting out the new spaces and help during our moves.

The herbarium suite was designed with a dirty-to-clean path for a specimen to follow – the cleanest area being the specimen store built to be large enough to contain an additional 300,000 specimens while fresh material for the herbarium arrives at the dirty end. IPM played an important role in every aspect of the design of the suite. In addition, demonstration space and windows have been provided for public engagement. Since the building was designed to minimise environmental impact, innovative solutions such as a special clay wall to regulate humidity and extra thick walls to reduce temperature fluctuation were incorporated in the collections store.

Having an active role in planning ensured that staff could speak authoritatively and passionately about the new building during many fundraising events. Being solely funded by members, visitors and supporters, the Society's philanthropy team raised over £40M to finance the building and adjacent plantings. This included an opportunity to sponsor a herbarium box, into which our collections were transferred from the old herbarium cupboards.

In spite of exciting challenges posed by different design stage iterations, fittings tenders (especially when purchasing specialist archival equipment) and covid, the RHS's herbarium has exceeded expectation and plays a central role in informing visitors of the RHS's scientific research.

Platycterium bifurcatum – one of the world’s oldest houseplants?

Ms Yvette Harvey¹

¹*Royal Horticultural Society, Woking, United Kingdom*

Always check the small-print should be a curator’s mantra – and it was the case in point here. A tiny note on the label of a specimen gave rise to a rather delightful discovery. The specimen is of a frond of the stagshorn fern, a common houseplant in the UK, and the note recorded that the living plant had been transferred to the Royal Horticultural Society’s garden at Wisley from the RHS’s previous garden at Chiswick when it was closing (1903/1904). Cared for by generations of horticulturists the actual plant, a supercentenarian, is still alive and wowing audiences in its home in the Glasshouse.

Portable Protocols: Safe Conservation in Temporary Labs

Ms Liatte Dotan, Ms. Fran Ritchie

¹*Harpers Ferry Center National Park Service, Charles Town,, United States,* ²*Garman Art Conservation Department SUNY Buffalo State College, Buffalo, United States,* ³*American Institute for Conservation, Washington D.C, United States,*

⁴*Society for the Preservation of Natural History Collections, Chicago, United States*

During the 2021 joint AIC/SPNHC meeting, a talk titled “Arsenic and Old Feathers: A Survey of Detection, Mitigation and Treatment Approaches for Pesticide-Affected Objects and Proposal of a Treatment Protocol for SUNY Buffalo State” discussed the need for written guidelines in handling and treatment of object with residual pesticides. While the particular impetus for this project focused on arsenic-containing taxidermy, the resulting research endeavored to provide practical tools for collection holding institutions and cultural heritage caretakers in dealing with hazardous materials. Among the resources provided in the report was a Handling and Treatment Consideration Flowchart; this tool was intended for the use of collection staff, conservators, researchers, and others working with affected materials to help inform their actions and protect themselves and their surroundings. In the summer of 2021, the flowchart was successfully enacted during a two-week onsite treatment blitz at Yellowstone National Park. Two conservators from Harpers Ferry Center set up a temporary conservation lab to treat over 50 avian taxidermy specimens from the historically significant Fishing Bridge Museum collection. Past examination established the presence of arsenic on all the specimens. Using the workflow as a guideline, a conference room was converted into a temporary treatment space where conservators carried out skin tear repairs, feather fills, and structural stabilization on the objects. The implementation of these measures demonstrates the feasibility for treating important pieces of scientific and artistic material while enacting necessary measures for human safety.

Presenting botanical type citation data from the International Plant Names Index as material citations

Dr Nicky Nicolson¹, Maarten Trekels², Dr Quentin J Groom², Robert Turner¹, Dr Jonathan Krieger¹, Dr Alan James Paton¹

¹*Royal Botanic Gardens, Kew, Richmond, United Kingdom*, ²*Agentschap Plantentuin Meise, Meise, Belgium*

(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The International Plant Names Index (IPNI, www.ipni.org) provides nomenclatural information for the scientific names of vascular plants from family down to infraspecific ranks. The editorial team scan scientific literature for nomenclatural events, recording orthography, standardised authorship and bibliographic reference for the containing publication, adding data for around two thousand newly described species each year. In 1997 the data extraction process was expanded to include type citations, so we now have more than two decades worth of type citation data. This can be analysed to help us understand how the specimens from particular collections are being cited and to work out where the types from a particular collector may be held. This is a valuable dataset as it bypasses the digitisation requirement (a specimen can be cited even if it has no digital presence) and therefore has representation from a wide range of collections. We present an overview of this type citation data, options for how it can be presented as a dataset of material citations and potential applications in the development of more automated approaches to extract types from literature sources.

Preserving and Sharing Museums and Collections Through Exhibit Hall and Collections Area Virtual Tours and 3D Specimen Photogrammetry

Dr. Ralph Kugler¹, Patricia Coorough Burke¹, Paul Mayer², Amanda Kopp¹, Jon Haas¹

¹Milwaukee Public Museum, Milwaukee, United States, ²Field Museum of Natural History, Chicago, United States

G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The Milwaukee Public Museum (MPM) has a long history of innovative exhibit design. The Museum is moving to a new building. While this provides the opportunity to further innovate, not all exhibits that are popular with the public will make the transfer. One way to preserve these exhibits for the future is to develop virtual tours. Several tours of major exhibit halls are on the MPM website. In addition to preserving the exhibits for the future, the tours also have provided a way to share the museum during the COVID-19 pandemic. Aside from 360 by 180 degree views of entire exhibit halls, the tours incorporate both text and audio of exhibit labels, behind-the-scenes and other types of informative videos, details of individual specimens and other types of information. For educators and students components are provided for museum visits as well as pre- and post-visit activities, including treasure hunts, quizzes, etc. One advantage of virtual tours is that parts of the museum that are generally closed to the public, such as collections storage areas and laboratories, can be incorporated into the tours. An example of an ongoing virtual tour project of the fossil invertebrates collection storage area in the Field Museum of Natural History will be presented. Ultimately, it is hoped this tour will connect to the database for the collections.

3D photogrammetric models of specimens are components of the virtual tours. In addition, the models have significant uses in other ways. The models can be 3D printed for handling by school kids, the public, and those with visual disabilities. With dimensional calibration, the models can be loaned to researchers in other institutions. This helps preserve the specimens by limiting the amount of handling and potential detrimental effects during transportation.

Preserving Biodiversity with IrisBG and ESRI

Laura Knutson Murray¹, Mari Rustan²

¹*Magnolia Maps, , USA*, ²*IrisBG, , Norway*

“The loss of biodiversity is permanent, with climate change one of the factors leading to this loss. We have about 12 million species on earth—not counting bacteria and other microorganisms—and we have given names to fewer than two million... Despite this gaping hole in our knowledge, we must act to preserve as many of the existing species while there is still time to do so.” - Dr. Peter H. Raven, President Emeritus of the Missouri Botanical Garden

Tracking biodiversity, through documenting living plant collections, requires constant attention to detail as plants change and grow and their environments change or can be modified. For over 25 years, IrisBG has refined a software and database solution for all aspects of managing living and preserved botanical collections. IrisBG facilitates everyday work with living and preserved botanical collections and enables easy accessioning with images and mapping, sharing of plant material, tracking the wellbeing of plants and much more.

When synchronized with ESRI’s suite of cartography products, users have an even more powerful set of applications that can be customized for their institution and used on any device for internal use or publicly shared. Mari Rustan of IrisBG and Laura Knutson Murray of Magnolia Maps will walk attendees through a live demonstration of how the Memphis Botanic Garden is creating digital records and sharing their collections with the world.

Preserving colour of wet specimens - The need to understand their uses and values for the collection

Ms Elodie Granget¹, Miss Marion Dangeon¹, Doctor Laura Brambilla¹

¹Haute École Arc Conservation-Restauration, HES-SO University of Applied Sciences and Arts Western Switzerland, Neuchâtel, Switzerland

(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Preserving the colour of specimens is a well-known problem in natural history wet collections, especially for botanical specimens whose pigments are often highly sensitive to alcohol.

The Research unit of the Haute-École Arc Conservation-Restauration of Neuchâtel, Switzerland, is carrying out the LIQUOR project that aims to understand the conservation and discoloration issues of botanical wet collections and strives to propose practical solutions to these problems. In that scope, ancient and modern recipes claiming to preserve the colour of plants and fruits were experimentally tested. The selected recipes were conceived to conserve green, blue-red, or yellow coloured plants as well as prevent opacification of the fluid for tannin-rich specimens. The methodology was the same for all recipes: test-specimens were prepared and monitored using photography and the coloration of the fluid was measured by photospectroscopy. The results showed that the actual colour was rarely preserved, and that the process of stabilizing pigmentation came at the cost of other aspects of the specimens, such as their 3D structure, their physical or chemical integrity.

It is therefore important to cautiously balancing the trade-offs of each fluid preservation recipe and to base the choice of preparation method on a good understanding of what uses will be made of these specimens. Hence, this project also includes a survey about the use and values of all types of wet collections. The aim of this survey is to understand in what way institutions use their wet collections (exhibition, education, research,) and the values associated to the different parts of these composite objects: specimen, fluid, jar, sealant. This investigation would help us to better orient our research towards the conservation of relevant characteristics and properties of the wet specimens.

Preserving the Genomes of Type Specimens: Lessons from the Museum of Comparative Zoology

Rina Morisawa¹, Adam J. Baldinger¹, Joseph D. Martinez¹, Mark D. Omura¹, José P. Rosado¹, Jeremiah R. Trimble¹, Andrew D. Williston¹, Dr. Scott V. Edwards¹, Dr. Gonzalo Giribet¹, Dr. Breda M. Zimkus¹

¹*Museum Of Comparative Zoology, Harvard University, Cambridge, United States*

G8: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Museum of Comparative Zoology (MCZ) is a unique institution in that it holds a large number of type specimens, which are the original specimens used in the formal description of a species. More than 31,000 databased primary types, including holotypes, syntypes, lectotypes, and neotypes, are currently hosted in the non-paleontological departments of the MCZ. These specimens are preserved in a variety of ways, both dry (e.g., skins, skeletons, whole animals) and wet (e.g., ethanol, formalin). Advances in DNA sequencing technology combined with rapidly decreasing sequencing costs will have a tremendous impact on many biological disciplines by allowing the use of specimens currently housed in museums. Unfortunately, most type specimens are housed among the general collections and not cryopreserved, and their DNA has been degrading rapidly over time. With the support of an NSF Collections in Support of Biological Research (CSBR) grant, the MCZ has begun subsampling approximately 17,000 type specimens present in its collections and depositing them in vapor-phase liquid nitrogen storage within the MCZ Cryogenic Collection. This work will prevent further DNA degradation to these invaluable specimens and will provide the possibility that at some point in the future, every name-bearing specimen may have its genome sequenced. We herein outline the goals of this project, comprehensive procedures developed for the grant, and discipline-specific sampling considerations. Since preserving the integrity of these historic specimens and minimizing external morphological damage were key factors, the removal of tissue, as well as the placement and size of any incisions, must be carefully considered. We provide examples from the first year of the grant, including subsampling completed in the Herpetology and Invertebrate Zoology Departments, and discuss both challenges (e.g., delays in starting subsampling) and opportunities (e.g., remote work allowing type status confirmation and inclusion of citations in our collection management system) resulting from the COVID-19 pandemic.

Press Juicy, Sticky Plants with Tissue Paper and Pillows of Silica to Prevent Mould and Retain Colour

Ms Nadia Cavallin¹

¹*Royal Botanical Gardens, Burlington, Canada*

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Plants with a high moisture content and fragile flowers, such as Tall Bearded Irises, will decompose and mould rather than flatten and dry if you try to press them using the traditional technique of laying them between newsprint and blotting paper. After several failed trials with various materials, I successfully pressed flowers of Tall Bearded Irises by laying them in tissue paper and covering them with press-sized pillows filled with silica gel. The resulting pressed flowers kept their shape, and for a while, their colour. Though the colours of the irises eventually faded, the same technique has helped to improve colour retention in pressed plants of other taxa.

Project #RetroPIDs: BHL's mission to unlock the world's biodiversity literature

Ms Nicole Kearney¹

¹*Biodiversity Heritage Library Australia (BHL Au), Melbourne, Australia*

RE) Reflections on the Biodiversity Heritage Library: Value in Collections and Collaboration (, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

In 2022, the Biodiversity Heritage Library (BHL) will upload its 60 millionth page of biodiversity literature. This massive repository of free knowledge includes content that is available nowhere else online, as well as accessible versions of content that is locked behind paywalls elsewhere. However, accessible does not equal discoverable.

Much of BHL's content is in the form of journal articles. Journal articles are the bibliographic unit of most interest to researchers: most academic work is published in articles and most citations in articles are other articles. However, the primary bibliographic units in BHL are volumes, which are uploaded into BHL with volume-level metadata, e.g. *The Zoological Journal*, v.1 (1824-1825). Volume data is useful from a bibliographic perspective, but it provides no information about the volume's contents.

If we are to unlock BHL's millions of pages of journal articles, BHL needs article data, particularly article titles, which contain taxonomic names, locations and biological terms. And, if those articles are to be part of the modern linked network of scholarly research and appear in reference lists as persistently linked citations, they need retrospectively assigned persistent identifiers (#RetroPIDs), specifically DOIs (Digital Object Identifiers).

Enter Team #RetroPIDs (AKA BHL's Persistent Identifier Working Group). Established in October 2020, Team #RetroPIDs has two ambitious goals: 1) to make the foundation of the world's biodiversity knowledge persistently discoverable, citable and trackable; and 2) to unlock the paywalled public domain literature on commercial websites.

In its first year, Team #RetroPIDs assigned new DOIs to 10,000 journal articles, bringing this literature into the DOI system; added 30,000 external DOIs to BHL articles, making BHL's open access versions discoverable via Unpaywall; and developed the tools and documentation to enable the entire BHL community to take contributed content from "just" accessible to persistently discoverable.

This paper will present the impact and challenges of this critical work as we continue to expand, enhance, and advocate for #RetroPIDs and #OpenAccess.

Publication vs. Collection Management: What was your CMS designed for?

Community Coordinator Teresa Mayfield-Meyer¹

¹*Arctos, Albuquerque, United States*

(ML2) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

In the Natural History Collections Community, digitization has been driven by researchers and data aggregators primarily interested in occurrences, but those managing the physical objects housed in a natural history collection are primarily interested in the care and management of physical objects. Unfortunately, meeting the needs of data aggregators has often led to database structures that do not support the day-to-day work of collection managers. This presentation will be a brief introduction to DarwinCore, GBIF DarwinCore Archives and a discussion of what might be missing when we allow aggregator needs to be the primary driver of development for collection management databases. I will introduce the TDWG MaterialSample Task Group and how development of new biodiversity standards might inform and advance development of better systems for managing physical objects and touch on how communities can help create better systems for meeting everyone's needs.

PyrΔTE: an AI-based pyrite tarnish probability generator

Miss Kathryn Royce¹, Morgan Davis², Ben Leyland²

¹University of Oxford, Oxford, UK, ²OR3D, Chirk, UK

PyrΔTE is the result of a pilot study conducted to determine whether AI can be used to help identify change in museum specimens. To simplify this proof of concept, numerical colour data were collected from hundreds of pyrite specimens from Oxford University Natural History Museum, National Museum Cardiff, and National Museums Liverpool. Over a dozen volunteers helped to collect thousands of colour data points. They and the collections' curators also assessed whether each specimen was either tarnished or untarnished. This data was then fed into two separate Regression AI modules in Python to identify patterns within the dataset. Here, the AI used the colour data to calculate tarnish likelihood and the overall colour difference (ΔE_{00}).

Multiple iterations of the calculator have been developed, increasing the size of the training dataset and adding new features with each version. The present version allows the user to input their own CIELAB colour values, either individually or as a series of data points in a .csv file. The user can also select either the default untarnished pyrite colour values or enter their own set of values to use in calculating the ΔE_{00} . Whilst this programme is presently limited in scope to colorimetry and pyrite, PyrΔTE demonstrates that, with further development, similar AI tools can be created to aid identifying and treating visual and material changes to museum objects.

(Re)using published georeferences with Biodiversity Enhanced Location Services (BELS)

Julie Allen², John Wieczorek³, Michael Denslow¹, Rob Gurlanick¹, Nelson Rios⁴, Rafe LaFrance¹, Edward Gilbert⁵, Deborah Paul⁶, Paula Zermoglio⁷

¹University Of Florida, Gainesville, United States, ²University of Nevada, Reno, Reno, United States, ³University of California, Berkeley, United States, ⁴Yale Peabody Museum, Yale University, New Haven, United States, ⁵Arizona State University, Phoenix, United States, ⁶Illinois Natural History Survey, University of Illinois Urbana Champaign, Champaign, United States, ⁷Universidad de Buenos Aires, Buenos Aires, United States

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

The research potential for data associated with specimens has changed dramatically due to the production of tools and community coordination around digitization and mobilization. However, many specimen records still only have textual descriptions of geographic locations where collecting occurred. Georeferencing - the conversion of these textual descriptions to mappable coordinates with associated uncertainties - still remains a significant bottleneck to the ready use of these data. The majority of data records published to aggregators such as iDigBio and GBIF still lack proper georeferences. The standards and best practices for georeferencing are mature. Tools such as Geolocate support generation of georeferencing metadata reflecting those best practices, e.g. valid coordinates, datum and information about spatial uncertainty. Of all the means to speed up georeferencing, one that potentially requires the least amount of extra work is to find and use a location record that is already properly georeferenced. Enter BELS: Biodiversity Enhanced Locality Services, built around a database of previously georeferenced locations found in GBIF, iDigBio, and the VertNet collaborative georeferencing projects. Using this gazetteer, we determine how many non-georeferenced locations may have georeferences retrieved from previous efforts. In this process, we explore these databases to determine the number and quality of the data available. Finally, we explore use-case datasets to examine the value of BELS for the community. We also discuss the integration of the gazetteer in commonly used tools such as GeoLocate and Symbiota. Integration with existing toolchains assures maximal uptake by the community.

Re-connecting communities in biodiverse places to their biological heritage

Dr Quentin Groom¹, Jodey Peyton², Catherine Childs³, Sarita Francis⁴, Luke Harding³, Annick Jackman³, Mike Pienkowski⁵, Eulyn Silcott-Greaves⁴, Catherine Wensink⁵, Rebecca Machin⁶

¹*Meise Botanic Garden, Meise, Belgium*, ²*UK Centre for Ecology & Hydrology, Crowmarsh Gifford, Wallingford, United Kingdom*, ³*National Trust for the Cayman Islands, Grand Cayman, Cayman Islands*, ⁴*Montserrat National Trust, Olveston Salem, Montserrat*, ⁵*UK Overseas Territories Conservation Forum, Nottingham, United Kingdom*, ⁶*Leeds Museums and Galleries, Leeds, United Kingdom*

(CC2) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Museums and herbaria played an important role in the colonial project: specimens collected from colonised countries were exported to museums in the metropole, to be named and catalogued by taxonomists, and appropriated and used by colonising powers. Exploitation of their colonies' biodiversity enabled colonial powers to improve crops, develop drugs and find new materials, thereby building wealth and improving the lives of people living in colonising, and colonised, countries. Despite museums and herbaria existing around the world, a legacy of colonialism means the world's most extensive and important biodiversity collections, and their associated libraries, technology, and staff, are housed in the wealthier Global North. People living in biodiverse places in ex-colonies live alongside, manage and protect the ecosystems surrounding them, yet receive fewer of the cultural, economic and intellectual benefits of the natural science specimens taken from their countries. This material is researched, used and enjoyed by people living far from its geographic origins, and from the communities who may understand them intimately. The Convention on Biological Diversity calls for 'the fair and equitable sharing of the benefits arising out of the utilization of genetic resources'. How can museums and herbaria in the Global North address this challenge and become relevant to people working and living in biodiversity-rich places? In this talk we describe the project titled 'From Blue Iguanas to Blue Vervain - sharing the Colonial Histories from the UK Overseas Territories', which is working to connect the biodiverse Caribbean UK overseas territories of Montserrat and The Cayman Islands with natural science collections around the world. We aim to learn ways to address issues of access and benefit-sharing, particularly how residents of these biodiverse places can benefit from the data and research linked to specimens originating in their islands.

Recovering an abandoned Zoological Museum – the case of the Natural History and Science Museum of the University of Porto, Portugal

Dr Luis Ceriaco¹

¹*Museu de História Natural e da Ciência da Universidade do Porto, Porto, Portugal*

G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Amassed since the late nineteenth century, the zoological collections of the Natural History and Science Museum of the University of Porto, Portugal, have been an important resource for teaching several generations of biology students as well as serving as the basis for the discovery of the world's biota. Among the approximately 650.000 zoological specimens housed in the museum, some collections are particularly important for researchers. Some collections have served as the main support for the first critical taxonomic revisions of different taxonomic groups of the Portuguese fauna, represent unique or rare sampling events in certain geographic locations around the globe, are the sole national representatives of extinct species, or are considerably rich in type specimens.

Despite its importance, the zoological collections were left almost abandoned in the late twentieth century/early twentieth century. The collection was at the time entrusted to a single curator, who, without the help of any technician or other staff, had to curate, study and provide access to the collections, at the same time that had the burden to manage all the daily paperwork associated with the museum. This has led to the deterioration of a considerable part of the collections and to an overall incapacity to answer to the needs and requests from the scientific community. In 2015 a new vision and project was implemented in the museum, resulting in the growth of its staff and the allocation of a considerable amount of funds to support the recovery of its collections and the establishment of a new research agenda associated to those. In this presentation, I will provide an overview of the last seven years of activities in the museum – from the creation of new reserve spaces, recovery of deteriorated specimens to cataloguing and digitizing data and specimen-based research projects. I will also present the challenges associated to the revitalization of an important, yet abandoned, museum, and highlight some of the ongoing projects related to the different types of research currently being done in the collections – from history of science, conservation of scientific specimens and integrative taxonomy.

Redesigning databases for comprehensive collection management.

Dr Christine Johnson¹

¹*American Museum Of Natural History, New York City, United States*

(ML1) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Powerful databases are fantastic. Balancing effort and information quality in data entry for both collections management and research use with a comprehensive database can be challenging. Hence, designing or adopting a database that easily allows for a many to one relationship among modules and for uploads, downloads and batch corrections of data is important. The Division of Invertebrate Zoology at the American Museum of Natural History chose to adopt the Axiell, formerly KE, EMu database as its collection management tool. Data from over 50 individual databases were migrated into a single unified system. The learning curve was steep, but “letting go” (see Waller’s presentation) of preconceived designs based on past database functioning and the desire to populate every field in lieu of skeletal catalog records with a quick specimen and label image has facilitated our collections management with relatively little data entry effort on the part of collections staff. Furthermore, when the world stops due a pandemic, these data are available for years to come. Here I will present some basic functionality and other tools to look for when designing or adopting a collections management database system.

Rediscovering the rocks of Surinam: giving structure and context to a collection with the aim of decolonization

Miss Frances Versluis¹

¹*Mineralogical-Geological Museum, Delft, Netherlands*

G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Sometimes we can be surprised by how little is known about collections which turn out to be very relevant. Meet the geological Surinam collection: until 2015 it was owned by the Mineralogical- Geological Museum in Delft (The Netherlands) and is now in the hands of the Naturalis Biodiversity Center, Leiden. Even though the collection (counting ~3500 objects) is badly registered and labeled, it holds great potential for research into the cultural history of geology in Suriname. Fortunately, the director of the Mineralogical-Geological Museum managed to acquire funds to put an end to the chaos and properly disclose and investigate this important collection.

The main goal of this collection based research is to provide a framework for the ongoing investigation on possibilities for decolonization. In other words: what do we do with objects collected from our colonies? When we know the circumstances under which different parts of the collection were obtained, we can assist in the decision-making on how to decolonize such a collection. Results are expected this February (this abstract will be updated when the research is finished). With the Surinam project, hopefully a good example is set on how to handle colonial material. We hope it will raise enough awareness to fund the next project with which we would like to decolonize the Indonesia collection of geology and to make it accessible again.

For this collection research a format for collection information was developed. Furthermore, the Surinam collection was restructured, photographed and linked to, for instance, the history of the Mining faculty in Delft, the Geological Survey of Surinam and to several dutch enterprises from the 20th century. Rocks which were supposed to be collected by Mr. Bijl (bijl is dutch for axe), turned out to be actually indian stone axes. A mining engineer who helped general Franco escape from Morocco was thanked for his participation in expeditions to find gold in Suriname, and encounters with hostile natives changed the course of the first exploration expeditions in the deep jungles of the country. Today, the new collection overview already supports ongoing geological research in Surinam.

Re-housing Taxidermy-mounted Bird and Mammal Specimens at the Michigan State University Museum

Collections Manager Laura Abraczinskas¹, Curator Barbara Lundrigan^{1,2}

¹Michigan State University Museum, East Lansing, United States, ²Michigan State University Department of Integrative Biology, East Lansing, United States

G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Established in 1857, the Michigan State University (MSU) Museum houses over 117,000 vertebrate specimens dating from 1844. Over the past 27 years, the Museum has successfully completed 12 grant-funded collections stewardship and data quality enhancement projects for both wet and dry vertebrate specimens. With funding from the U.S. Institute of Museum and Library Services, the Museum is improving accessibility, environmental conditions, and housing for more than 5,600 vertebrate specimens, including bird and mammal taxidermy mounts that are stored in substandard conditions. The specimens include rare, endangered, and threatened species dating to the earliest days of the University, a time when specimens were often prepared in a life-like pose, making storage challenging. The specimens are at risk from a variety of threats, including damage or loss from physical forces, pests, and environmental contaminants. The crowded, inefficient storage arrangement restricts accessibility and hampers use. Project activities include relocating or replacing old cabinets to accommodate new cabinets and shelving units that can properly house and protect these specimens. The space reconfiguration for the specimens is designed to accommodate them by size over a standard taxonomic arrangement. Drawer and shelf liners are being installed, along with custom-made dust covers to fit over mobile shelving units. The risks to specimens from physical forces and damaging elements is being mitigated or minimized. Michigan State University undergraduate students are assisting with all aspects of this re-housing project. MSU Museum staff are committed to managing and housing collections according to the highest professional standards and ensuring continued availability of these important specimens.

Remote Volunteering: Publication Round-up

Mrs Nicole Volden¹

¹*New Mexico Museum Of Natural History And Science, Albuquerque, United States*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The New Mexico Museum of Natural History and Science (NMMNHS) collections were closed to volunteers due to COVID-19 from March 2020 to November 2021. During much of that time, staff were working remotely. One of the big challenges staff faced was keeping our dedicated volunteers engaged. We saw an opportunity in Arctos, the database NMMNHS had recently migrated into. Arctos has an excellent framework for publications and citations (linked to identifications), and NMMNHS had not previously tracked citations. We designed a data entry spreadsheet for paleontology publications based on the Arctos bulkload format and ease of use for volunteers. We recruited a group of six volunteers who usually work in our paleontology preparation lab and collections. They received training on data entry over video conference before using the spreadsheets to enter citations and identifications from publication pdfs. The collections manager gathered publications by scouring digital archives, curator bibliographies, and Google Scholar. Volunteers read and entered approximately 900 publications. After data entry the collections manager checked the data and uploaded it to Arctos. Progress was tracked through an Arctos project page. Upload is currently 38% percent complete and by the end of upload we expect to have added at least 15,000 specimen citations and identifications. The project was very successful at keeping this group of volunteers engaged. All but one volunteer stayed with the project for the full ten-month duration, and all reported they enjoyed the work. Particularly they appreciated the opportunity to learn more about fossils by exploring paleontology literature and were thrilled when the literature discussed specimens they had interacted with during their volunteering.

Renewing Curation of the Science Museum of Minnesota's Biology Collection

Dr Catherine Early^{1,2,3}

¹Science Museum of Minnesota, Saint Paul, United States, ²Bell Museum, Saint Paul, United States, ³Florida Museum of Natural History, Gainesville, United States

G11: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Science Museum of Minnesota's Biology Department is a registered natural history collection of ~170,000 plant and animal specimens. We are the largest collection of mammal specimens in Minnesota and are also strong in arthropod specimens. Historically, the focus of our collectors has been regional, resulting in a robust representation of the biodiversity of Minnesota, with other small collections from Alaska, Antarctica, and Mexico. Although the Biology Department has seen its specimens used for research in the past, its activities were significantly reduced during the almost 20 years it spent without a Curator, which was corrected with the creation and filling of a permanent, full-time Curator position in 2020. Fortunately, the persistence of the Biology Department's Collections Manager and the museum's Director of Collections Stewardship throughout that period mitigated the potential for neglect and loss of institutional knowledge, but significant challenges that resulted from decades of understaffing remain. For example, before 2020, almost none of the records of the Biology Department's collections were digitized. The Biology Department's collections are our greatest strength, and growth and preservation of these collections are a top priority, but it is difficult to strategically grow without an understanding of current holdings. Thus, a major focus of my efforts in my first two years as Curator has been digitization and reorganization of the collection. This process has been slowed by the COVID-19 pandemic, which limits the number of people who can work in the collection at a time, and by limited funding, which means that this work is mostly done by volunteers. Another challenge resulting from previous understaffing and lack of digital presence is relative obscurity of the collection, including to staff within other parts of the same institution and to regular visitors and members of the museum, as well as to outside researchers whose work would benefit from our specimens. In this talk, I will give an overview of the Biology Department of the Science Museum of Minnesota and share some lessons learned as I have addressed these challenges in my first curatorial position.

Rescuing an old collection

Mister Pasquale Ciliberti¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture
Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

RESCUING AN OLD COLLECTION.

Mosquitoes are important vectors of human diseases. Dutch medical entomologists have been studying the distribution and vector competencies of tropical mosquitoes at least since the beginning of the 20th century, mainly in former Dutch colonies such as Indonesia and Suriname.

Among them, Johanna Bonne-Wepster played a pivotal role. Her goal was to give non-specialists the tools to identify possible vectors for disease in humans. Johanna Bonne-Wepster did not have a university degree, however, following her husband, pathologist Cornelis Bonne, she became interested in medical entomology and eventually became a renowned mosquito taxonomist. She was ahead of her time: in a period where the focus was only on medically important species, she recognized and advocated the importance of studying and describing also non vector species as well. Her contributions to the field of taxonomy was recognized in the form of a doctorate honoris causa awarded by the University of Amsterdam in 1951.

The collection she built, consisting of material she collected and material sent to her by fellow entomologists, was donated to Naturalis Biodiversity Center (NBC) in Leiden. Pinned specimens had only a number, this number linked the single specimens to the information in the collection's associated notebooks. The notebooks are very old and therefore data could be lost.

I will describe the efforts made by Naturalis to rescue the information in the notebooks and make the collection available to the scientific community.

Research and conservation of fish mounts on the example of Estonian Museum of Natural History's collection.

Ms Eleri Paatsi¹, **Mr Lennart Lennuk**¹, Ms Helen Lennuk²

¹*Estonian Museum Of Natural History, Tallinn, Estonia*, ²*The Conservation and Digitisation Centre Kanut of the Estonian Open Air Museum, Tallinn, Estonia*

The fish mounts were investigated using scanning electron microscopes as well as arsenic detection with chemical tests. Test results were all negative. Majority of the fish mount collection was created between 1947 and 1967. The oldest specimen is from 1947 and the latest from 1979. The fresh fish was mainly collected from fishing companies. Additionally, museum employees caught the fish themselves from Estonian bodies of water. Foreign collection grew thanks to Estonian fishing vessel expeditions to the Black Sea, Atlantic Ocean and Yakutia.

The most common problem for fish mounts - mechanical damages - were caused by poor preservation conditions. Missing pieces of fin, broken or totally missing fin were frequent problems. Due to unsuitable, rigid filling, the skin dried tighter and seams were torn. All mounts on wooden stands also had a potential danger of corrosion. Moreover, the stands were unstable. The visual aesthetic of these mounts was disrupted by missing eyes or by tape amendments.

To detect mold activity, find suitable wet cleaning solution, and discover the most effective adhesive for Japanese paper and fish skin research was carried out. In prior stated questions, these would be the correct approach to conserve the natural history's collection. Most of the objects were treated in a conservative manner, although in some fish these additions were more outstanding.

Some of the damage on the mounts was on a wide scale that allowed conservators to use methods from leather, paper, binding and metal conservation. In most cases Japanese paper, Evacon-R and Lascaux 498 HV adhesives were used. In the last phase of work, acid-free carton boxes with the same material dividers were created. All information was written in labels which were attached to mounts.

Resurrecting the orphaned Lord Fairfax Community College herbarium (LFCC).

Dr Andrea Weeks¹, Mr. Matthew Sheik¹

¹*George Mason University, Ted R. Bradley Herbarium (GMUF/LFCC) and the Department of Biology, Fairfax, United States*

G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

This presentation describes the rescue and restoration of an orphaned regional herbarium in the United States and its simultaneous integration as a digitized resource within the iDigBio network. Since Summer 2019, the George Mason University herbarium (GMUF) in Fairfax, Virginia, USA has been incorporating the Lord Fairfax Community College herbarium (LFCC), a collection of approximately 12,000 vascular plant specimens created by Professor Robert Simpson and his students in last quarter of the 20th century. The majority of these specimens were collected from the north-western montane physiographic provinces of Virginia, regions that have been under-collected historically and are now undergoing extensive anthropogenic modification. We have transformed LFCC from an unorganized and deteriorating collection into a publicly-accessible research resource by using a workflow that has incorporated the skills of our undergraduate students and volunteers with those of project personnel. LFCC specimens were processed through triage, repair, barcoding and skeletal databasing, nomenclatural annotation, imaging, crowd-sourced label transcription, and, finally, filing into cabinets alongside GMUF specimens. We report here the methods used, unanticipated challenges encountered during the project, as well as the first summary of the holdings of LFCC and the historically- and scientifically-significant specimens that have been uncovered in the process. Among these discoveries include new state and county records of native and introduced plant species and the original collection notebooks and papers of Lena Artz, a pioneering mid-20th century US explorer and plant collector of shale barrens in the Appalachian Mountains.

Reveal, Reclaim and Recognise: Digging under the hidden narratives of natural history collections.

Ms Miranda Lowe¹

¹*Natural History Museum London, London, United Kingdom*

(CE) Civically engaged natural history museums: transforming public programmes to address societal challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Decolonising natural history collections and related knowledge requires provenance research, tracing how specimens and objects were collected, acquired and moved worldwide as well as acknowledging the collaboration of diverse communities in the process. It reveals the influence of local academic or Indigenous knowledge and its subsequent suppression. These narratives are commonly absent from the interpretation of natural history collections particularly in relation to colonial histories which will be explored in this talk. The misrepresentation of the past is problematic because it alienates non-white audiences. Acknowledging difficult pasts is an important first step in creating more inclusive and representative interpretation across the natural history arena.

Running a Museum on Empty: Creative ways to maintain a museum and create new exhibits on a shoestring budget

Miss Ariana Lushtak¹, Ms. Jamie Page¹, Ms. D. Lila Saligman¹, Ms. Lyndell Bade¹

¹*Colby College, Waterville, United States*

(YS) Year of the Student: Attracting College Students to Campus Museums, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Biology Natural History Museum, when it was founded, had its own building and designated exhibit space. Over the subsequent 150+ years, the cases have been moved to different campuses and different buildings. We currently have built-in cases in one science building and the same display cases from the 1800s scattered throughout an older, connected science building. The current “museum” consists of disparate cases throughout multiple floors in two buildings. There are definite challenges with maintaining and renewing the exhibits in this setting, as well as having no specific budget or funding source for this work. Identifying individuals in other departments kind enough to help with art, signage, and printing has also required creativity. Most of the exhibit work (restoration, updates, and new exhibits) has been undertaken by undergraduate students at Colby College. They have created innovative, interdisciplinary, and creative ways to tackle budget, resource, and logistics challenges. This presentation will highlight some of the challenges and creative ways used to meet those challenges.

Running Out of Time: Extinction, Impermanence and Museum Display

Dr Alice Would¹

¹*University Of Bristol, Bristol, United Kingdom*

(EX) Exhibiting Extinction and Endangerment, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Time plays a critical role in the curation and display of natural history specimens. This is particularly the case when curation relates to extinct animals, as their individual and their species-wide times have ended. Specimens are all that remains of these lifetimes and assuring their protection is therefore time critical. Museums make decisions about whether to store these specimens and remains away – an attempt to freeze creatures in time – or whether to keep them on display, to act as a reminder of the lives and liveliness of the past in the hope of enacting change for the future. In this paper, I will track the historical relationship between endangered and extinct taxidermy specimens, their display in museums and exhibitions, and the ideas of time and impermanence.

Beginning in the Victorian museum, with reference to the collection of the hunter Charles Peel, I will explore how extinction was first displayed, and how the ideas of time, permanence, and instability came together in museum spaces. The looming threat of extinction led to a paradoxical drive to preserve creatures through taxidermy, and further contributed to the current extinction event. I will then track these creatures across the twentieth century, when they were donated to the Royal Albert Memorial Museum (RAMM). The narratives associated with these specimens have been in flux, as have the skins themselves: it is estimated that 85% of this collection has been lost as they have succumbed to the ‘ravages’ of museum pests. This is a second loss for the individual creature, and a mirroring of wider species extinctions. Their bodies, in death, are still engaged in both time and its ending.

In demonstrating how interwoven the past, present and future are with relation to extinct and endangered taxidermy, I suggest that these stories have significance for potential displays. As specimens, they are indicative of the entanglement of human and non-human lives, the proximity of our times, and our role in conserving the living and the dead. I will consider how we might reveal these times, absences, and endings, with taxidermy.

Sampling strategies, techniques and curation of the Swedish Environmental Specimen Bank

Curator Sara Danielsson, Senior Assistant Anna Jerve, Senior Assistant Linnea Brokmar

¹*The Swedish Museum of Natural History, Stockholm, Sweden*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

The Swedish Environmental Specimen Bank (ESB) is a natural history collection largely consisting of frozen tissue samples from various animal groups that is held within the Swedish Museum of Natural History (SMNH). The Swedish ESB was one of the first environmental specimen banks worldwide, with the oldest samples dating back to the 1960s. This collection was first developed out of concern for environmental contaminants (i.e., mercury, DDT, PCBs) and their effects on Swedish wildlife. While SMNH researchers were able to demonstrate the utility of museum dry collections for researching mercury, fat-soluble contaminants could not be analyzed from this material. This created the need for a new type of collection aimed at preserving and storing animal soft-tissues. Annual collection of biological material to the Swedish ESB commenced in 1964, first focusing on only a few species and sampling stations and, over time, expanded to incorporate material from long-term environmental monitoring programs. Today, around 10,000 new samples are stored in the ESB annually, including species from both aquatic and terrestrial ecosystems and ranging from primary producers to top predators, in addition to sediment and human breast milk samples. Specimens for the ESB are collected by SMNH staff, fishermen/hunters, and also donated from the public and government agencies. The majority of the frozen material is stored at a temperature of -25°C with a smaller part at -80°C. Larger animals that arrive whole are sampled to extract tissue samples and skeletal elements, while smaller specimens are generally vacuum-packed and stored whole until they are sampled for study. There is also a smaller dry collection in the ESB composed of mineralized and keratinized structures collected from invertebrates, fish, birds and mammals, extracted from specimens stored in the freezers, as well as histological samples and plant material. This diverse collection of material has enabled researchers to use specimens from the ESB in studies on contaminants in the Swedish environment, including those related to, e.g., genetics, diet/nutrition and stable isotopes. The ESB serves as a time capsule, capturing historical trends of environmental contaminants that tell the story of Sweden's past, present and eventual future.

Scaling 3D Digitization of Natural History Collections: Use Cases from Anthropology & Entomology

Mr Nelson Rios¹, Dr. Doug Boyer³, Dr. Neil Cobb⁵, Dr. Roger Colten¹, Mr. Michael Denslow⁶, Dr. Nicola Ferrier², Dr. Lawrence Gall¹, Dr. Robert Guralnick⁶, Dr. Mark Hereld², Dr. Agnete Lassen¹, Dr. Crystal Maier⁴, Dr. Naomi Pierce⁴

¹Yale Peabody Museum, New Haven, United States, ²Argonne National Laboratory, Lemont, United States, ³Duke University, Durham, United States, ⁴Harvard Museum of Comparative Zoology, Cambridge, United States, ⁵Biodiversity Outreach Network, Flagstaff, United States, ⁶University of Florida, Gainesville, United States

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Multi-view imaging, whereby objects are photographed from multiple camera poses, provides a simple, yet effective approach to generate suitable datasets for deriving the external three-dimensional structure and color of target objects. These datasets can also be used to extract content which has been traditionally difficult to acquire from single view imagery and/or manual transcription, such as the information written on labels attached to pinned insects. Furthermore, modern computational techniques utilizing machine learning can leverage multi-view datasets to improve upon object detection, trait extraction and species recognition. Despite the value multi-view imaging can provide, technical barriers still limit applicability to high-throughput mass digitization across diverse object types varying in shape, size, color, texture, and rigidity. Here, we present ongoing development of a flexible, low-cost, open-source hardware/software solution to high-throughput multi-view imaging called COPIS (Computer Operated Photogrammetric Imaging System). The current implementation of COPIS consists of modular imaging chambers that house 1 or more high-resolution cameras mounted on 5-axis cartesian gantries. Custom control software allows technicians to define and orchestrate the actions of each camera within the available three-dimensional environment. Using this system, it is possible to create consistent and reproducible workflows for multi-view imaging. Additional metadata such as known camera position and view angle may be used to further improve 3D reconstruction. Two example use cases of this technology will be presented: 1) results from multi-view imaging and 3D reconstruction of artifacts from the Division of Anthropology and the Yale Babylonian Collection at Yale Peabody Museum of Natural History and 2) ongoing work to develop “LightningBug”, an end-to-end pipeline for pinned insect digitization that includes 3D specimen reconstruction and label extraction.

Scaling up digitization in entomology collections - a new approach initiated and enabled by the Museum fuer Naturkunde Berlin, supported by Naturalis Biodiversity Center and realized by Picturae

Dr Frederik Berger¹, Elena Grigoryeva¹, Lukas Kirschey¹, Luc Willemse²

¹Museum Fuer Naturkunde Berlin, Berlin, Germany, ²Naturalis Biodiversity Center, Leiden, Netherlands

G7: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Millions of pins in entomology collections carry valuable information in form of labels that have been described and maintained over generations. Digitising this information is one of the major challenges of this decade in collection digitisation. This will enable direct access to the data of the collection event via databases.

Within the project for collection discovery and development at the Berlin Natural History Museum the requirements for standardised and automated high-throughput collection disclosure were defined in 2020-2021. The aim of this first pilot project is to digitally record 500,000 specimens from the Hymenoptera collection. The project is not limited to mere imaging, but also includes conservational preparation as well as the digital recording of the collection data by collection management. From the very beginning, it was clear that technological innovation would be needed to accelerate the process of digitisation. The MfN opted for an EU-wide public tender. In the bidding process, the Dutch company Picturae was able to present the most convincing proposal for implementation.

In an initial step, the process involves the creation of an image at drawer level. Based on this image, collection management and curation staff indicates the position of the associated taxa and records the present metadata. As this task requires a profound knowledge of the collection, it cannot be easily outsourced to service providers. In the next step of re-housing, the specimens are placed into new unit trays. Only during the final process the specimens are imaged on a conveyor system.

The first prototype for an automated digitisation line was extensively tested at the Naturalis Biodiversity Center in Leiden in mid 2021. After successful trial runs, the system was moved to Berlin and put into operation. Further improvements on all levels followed. In January 2022, the system is about to enter regular operation.

This presentation intends to explain the decisions behind this ambitious project, to address the challenges and to present the successes. It is our wish that this solution for mass digitization in entomology collections will become available to many institutions facing the same challenge.

SciCoMove: Scientific Collections on the Move: Provincial Museums, Archives, and Collecting Practices (1850–1950)

Dr Patricia Mergen^{1,2}, Dr Denis Diagre-Vanderpelen¹, Mrs Nicole Hanquart¹, Prof Nathalie Richard³, Dr. Inna Pravdenko³, Dr Irina Podgorny⁴

¹*Meise Botanic Garden, Meise, Belgium*, ²*Royal Museum for Central Africa, Tervuren, Belgium*, ³*Le Mans University, Le Mans, France*, ⁴*Argentine National Council of Science, Buenos Aires, Argentina*

G11: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

In May, the SciCoMove project was launched, with funding from the European Commission through the prestigious Marie Skłodowska-Curie Actions Staff Exchanges grants. SciCoMove is a collaboration between organisations from Europe and Latin America, focusing on collecting practices in museums and archives from 1800 to 1950.

The project addresses the history of paleontology, anthropology, botany, zoology and applied sciences by studying the collection items and notably their provenance. The heart of the project is based on staff exchanges between participating institutions via secondments, each being in the form of specific case studies. Additionally there will be workshops and training schools organized on methods, approaches and best practices on the studies and usages of the collections and archives, by making use among others of MOOC (Massive Open Online Courses). There are experts groups formed addressing the usage of collections for exhibitions and cross cutting themes on skull collections, herbaria or applied sciences such as criminology.

The project aims also to bring smaller provincial institutions in adhering to the principles of FAIR data, into adopting modern collection management and in following international standards such as those of the TDWG (Biodiversity Information Standards).

The proposed presentation, after a short introduction of the project, will be on the case studies and secondments foreseen by Meise Botanic Garden. The first, one is on its expertise in roses collections and their historical background. The other secondments are focusing on the assessment of the collections of the visited institutions, to bring them closer to the DiSSCo infrastructure (Distributed System of Scientific Collections), on how to make their collection data more open and FAIR, as well as planning the digitization and publishing of smaller collections. Beyond the collections, it is also planned to address the application of the Plazi Treatment Bank on their available literature and archival documents and to make their content accessible to platforms such as Zenodo, GBIF (Global Biodiversity Information Facility), GEOCASE (Earth Sciences Collections Portal), BHL (Biodiversity Heritage Library), EUROPEANA

Setting Natural Science Data Free: Scoping UK Collections

Miss Tara Wainwright¹, Dr. Ella Howes¹, Mrs Helen Hardy¹

¹*Natural History Museum, London, United Kingdom*

The UK's museums and botanic gardens hold millions of natural history specimens of scientific importance. Unveiling the contents of the UK's collections will enable further digitisation to unlock the full scientific potential of UK natural science collections (NSCs). This project, funded by the Arts and Humanities Research Council (AHRC), aimed to discover how many specimens are in UK NSCs, and what those specimens consist of. A survey based on the European SYNTHESIS+ survey was distributed to NSC holders across the UK. To encourage collection holders of all size and capabilities to participate, the survey was graded to allow different levels of granularity. For all institutions, we obtained estimates for the number of biological and geological specimens held in their collections, as well as the extent to which these specimens have been digitised. Further details were provided for some institutions, with 60% of respondents providing a breakdown of their collections by taxonomic group, 51% by preservation type, and 31% by stratigraphy. Here, we will discuss the results of this nationwide scoping exercise and present a visualisation of the data obtained via a Power BI data dashboard. With over 80 responses, we now have the most up-to-date estimate of what is held in UK NSCs and a greater understanding of the level of digitisation across a range of institutions.

Setting Natural Science Data Free: UK Collections' Digital Readiness

Miss Tara Wainwright¹, Dr. Ella Howes¹, Mrs Helen Hardy¹

¹*Natural History Museum, London, United Kingdom*

G1: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Digitisation has the potential to create a sustainable and freely accessible resource, unlocking vast amounts of data to be used by researchers across the globe. With a variety of reasons for digitising their natural science collections (NSCs), institutions face a diverse set of digitisation challenges. Understanding the drivers and hurdles for each individual collection is crucial in building an effective strategy and business case for the digitisation of UK collections. As part of the Arts and Humanities Research Council (AHRC) funded scoping project, we distributed a 'digital readiness survey' to NSC holders to gain insight into their current digital readiness. The survey was split into four key sections, asking respondents about (1) how natural science digitisation is prioritised within their institution, (2) their institutions' current capabilities in digitising their collections, (3) the accessibility and management of their collections data, and (4) the training required to increase their institutions' digital outputs. We received responses from 89 institutions across the UK. These results are being used to improve the digitisation of UK NSCs, by aiding the creation of digitisation training resources that will be usable for all collections holders. In this talk, we will outline the responses to the survey, highlighting the key barriers institutions face in digitising their NSCs. We also consider how these institutions can be supported to improve the amount of digitisation being undertaken and increase the accessibility of this data.

Setting priorities for managing previously unmanaged collections

Mr Hans Kristensen¹, Charlotte Vikkelsø Hansen¹, Simon Kongshøj Callesen¹, Kent Olsen, Thomas Simonsen¹

¹*Natural History Museum Aarhus, Aarhus, Denmark*

G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

With ever dwindling resources, the need for thorough planning and prioritization of collection care efforts are becoming ever more obvious. This is particularly a challenge for planning and prioritizing conservation and collection care efforts for previously unmanaged (unloved) collections, and collections managed by different curatorial practices and traditions.

Here we present a model—successfully implemented at the Natural History Museum Aarhus, Denmark—aiming at gaining detailed insight of the content and state of preservation, and level of cataloguing for each collection. This insight is used to assess, plan, and prioritize efforts across all collections to ensure their long-term preservation and accessibility, as well as cataloguing unregistered specimens. The project involved defining a large number of qualitative and quantitative values or variables for each collection subset—here termed metaregistration of the collections. These variables include—but are not limited to: number of specimens in the collection; percentage of specimen in the collection catalogued in the museum’s database; physical size of the collection (number and dimensions of drawers, containers, meters of shelf space etc.); storage location; preservation state of specimens; recommended and actual climatic conditions; taxonomic content; current and earlier curators etc. These values were assessed in five categories: actions needed for the immediate safekeeping; long-term preservation; correct storage; accessibility to and cataloguing of the specimens in the collections. Based on ratings values in these five categories actions needed for each collection were prioritized and listed in a Plan For Conservation and Plan For Cataloguing. During the metaregistration process, collections and specimens outside the museum’s area of curatorial responsibility were identified and deaccessioned. The multiple steps in this process are presented with a discussion on how to (or not to) implement a similar approach at other institutions.

Setting quality thresholds for the use of natural history collection specimens in scientific studies

Ms Annmarie Fearing¹, Ms Emma Villemarette¹, Dr Peter Kyne², Dr Kevin Feldheim³, Dr Alec Moore⁴, Mr Nigel Downing⁵, Dr Kelcee Smith⁶, Mr Jeff Whitty⁷, Mrs Tonya Wiley⁸, Dr Barbara Wueringer⁹, Dr Nicole Phillips¹

¹University of Southern Mississippi, Hattiesburg, United States, ²Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia, ³Field Museum of Natural History, Chicago, United States, ⁴School of Ocean Sciences, Bangor University, Menai Bridge, United Kingdom, ⁵University of Cambridge, Cambridge, United Kingdom, ⁶Louisiana State University, Baton Rouge, United States, ⁷Sawfish Conservation Society, Bradenton, United States, ⁸Havenworth Coastal Conservation, Palmetto, United States, ⁹Sharks And Rays Australia, Bungalow, Australia

G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Specimens held in natural history collections are an invaluable resource for studying biodiversity and informing conservation. To be included in scientific studies, it is critical that natural history specimens have reliable data regarding their collection date and location. For many studies, the rationale behind the inclusion or exclusion of specimens with collection data is largely subjective. If specimens with misinformation are included it can lead to inaccurate results. Misinformation may stem from inaccurate or missing information during the recording of original documents, during the creation of subsequent documents, and/or from anecdotal accounts. Here, we developed a standardized method to determine threshold criteria for when specimens should be included in a scientific study based on confidence in the accuracy of their associated collection data. Data confidence scoring charts were designed to assign a ranking to a specimen's collection data based on its source (e.g., original logbook, museum tag) and thresholds for the inclusion of specimens in scientific studies were recommended. Our threshold criteria will help improve consistency and comparability between studies that use natural history collection specimens. This provides an objective means for researchers to determine which specimens may have more reliable collection data. We demonstrate the utility and application of this method through specimen (e.g., dried rostra) datasets from the highly threatened sawfishes.

"Shell games": A case study of storage and rehousing paleontological and geological specimens after critical infrastructure upgrades to a collection space.

Dr Lisa Boucher¹, Ms. Liath Appleton¹

¹*Non-vertebrate Paleontology Laboratory, Jackson School Museum of Earth History, University of Texas at Austin, Austin, US*

Even with careful planning, large-scale moves and construction projects often lead to unforeseen challenges. In this presentation, we will highlight some of the unique obstacles and constraints faced during a renovation project as well as key curation opportunities and lessons learned. The Non-vertebrate Paleontology Laboratory as part of the Jackson School Museum of Earth History recently renovated a previously non-climate-controlled collection space through a generous donation and a National Science Foundation grant (NSF-1458198). The space stored approximately 1/3 of our collection in an enclosed wire-mesh metal cage within a larger building. Renovation included enclosing the space with drywall, the installation of two heating/cooling units, modification of an external entry, and installation of new doors to an adjacent storage space resulting in an increase in square footage. The project required extensive planning before the construction phase to sort and prepare specimens for the move to temporary storage at an off-site facility. It also required logistical planning for the ordering and installation of new cabinets and a walk-in freezer for pest control of the materials to be rehoused into the new space. Our challenges included construction delays leading to increased costs for storage space and the need to shorten our timeline for rehousing specimens. We have a small full-time staff, and we were primarily assisted by graduate and undergraduate students, researchers, and other volunteers. Under these circumstances, we developed a modified freezing protocol and workflow that incorporated image capture of specimen drawers. We transported and imaged over 4,000 cabinet drawers. During this process we also discovered damaged, uncatalogued, and misplaced specimens including types. Our rehousing was completed during the fall of 2019 and due to covid-related constraints post-rehousing data curation continues. Some general lessons include, increase the estimated time for each step, be prepared for the unexpected, and best practices must be balanced with reality. Despite the challenges, a move offers an excellent opportunity to reorganize, improve storage capacity and conditions, incorporate digitization as part of the process, and for specimen rediscovery.

Showcasing Science: The art of specimen presentation

Illustrator Jacki Whisenant¹

¹*University of Wisconsin - Madison Zoological Museum, Madison, United States*, ²*Wisconsin Insect Research Collection, Madison, United States*

Scientific illustration is a multifaceted practice, with approaches that range from traditional techniques rooted in historical practice to cutting-edge digital innovations. Museum specimens can be presented in a variety of ways: through high-resolution photography, naturalistic illustration, graphic stylization, digital modeling, or a blend of techniques. Are they being presented as direct specimens or recreated as living organisms? To what extent is stylization clarifying or obscuring?

What style is best for a publication, a book, an outreach presentation, a museum display? It is vital to consider what visual approach to use for reaching different target audiences, and how the imagery aligns with the story being told. This poster presents a series of comparative visualizations to consider what approach is most effective for communication in different contexts.

Smartphone microscopy – Tips for taking high-quality microscope images with a phone camera

Dr Bob Gooday¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

The ability to take high-quality microscope images is growing in importance among natural science collections as the drive for digitisation continues and collections research becomes increasingly reliant on observation of the microscopic realm. A suite of digital microscopes or microscope-mounted cameras is now an essential facility at any collections or research institution. However, factors such as cost, size, and availability of compatible IT facilities mean that many institutions are limited in the number and accessibility of specialized photomicrography systems. Access to such facilities has also been greatly reduced for many people during the ongoing pandemic.

Standard optical microscopes without attached cameras are cheaper, more transportable, and in many institutions already commonplace. They can be moved into personal offices or even into home workspaces more easily than dedicated photomicrography facilities. It can therefore be much more convenient to use these for generating photomicrographs when the need arises.

The optics and software in modern smartphone cameras make them perfectly suited to taking microscope images down the eyepiece. The primary obstacle to taking photographs, and especially videos, is camera instability. This can be overcome using certain freehand techniques or the use of a home-made or commercially available adaptor. I will be sharing some smartphone photomicrography tips, as well as showing images and videos of geological thin sections taken with a smartphone.

Spatial uncertainty in data from Natural History Collections as mediated by GBIF. Implications for ecological research.

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(MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Natural history collections (NHC) represent an enormous and largely untapped wealth of information on the Earth's biota, made available through GBIF as digital preserved specimen records. Precise knowledge of where the specimens were collected is paramount to rigorous ecological studies, especially in the field of species distribution modelling. Here, we present a first comprehensive analysis of georeferencing quality for all preserved specimen records served by GBIF, and illustrate the impact that coordinate uncertainty may have on predicted potential distributions. We used all GBIF preserved specimen records to analyse the availability of coordinates and associated spatial uncertainty across geography, spatial resolution, taxonomy, publishing institutions and collecting time. We used three plant species across their native ranges in different parts of the World to show the impact of uncertainty on predicted potential distributions. We found that 38% of the 180+ million records provide coordinates only and 18% coordinates and uncertainty. Georeferencing quality is determined more by country of collection and publishing than by taxonomic group. Distinct georeferencing practices are more determinant than implicit characteristics and georeferencing difficulty of specimens. Availability and quality of records contrasts across world regions. Uncertainty values are not normally distributed but peak at very distinct values, which can be traced back to specific regions of the world. Uncertainty leads to a wide spectrum of range sizes when modelling species distributions, potentially affecting conclusions in biogeographical and climate change studies. In summary, the digitised fraction of the world's NHC are far from optimal in terms of georeferencing and quality mainly depends on where the collections are hosted. A collective effort between communities around NHC institutions, ecological research and data infrastructure is needed to bring the data on a par with its importance and relevance for ecological research.

Specimen Data Refinery - A novel approach to automating digitisation

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(ID1)Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

There are two main rate limiting steps in mass digitisation of natural history collections: 1) physical handling - the rate at which we can retrieve, select and prepare specimens for digitisation, then returning them to collections; 2) the extraction of data from images - either from the specimen itself or from its labels - e.g. measurements, transcription, georeferencing.

Over the past three years we have been developing the Specimen Data Refinery (SDR) to dramatically scale up the extraction of data from specimen images in an automated way that conforms to FAIR (Findable, Accessible, Interoperable and Repeatable) principles. The SDR uses a series of machine learning models, packed into modular tools, that perform semantic segmentation, optical character recognition, hand-written text recognition, barcode reading and natural language processing to identify labels, text lines, and named entities.

We present the SDR and an evaluation of its use in automating the linkage between specimens, their UIDs, and for related linked data like taxonomy, people and geographic names. We will discuss outstanding challenges and potential for future development.

Specimen Discovery through Community Science Efforts at the Botanical Research Institute of Texas

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The Botanical Research Institute of Texas Philecology Herbarium is home to almost 1.5 million botanical specimens from four distinct collections: Botanical Research Institute of Texas (Herbarium Code: BRIT), Southern Methodist University (SMU), Vanderbilt University (VDB), and the R. Dale Thomas Collection from the University of Louisiana at Monroe (NLU). These specimens are in various stages of the digitization workflow (image → label transcription → locality georeferencing), with label transcription being the greatest bottleneck preventing specimen discovery by the research community. Previous imaging efforts resulted in an excess of 81,000 images of North American specimens from the VDB collection uploaded to the TORCH Symbiota portal with only barcode identifiers accompanying specimen images. The award of a U.S. National Science Foundation Thematic Collections Network grant to digitize all Texas and Oklahoma specimens (TORCH TCN; torcherbaria.org) required the development of an efficient method to locate project specimens amongst these 81,000 images. Through the Crowdsourcing function within Symbiota, staff launched a virtual community science program to quickly add minimal data to these images, allowing easier discovery for specimens related to the TORCH TCN, for potential future grants, and researchers. Volunteers stayed engaged in the program through repeated training sessions, realistic timelines, and progress updates. A Google form allowed participants to easily submit questions and problems as they were discovered. The combined efforts of twenty volunteers and staff working asynchronously through the Dr. Kral's Treasure Chest crowdsourcing project resulted in all ca. 81,000 images searchable with scientific name, country, state, and county. The project was completed in nine months, and celebrated with a capstone event and gift recognizing the contributions of volunteers. The impact of this project was immediately noticed with requests from researchers via email regarding specimens involved in the project. The Herbarium now can prioritize the complete digitization of these specimen records as directed by research requests and funded projects, and apply this method to future community science transcription efforts.

Specimen-based model clade research and its implications for biodiversity conservation

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MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Collectively the herbaria of the world contain almost 400 million specimens that provide an unparalleled spatio-temporal record of plant biodiversity at a global scale over the past few centuries. The use of herbarium specimens has been central to our research focused on the woody angiosperm clade Viburnum (Adoxaceae, Dipsacales), a group of approximately 165 species of shrubs and small trees with an almost global distribution. In addition to conducting systematic research within Viburnum, we have been developing Viburnum as a model clade to study various evolutionary phenomena. Herbarium specimens have been central to our efforts by providing morphological, anatomical, phenological, genetic, and spatio-temporal distribution data that have yielded numerous discoveries with conservation implications. Our studies have resulted in species discovery and improved species delimitation, information on rarity, modeling of ecological niches, improved understanding of phenology, and data on regional phylogenetic diversity, to name a few. In this talk we will highlight specific examples of our research centered on species in the Americas and discuss the potential conservation applications of this work. More specifically, research on the Viburnum nudum complex has revealed the presence of a largely overlooked cryptic species on the North American coastal plain. Research on V. lentago and relatives has provided information on the importance of phenology for maintaining species boundaries and has provided information about phenological change over time. Niche modeling has revealed the presence of a glacial refugium in the southern United States that was used to predict previously unappreciated genetic diversity within the V. dentatum clade. Finally, research on Viburnum occurring in threatened neotropical cloud forests has revealed micro-geographic morphological and genetic diversity in the Oreinotinus clade. These findings have important conservation implications at this time of rapid global change and would not have been possible without herbarium specimens.

Specimens, tissues, DNA samples and permits: how databases can support comprehensive collection management.

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(ML2) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The demands and use of samples in collections steadily increase. At the same time, compliance measures, e.g., stemming from the Nagoya Protocol, require us to keep samples well documented and linked with permits. Standardising workflows is essential for modern collections management, not only to keep use of samples documented. However, if recalibrations of workflows and processes are needed to keep permits organised and connected with tissues, DNA samples and corresponding vouchers for joint research or major sequencing projects, this often is perceived as a burden or challenge. In fact, both is closely connected and not only is required for comprehensive collection management, but also key for redesigning databases to support the work of collection staff at an early stage to improve collection management.

State of the Arch: The recent removal, conservation, 3D scanning and reinstatement of the large 135-year-old 'double' whalebone arch located in The Meadows in Edinburgh, UK.

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Edinburgh's famous double whalebone arch comprising four huge bones made from the lower jaws of two very large baleen whales originally formed part of a stand manned by the Shetland and Fair Isle Knitters at the International Exhibition of Science and Art which took place in Edinburgh in 1886. The knitters gifted the arch to the city after the exhibition and it became a well-loved local landmark in 'Jawbone Walk', one of the entrances to the park known as The Meadows. However, after withstanding the Scottish weather for over 130 years without protection but with occasional repairs, they had deteriorated to the point that they were no longer considered safe to walk under. Large areas of bone had rotted away or fallen out, as had some old repairs. The four bones – all about 6 meters long and weighing around a quarter of a ton each - were carefully removed and allowed to dry out, and then were assessed, cleaned, consolidated and repaired with a bespoke lime mortar (including NHL2 lime that would ensure the fills were breathable and relatively flexible). After conservation work was complete each bone was 3D scanned in detail before being given protective coats of casein-infused limewash. The scaled 3D digital models of the bones were particularly useful for designing the new supportive metal armature that will hold the bones securely in place when they are reinstated. Just as importantly, the digital 3D models will be useful for conservators in the future to assess the degree of degradation of the bones from weathering compared to the point in time when the scans were undertaken, after the conservation work was completed. In due course, these scans could even allow the bones to be replaced with identical replicas to save the original specimens, either by 3D printing them in a suitable medium, or by being cast in bronze. The conservation work had to take into consideration the large volumes of bone loss, how different materials would respond differently to constantly fluctuating environmental conditions and how the bones would be moved and handled, considering their large size and weight.

Stay on top of permits, MATs and MTAs – collating sample and legal information with existing data management systems in compliance with legal requirements. The GDM at MfN – a case study.

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G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

Not only the Nagoya Protocol for Access and Benefit Sharing (ABS) requires to file and sometimes transfer legal and sampling information associated with collection specimens – other regulations also result in specimen related paperwork and information that needs to be securely filed in relation to the respective specimen. These may include files such as documents on species protection, collecting permits, invasive sampling protocols and other specimen specific information. So far, there is hardly any ready-made collection data management system that supports documentation in alignment with national and foreign laws on ABS or other legal framework and that is capable to associate these and other records such as media files, research activities and the related (meta)data.

The Generic Data Module (GDM), a software developed in the DFG funded project German Federation For Biological Data (GFBio; <https://gfbio.org>), was designed and implemented by the Museum für Naturkunde Berlin (MfN) in order to overcome some of these challenges. Originally developed to accommodate additional (meta)data that does not fit in static data models of collection management systems, GDM enables proper documentation of ABS related information. It was developed as a component of the modular DINA system ("DIGital information system for NATural history data", <https://dina-project.net>) along the lines of various use cases such as adding research data to specimen records or gathering metadata from digitization processes. The GDM bridges the gaps between administrative demands on the implementation of ABS regulations and the data model of collection management systems. In fact, this online tool is so flexible that it not restricted to a collection environment but could be used as a standalone tool in diverse contexts of metadata and research data management.

In an MfN case study, this presentation will introduce the GDM as

- (1) a versatile addition to collection management systems for metadata management in compliance with legal requirements as imposed by ABS regulations and others,
- (2) a metadata model relevant for the ABS documentation in connection with the existing collection management system at MfN
- (3) an illustration for GDM's flexibility in associating files, metadata and other information with existing data, e.g. specimens.

Strengths and limitations and of iNaturalist for plant research

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iNaturalist (<https://www.inaturalist.org/>) defines itself as an 'online social network of people sharing biodiversity information to help each other learn about nature', and it is likely the largest citizen science web portal of the world as it includes over 88 million observations of nearly 345,000 species produced by a community of almost 2 million users by January 2022 (for plants, about 36 million observations of nearly 128,000 species by 1,3 million users). The strengths and potentialities that explain the success of the platform are reviewed and include, among others, its easiness of use and low technical requirements (just a camera and internet connection are needed), immediacy (with the App installed on a mobile phone the observations are published instantly, linking the images taken with the GPS coordinates), open-access (released under a Creative Commons license by default), the possibility of interacting with other users (which allows, among other things, to be helped and to aid identification--crowdsourced species identification), artificial intelligence-aided identification (only for the App), versatility ('projects' can be created for certain species or regions or a certain time scale, which makes it a very useful tool for educational or Bioblitz-type projects), and the automatic incorporation of the 'validated' records (labeled as research grade) to GBIF, the main platform for biodiversity data on a planetary scale. Limitations of iNaturalist are also identified (e.g. lack of representative photographs for many observations, or the relatively high frequency of identification errors) with suggestions to fix them being finally provided.

Study of plants phenology from plants herbarium specimens by machine learning algorithm

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MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Many scientific initiatives rely on data found in natural history collections. Large databases are being generated from these collections as a result of recent initiatives in mass digitization, which can provide new insight. We show how deep convolutional neural networks may be used to analyse photographed herbarium specimens in this paper. By extracting data from photographs of herbarium specimens—preserved plant material curated in natural history collections—machine learning (ML) has immense promise to drive scientific discovery, but ML techniques have only recently been applied to this rich resource. Plant phenological phenomena such as growth and reproduction have particularly bright potential for ML. Plant phenology is an important frontier for the application of machine learning techniques in science and society since it is a major indication of climatic change, a driver of ecological processes, and a critical determinant of plant fitness. We present a flexible, modular ML approach for collecting phenological data from photos of DD herbarium (Dehradun Herbarium) specimens in this paper. Machine learning is a good way to acquire vast amounts of phenological data from herbarium specimens in a quick and effective way. When paired with other data, such as spatiotemporal data collected from specimen labels during digitization, these data allow for the discovery of phenological patterns on previously unimaginable scales. Strategic research and investment in specimen-based machine learning approaches, as well as the aggregation of herbarium specimen data, could lead to a greater knowledge of life on the planet. In this paper, we created a machine learning (ML)-based software programme that allows us to visualise plant phenological patterns of DD Herbarium's in relation to spatiotemporal criteria.

Successes in utilizing museum collections and community collaborations to study the establishment of eastern fox squirrels in Utah

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(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The eastern fox squirrel (*Sciurus niger*) is natively distributed east of the Rocky Mountains in North America. This species was introduced in multiple places along the west coast of the United States nearly 100 years ago and has since become naturalized in urban environments elsewhere in the west. Most recently, fox squirrels appeared in Salt Lake City, Utah in 2011 and their population has continued to grow and expand across the Salt Lake Valley in northern Utah. While the source of this population remains unknown, it is evident that fox squirrels became naturalized in Utah's urban environments, which might displace established populations of two native squirrel species, the red squirrel (*Tamiasciurus hudsonicus*) and the rock squirrel (*Otospermophilus variegatus*). To examine the expanding distribution of fox squirrels, and explore questions about their impact on native fauna, the Natural History Museum of Utah (NHMU) is harnessing the power of citizen science to track fox squirrel distribution and their interactions with other squirrels in Utah. Using nearly 2500 observations made by members of the community we have tracked the distribution of fox squirrels across the valley over the past 10 years, as well as documented their behavior and interactions with native squirrel species. Observational data are supplemented with specimens collected and donated to NHMU collections. Combining observational data and voucher specimens unlocks the potential for additional areas of research, such as examining population genetics or morphological features that could reveal the source from which the Utah population originated. Citizen science can be a powerful tool to both engage the local community and supplement traditional vouchered specimens, allowing us to rapidly build a large dataset to study how a non-native species becomes established and their potential impact on urban ecosystems.

Symbionts with Secrets: What We Have Learned from Avian Feather Mites

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In the Boves Lab at Arkansas State University, USA, we have continued to develop our studies of feather mites (Arachnida: Acariformes: Analgoidea and Pterolichoidea) associated with passerine bird hosts. By collecting mites from birds in the field primarily during the host breeding season and migration, we have been able to describe new feather mite species, explore aspects of their life history (e.g., life span, diet), and assess their symbiotic relationships with their hosts (e.g., associations, consequences on hosts). We have used wet, slide-mounted, and living feather mite collections as well as host specimens to conduct our research projects. This work has allowed us to explore this symbiosis at multiple levels, including the individual (e.g., feather mites' relation to host condition/physiology, contextual mediation of mite abundance), population (e.g., mite evolution and speciation), and species (e.g., mite-host associations and host specificity) levels. Our studies provide insight into the mechanisms underlying the feather mite-bird symbiosis, as well as other symbioses involving tightly associated organisms more generally.

Synthesys+ Virtual Access projects at the Museum für Naturkunde Berlin – data, experiences and outcomes

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(VA1) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The Synthesys+ Virtual Access (VA) program is a European funded pilot scheme based on the model of Digitization on Demand. Researchers propose a project that utilizes digitization of collections or collection objects by the holding institutions for the wider benefit of the community. A successful VA proposal means that participating organizations will receive SYNTHESYS+ funding to digitize their own collection via their own workflows.

Museum collections represent a huge, untapped resource of information on the distribution and life histories of animals. To record this information and make it widely accessible will help researchers address questions that are concerning biodiversity, extinction, conservation, global health etc.

The Museum für Naturkunde in Berlin (MfN) participated in two projects funded in Call 1 that aided these vital questions and helped create a “COVID-19 Chiropteran knowledge base” as well as supported “Data mobilisation for IUCN conservation assessments of global freshwater bioindicators”.

Here, bats of the families Rhinolophidae but also the phylogenetically most closely related families Hipposideridae and Rhinonycteridae were digitized in a standardized way across all nine participating European institutions hoping that this knowledge base will support future virus studies.

To support IUCN conservation, insects of the orders Ephemeroptera, Plecoptera and Trichoptera were photographed and cataloged for the first time at MfN as these freshwater invertebrates play a vital role as standard indicators of water and habitat health.

This year’s funded projects will see the digitization of fossil material at the MfN in a project called “Harmonizing verbatim names in digitized collections – the Krantz material as a model” as well as the creation of a “Bryozoa Identification Tool (BIT) for Quaternary and Recent Mediterranean and North Atlantic Bryozoans”.

This presentation will introduce these projects; share its results as well as workflows, experiences and lessons learned along the way.

Tackling Pests in the Public Eye – Procedure for Removing Mold and Dermestids from Herpetology Skeletal Specimens

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G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

From insects and decay to fluctuating light and humidity levels, natural history collections face a slew of risks that can damage specimens and decimate collections. Preventative measures (i.e., proper specimen storage and frequent observation and maintenance of specimens) can mitigate some risks, but how do you tackle and eliminate issues, particularly biological ones, once they arise?

When reorganizing and inventorying the osteological collection in the section of Amphibians and Reptiles at the Carnegie Museum of Natural History in summer of 2021, section staff discovered dermestid frass, molts, and carcasses in the specimen boxes, as well as inactive mold on nearly every skeletal specimen. In collaboration with the museum's conservator, we created a standard operating procedure to strategically address the issue and thoroughly clean the bones and specimen boxes. Fortunately, no living pests were discovered in the specimen storage containers, suggesting that the remnants were residuals from initial specimen preparation. Regardless, pest parts were saved for future identification by the curator of Invertebrate Zoology. The skeletal specimens also varied in size and fragility, requiring various techniques to ensure all mold was successfully removed without damaging the specimen. This was an excellent opportunity to use a publicly visible lab space (as opposed to a space behind the scenes in the collection) to clean the specimens, allowing the public to see the process and interact with section staff and work-study students. This collaborative and publicly visible effort enabled us to explore and determine the best methods to clean and preserve osteological specimens and to establish procedures to improve collection spaces and mitigate the establishment of future risks.

Taking Up Space: The Sedgwick Museum's co-curated Community Cabinet

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(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

The Community Cabinet programme challenges stereotypes and preconceptions of a historic University Museum by inviting local people to display their geological collections and share their interest in Earth Sciences with museum visitors.

Built in 1904 to house the University of Cambridge's geological collections, the Sedgwick Museum of Earth Sciences holds over two million specimens from around the world. Its historical collections contain familiar names in European Earth Sciences from the last two centuries and draws on the scientific expertise of the University of Cambridge's Department of Earth Sciences. The Museum is a member of the University of Cambridge Museums consortium (UCM).

The Museum actively welcomes diverse audiences, striving to break down barriers to Earth Sciences and challenging stereotypes within the Earth Science and Museum sectors. Since 2015 the museum has co-curated displays with people from the local community to contribute to making it a more welcoming, relevant, inclusive, and democratic space.

Involving contributors throughout the exhibition process, from loans documentation to label writing and installation, both empowers them and helps demystify many aspects of museum practice. It also encourages the Museum to reflect and revise these practices to facilitate broader accessibility and participation.

The lockdowns and intermittent nature of reopening during the Covid-19 pandemic shifted our focus for community cabinets. The latest Community Cabinet 'Gravel Hunters' was developed from an online resource of the same name, produced to encourage families to get outside and explore their local area for fossils in gravel driveways and car parks.

We have found that valuing communities and embracing their relationships and experience with Earth Sciences has created mutually beneficial experiences for both those communities and the Museum. The displays decentralise and diversify the voices present in the gallery, and allow the contributors and museum staff to connect in unique ways, creating new possibilities and opportunities.

Relationships formed through the community cabinets have organically created a community of people who feel a sense of belonging to the museum through volunteering, repeat visits, and regular exchanges on social media. We aim to develop and sustain these relationships through the introduction of a community cabinet alumni network.

Taxa proposed by Pourret based on the specimens conserved in Salvador Herbarium (18th century)

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The Salvador Herbarium (17th–18th century) is the oldest and best-documented pre-Linnaean one in Spain and consists of 4,960 plant sheets collected by the brothers Joan and Josep Salvador and their father Jaume, or acquired by exchange with important contemporary botanists such as Boerhaave, Tournefort, Antoine and Bernard de Jussieu, Petiver, Magnol, Nissole, Triumfetti, Vaillant, Garelli, and Garidel. Its labels bear pre-Linnaean names used in the works of Tournefort, Bauhin, Lobel, Dodoens, Magnol or Clusius, among others.

Around 1782, the collection was revised for the first time by Pierre André Pourret (1754–1818), a French clergyman who lived in exile in Spain at Santiago de Compostela from 1789 until his death. Pourret added the Linnaean name of the species to the labels of the collection and, in some cases, took out duplicates for his own herbarium, now conserved in MAF as an independent historical collection. In addition, he sent some of these specimens to Lamarck in Paris and to Willdenow in Berlin, which are now preserved in the P and B-Willdenow herbaria, respectively.

Pourret described some taxa based on the specimens of Salvador Herbarium as new species under the Linnaean system. Nevertheless, he also proposed other taxa on the labels of the Salvador Herbarium that had never been described anywhere. In this study, we have identified all names proposed by Pourret on labels of this herbarium—including those validly described and published and those not described anywhere—in order to clarify the revisions made by this botanist and elucidate the history of the herbarium during the 18th century. Research has included the study of the protologues of these names, papers including information about the typification of these taxa, online taxonomic databases and for the pre-Linnaean nomenclature, we used the Codex Botanicus Linnaeanus (Richter, 1835–1839).

Taxidermy Vertebrate Specimens at the Natural History Science Museum of University of Porto (MHNC-UP) and the need of an Illustrated Glossary for the Conservation Assessment

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G9: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

Taxidermy specimens allow researchers to study the morphological characteristics of different animals and provide important data to taxonomy, systematics, or evolutionary biology studies. These specimens can also engage the public with the natural world through exhibitions and educational activities.

The Natural History and Science Museum of the University of Porto (MHNC-UP) house historical collections of taxidermy specimens, collected from the mid-nineteenth century to mid-twentieth century. During the last 100 years these specimens have experienced various situations of deterioration and damage as a result of incorrect/improper handling, storage, display and research uses.

As a case study, we conducted a conservation assessment of approximately 500 specimens from various vertebrate collections (fish, amphibians, reptiles and mammals). Afterward we applied standard terminologies and definitions to describe the type of materials used in the mounting processes (filling, internal structure etc.), and the pathologies associated with the degenerative process of the specimens. All specimens used in this study were photographed in order to be used as part illustrated glossary addressing the main pathologies associated. This presentation will present some of the main problems we identified.

TaxonWorks: A User's Perspective: Digitizing a specimen start to finish

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(DC) DemoCamp - A live demonstration of software and applications relevant to the management, analysis, dissemination, and use of natural history collections, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

In this TaxonWorks (TW) digitization workflow demo, I will demonstrate the complete image to digital collection object workflow for an insect specimen. Prior to using TW, data was stored across multiple databases including FileMaker and Microsoft Access which required a lot of effort to coordinate and update. Using TW, I will show how to quickly pull in an image or set of images and then transcribe and parse out all the information. Highlights of this demonstration focus on such features as "soft validation" enhancing both data quality and completeness, and verbatim label "buffered" fields to store primary raw data permanently. It is also important to note that in TW, anyone can customize both the data captured and fields presented in the TW User Interface to speed data entry; and that some data, like people information, is shared across projects so that reducing duplication of effort where possible is also built into the TW model.

Teaching natural history remotely: what did we learn, what should we keep, and what can we do better?

Ms Stephanie Holt¹

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In 2019 I was building a new training programme for the Natural History Museum, developing on from the success of our previous Identification Trainers for the Future programme. And then, of course, the pandemic hit, just as we were about to launch the programme in 2020. Like many other training deliverers, particularly those of us who teach primarily with collections or specimens, this created a huge dilemma - wait until the pandemic ended (surely only a few weeks!), or try to see if there were some way of reaching out to people wanting to engage in nature. Watching people wanting to start to understand the wildlife they were suddenly observing all around them in their gardens or from their windows, it was clear that waiting this out wasn't an option, everyone wanted to know what they were finding, and those of us already committed to field natural history were, to be fair, slightly climbing the walls looking for new avenues to develop our skills further. But how on earth does one deliver specimen-based training online? Without that connection to either collections in the lab or specimens in the field? In this talk I'll share how we tackled this problem, developing skills previously unknown in this ecologist at least (video editing was certainly not something previously on my CV!) to create the online Introduction to UK Natural History Course. We'll also look at what we learnt, what our students had to say, what others are doing, and what we'll be taking forward as we find ourselves not just hybrid working, but hybrid teaching in the future too.

Teaching specimens: masterpieces of preparation and their problematic histories.

M.a. Fabian Neisskenwirth¹

¹*Restaurierung und Konservierung naturhistorischer Sammlungen, Mülheim an der Ruhr, Germany*

(NW1) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Teaching specimens have had an important role in German natural history museums. They were part of the first exhibitions and served as important representatives of nature during the latter part of the 19th century. Their significance is not only because of their didactical arrangements, but in their functional nature that was understood and dominated by humanistic representation. As a result of the German Reich goal to indoctrinate its civil population and teach the basics of natural sciences (“Naturkunde”) a flourishing market developed for companies specializing in the manufacture of these artifacts in cities such as Berlin, Halle (Saale) and Prague. Names of manufacturers such as Linnaea, Schlüter and Frick, can be found in almost all collections of Europe, showing the influence these displays of nature in the education of modern western society. The production of fluid preserved specimens resulted in many improvements in preparation techniques, including unique colorful injection methods, extremely delicate preparations of nerves and cardiovascular systems, and the arrangement of specimens in lifelike habitats, all in jars that were sealed so tightly that many can still be found in a good state of preservation today. But behind all this technical expertise lie hidden stories of vivisections, a market for human remains, and the uncontrolled hunting of species on the edge of extinction. This presentation will highlight some of these fluid preserved specimens that can be found in our collections, showing their relevance for natural history collections, preparation techniques, and the need to dig into the stories of their manufacturers for dignified display and preservation.

Testing An Alternative Shelving Arrangement to Optimize Space and Task Efficiency in a Fluid Fish Collection

Adam Cohen¹, Dean Hendrickson¹, Melissa Casarez¹

¹*University Of Texas At Austin, Austin, United States*

(ML1) Managing Long-Term Sustainability in an Uncertain Future, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

For centuries, a taxonomic and alphabetic arrangement (TAA) of objects on shelves prevailed in fluid-preserved natural history collections while they were managed mostly by scientists for their own or visitors' on-site research using physical specimens. However, most modern collections are now databased and internet-accessible, facilitating diverse forms of research accomplished remotely and decreasing the frequency of need for physical access to specimens, yet the way specimens are shelved and accessed remains nearly universally unchanged. With our fish collection struggling with both severe space limitation and unprecedented rapid growth supporting externally funded research that requires rapid specimen processing and data publication, we started shelving in an object (jar) and catalog number-based arrangement (OCA). To make that possible in our limited and near-full space, without altering our physical shelves in any way, we eliminated all between-jar spaces in our collection, including the customary space between taxa, while keeping it in its original TAA-based order (thus eliminating TAA-based growth capacity). In the resultant empty shelf space, we implemented an OCA shelving system for all newly cataloged jars. Once the OCA contained a relatively large number of jars, we carried out pragmatic, TAA-OCA comparisons. Volumetric jar storage capacity in the OCA is 17% > TAA, and adjusting the OCA's vertical shelf spacing to optimize for each of our 3 jar sizes (impossible in the TAA), could increase that to 115% > TAA. Ten of 15 routine staff tasks were more efficiently accomplished in the OCA than in the TAA, and the OCA greatly decreases shelving errors (misplacement). We discuss ways to improve efficiency in the OCA for the 5 tasks on which the TAA out-performed it, and report ancillary, unanticipated benefits, such as a way to much more efficiently and quickly monitor fluid levels across all jars. All newly cataloged specimen jars continue going into our OCA, and we have significantly postponed hitting the point of absolutely being unable to continue growing. We are hopeful that eventually, a move to a new space will enable conversion of the entire collection from TAA to a more fully-optimized OCA.

The "Museo Giovanni Capellini": a case study on how to drive a Nineteenth Century geological collection to modern times.

Dr Michela Contessi¹, Prof. Roberto Barbieri^{1,2}

¹Collezione di Geologia "Museo Giovanni Capellini" - University of Bologna, Bologna, Italy, ²Department of Biological, Geological, and Environmental Sciences - University of Bologna, Bologna, Italy

The "Museo Giovanni Capellini" is part of the integrated museum system of the University of Bologna (SMA - Sistema Museale di Ateneo). The museum, hosted in an 18th-century building, includes a bulk of 16th-century geological and paleontological collections dating back to one of the oldest Natural History Museum, created by Ulisse Aldrovandi in 1556. Most of the two million specimens now hosted in the museum, though, were acquired by the geology professor and rector of the Bologna University, Giovanni Capellini (1833-1922). Capellini dedicated his long life to the creation and implementation of his museum, which, by the beginning of 1900 hosted one of the most important paleontological collections in Europe. After his death little was done for the museum, and in the early 1960s, when the new-born Institute of Geology and Palaeontology was built, the museum was literally cut in half and the collections crowded in half the original space. Structural issue arose due to this moving, and the museum was closed to the public for almost 30 years.

Nowadays the museum, with its antique furniture and popular fossils, such as the iconic Italian skeleton cast of *Diplodocus carnegii*, is a popular touristic attraction in Bologna. Nevertheless it still has relevant issues related to the overcrowded specimens in the showcases. Here we present some possible solutions on how to reduce the museum overcrowding by moving part of the collections in a ad hoc repository, thus maintaining a balance between modern exhibitions, new technologies applied to public engagement and the historical layout of its rooms. In other words, to preserve its most peculiar feature, that of being a real "museum in a museum".

'The Art of Observation of things': Agostino Scilla's (1629-1700) fossil shark-toothed dolphin (*Squalodon melitensis*) jaw from the Woodwardian Collection at the Sedgwick Museum of Earth Sciences, University of Cambridge

Mr Dan Pemberton¹

¹*Sedgwick Museum Of Earth Sciences, University Of Cambridge, Cambridge, United Kingdom*

In 1670 Renaissance artist Agostino Scilla published an illustrated book concerning the nature of fossils. *La vana speculazione disingannata dal senso (Vain Speculation Undeceived by Sense)*, is widely accepted as being the first accurately illustrated book arguing an organic origin for fossils.

During the late 17th and early 18th century, the question whether fossils were the remains of living organisms or were 'Jokes of Nature' spontaneously generated within the ground, was a matter of debate. Scilla, previously interested in the study of ancient 'medals', mostly Roman coins, switched his interest to fossils. Through observation, experimentation and dissection, he came to the conclusion that fossils were the remains of living organisms.

Scilla illustrated his book with carefully selected specimens that supported his arguments. One of these is a piece of rock from Malta containing a fragment of jaw-bone with three teeth. He used this to counter the argument that the fossil shark teeth, or 'tongue stones' of Malta, were produced through a process of spontaneous generation. His dissection of shark jaws demonstrated that the teeth are embedded in connective tissue that would decay and release them after death, increasing their chances of dispersal. This specimen clearly showed a piece of jaw from an animal whose teeth had roots embedded in sockets within the jaw-bone. The isolated occurrence of shark teeth as fossils was therefore a matter of dispersal rather than spontaneous generation.

In 1717 English physician Dr John Woodward (1665-1728) bought Scilla's collection and the drawings he had made for his book. The collection comprises about 300 shells and bones of modern and fossil sea creatures. Dr Woodward's collection was acquired by the University of Cambridge after his death in 1728. It is rare for a collection from this period to remain intact, particularly one that can be associated with a figured publication. Specimens such as this are important for those interested in the history and philosophy of science, or the intersection between material and visual culture in the early modern period. Early illustrations such as this also have practical use in contributing to the condition history of an object.

The Beinn Bhreac Boulder

Ms Emily Brown¹

¹*National Museums Scotland, Edinburgh, United Kingdom*

The remains of Scotland's most famous mineral boulder – the Beinn Bhreac Boulder - sits proudly at the end of the Earth System Collection of National Museums Scotland. Found by renowned Scottish mineralogist Matthew Forster Heddle, it is the source of nearly 20 different minerals, including the first example of the feldspar amazonite to be found in Scotland. Once part of a pegmatite vein cutting through the nearby Ben Loyal nordmarkite intrusion, the unique mineralogy and history of the Beinn Bhreac Boulder makes it an excellent focus for outreach projects, and it recently featured in our first online exhibition, hosted by therock.show.

The Biodiversity Heritage Library as a platform for connecting natural history materials

Mr. Joseph deVeer¹, Ms Diane Rielinger²

¹Harvard University Ernst Mayr Library and Archives of the Museum of Comparative Zoology, Cambridge, United States,

²Harvard University Botany Libraries, Cambridge, United States

RE) Reflections on the Biodiversity Heritage Library: Value in Collections and Collaboration (, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Biodiversity specimens are a critical component for understanding the natural world. Knowledge is enhanced when researchers have access to related materials such as field notes, correspondence, identifications, published papers, genomic sequences etc. (Lendemer et. al. 2020). The Extended Specimen Network initiative (Webster, 2017) proposes to take advantage of computing and digitization to make these additional pieces of specimen information available to scientists at their fingertips. Researchers interested in archival materials such as field notes and correspondence would no longer have to travel long distances to access materials from various collections around the world.

The Biodiversity Heritage Library (BHL) provides a platform for some of the pieces of an extended specimen to be discoverable, accessible, and connected. Harvard University's two natural history libraries, Ernst Mayr Library and Botany Libraries, maintain separate archival collections and put open access digital versions of archival materials into the BHL platform. In this presentation, case studies will focus on ways the BHL platform enables researchers to connect archival materials related to William Brewster and Walter Deane whose archival collections reside in separate libraries. Additionally, examples will be shown of how BHL can be used to connect archival materials from Harvard University with related items in other repositories around the world and to specimens within the Harvard University Museum of Comparative Zoology specimen database.

References:

Lendemer, James, Barbara Thiers, Anna K Monfils, Jennifer Zaspel, Elizabeth R Ellwood, Andrew Bentley, Katherine LeVan, et al. "The Extended Specimen Network: A Strategy to Enhance US Biodiversity Collections, Promote Research and Education." *BioScience* 70, no. 1 (January 1, 2020): 23–30.

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Webster, Michael S. *The Extended Specimen: Emerging Frontiers in Collections-Based Ornithological Research*. CRC Press, 2017.

The Bryophyte collection of the Botanical Institute of Barcelona: specimens from Catalonia (Spain) and applications in conservation

Miss. Alba Martín¹, Mr. David Pérez Prieto¹, Mrs Neus Nualart¹

¹*Botanical Institute of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain*

The Botanical Institute of Barcelona preserves an important collection of bryophytes with more than 7000 specimens conserved in 127 boxes. Most of this collection comes from the exchange of material with other European herbaria, but it also includes material from the Iberian Peninsula collected by prominent bryologists such as Creu Casas (1913-2007), a pioneer in the study of bryology in Catalonia, or Josep Vives (1931-1993), expert of the bryophytic flora of Catalonia and the Balearic Islands. Although the collection is fully organized alphabetically by genus and species, it was not digitalized. In the present work, a review of all the boxes has been carried out in order to inventory the specimens from Catalonia (Spain). The tasks carried out have included the assignation of a catalogue number for each sample and the photograph of the label, from which a taxonomic thesaurus has been prepared and later all specimens have been computerized.

The objectives of this work have been: (1) to carry out an analysis of the Catalan material, identifying if the content is representative of the taxa that we find in Catalonia and detecting which is lacking in order to establish new collection strategies and donations to enrich the collection, (2) to characterize the collection from a taxonomic, temporal and geographic point of view, highlighting the characteristics that make it more significant and (3) to enhance the value of this collection as a repository of biodiversity by evaluating threatened taxa according to the red list of bryophytes in Catalonia.

The challenges of the preparation, display and subsequent conservation of the world's largest leatherback turtle specimen.

Mr Julian Carter¹

¹*Amgueddfa Cymru National Museum Wales (UK), Cardiff, United Kingdom*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The leatherback turtle on display at National Museum Cardiff was washed ashore on a beach in North Wales in September 1988. Sadly, the turtle had drowned after being trapped by fishing lines. The turtle attracted worldwide attention as it was the largest and heaviest turtle ever recorded, measuring almost 3m (9ft) in length and weighing 914 kilos (2,016 pounds).

The Museum was keen to exhibit the turtle. However preparing such a specimen for display was not straight forward. After undergoing an autopsy for scientific information, the specimen was prepared using taxidermy techniques. The skeleton was also removed and prepared for display alongside the body. In 1989 the taxidermy mount and associated skeleton were then put on display in their own gallery, with linking displays on the leatherback's history, threats, ecology and conservation.

Within a year significant cracks and other issues started to affect the specimen which were patched up in a variety of ways, but after a further 15 years on display, significant damage was again occurring to the specimen due to multiple factors. Extensive conservation work was carried out to remove the old repairs and carry out more museum appropriate conservations treatments, and the specimen was moved to a better display location.

However by 2020 cracking and distortion was again affecting the specimen. These were now know to be due to a combination of the taxidermy method used and ongoing environmental issues, primarily low RH. With the galleries shut due to the Covid pandemic the opportunity was taken to take a new conservation approach that took into account these issues, and the specimen was fully conserve the in-situ.

This specimen spot-light talk will explore the journey of preserving, conserving, and displaying this special and highly popular specimen.

The Chiapas Maya Project - an Update

Ms. Lori Benson¹, Ms. Helena Rojas²

¹Independent/Chiapas Maya Project U.S., Bath, United States, ²Independent/Chiapas Maya Project Mexico, Comitán, Mexico

G2: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The Chiapas Maya Project was first conceived to create a virtual archive of the material culture of the Highland Maya of Chiapas, Mexico. The archive includes objects, images, recordings, and written records to document a rapidly changing culture. The project's scope has changed over the four years. Several events have happened in the past two years, including the deaths of two principal partners, a global pandemic, and the change in perception of how we could engage with indigenous communities.

As of January 2022, CMP is reconsidering what this project could become. Working together with old and new partners, the project leaders will help define smaller projects to build into a larger goal. Each group will determine their project, build a budget, and move forward when funding is available. New partners in Mexico are being identified in collaboration with museums, collectors, and community groups. Local partners are involved with CIPRI, Cultural Intellectual Property Rights Initiative (<https://www.culturalintellectualproperty.com>), to translate and disseminate the 3cs' rule of consent, credit, compensation, and socialize the concepts with indigenous communities.

A project now underway is the design and production of a small book or librito using the skills of the staff and photographers of the Chiapas Photography Project (CPP). The librito will be used for fundraising and marketing.

CMP will use Mukurtu (<https://mukurtu.org/>) for collections not currently digitized. The database structure will be ready by the end of March 2022. It will be accessible on the website www.chiapasmayaproject.org, currently under development.

The project will focus on training in collections management and preservation techniques so local museum personnel and indigenous community members can administer and care for their collections. We hope to establish connections with collections and conservation communities worldwide.

CMP continues to face problems with the lack of infrastructure and equipment, technical support, and funding. The Mexican Project Lead is pursuing non-profit status to enhance our fundraising possibilities.

The Chiapas Maya Project is moving slowly, but with that has become more inclusive. The project has shifted to focus on the needs of the indigenous communities and our museum partners.

The design and fabrication of a lightbox for use in the imaging of herbarium specimens

Miss Sally King¹, Miss Robyn Drinkwater¹

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

With the expansion of the digitisation programme in the herbarium of the Royal Botanic Garden Edinburgh (RBGE), we needed to establish new and portable imaging stations. The use of a lightbox rather than an open copy stand set-up allows for imaging to take place within the collection space. If necessary, it can be moved to a new site within the collection building, reducing the distance specimens need to be transported. Lightbox availability for imaging herbarium specimens has been very limited. The MK Digital Direct Photo-eBox Bio widely used in US herbaria has been discontinued. There was hope that an alternative lightbox designed by Oat Foundry LLC for the Mid-Atlantic Megalopolis Thematic Collections Network (MAM TCN) would be available for purchase by other interested parties but after prototypes were developed the lightboxes did not go into production. The Consortium of Pacific Northwest Herbaria use the commercial product photography lightbox Ortery Photosimile 50, however the ability to control brightness and uniformity of light is limited.

We reached out to various fabricators with a maximum budget of £5,000 per unit with requirements and specifications informed from our own experience and that of MAM's fabrication experience with the Oat Foundry LLC. Essential requirements included: a light source with a high CRI value and colour temperature close to 5,000K that emits negligible amounts of heat, and flicker free the dimmer units. This poster details the specifications, requirements and resulting lightbox design created by the local fabricator Stoane Lighting and design adjustments for future units.

The Durfort Mammoth at the Muséum National d'Histoire Naturelle, Paris : a Specimen that accounts for 150 Years of Restoration Practices

Professor Veronique Rouchon¹, Dr Alice Gimat¹, M. Vincent Pernegre³, Mrs Christine Argot², Mrs Cécile Colin-Fromont⁴, Pr Gael Clément²

¹*Centre de Recherche sur la Conservation (CRC UAR3224), Muséum National d'Histoire Naturelle, CNRS, MC, Paris, France,* ²*Centre de Recherche en Paléontologie (CR2P UMR7207), Muséum national d'Histoire naturelle, SU, CNRS, Paris, France,* ³*Direction Générale Déléguée aux Collections (DGD-C), Muséum National d'Histoire Naturelle, Paris, France,* ⁴*Direction Générale Déléguée aux Musées, Jardins botaniques et parcs Zoologiques (DGD-MJZ), Muséum National d'Histoire Naturelle, Paris, France*

G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The Durfort mammoth (MNHN.F.DUR1022) belongs to the species *Mammuthus meridionalis* and is named after his place of discovery (Durfort, Gard, France). It is one of the largest mammoth fossils known in the world and constitutes a masterpiece of the paleontology gallery of the Muséum National d'Histoire Naturelle, Paris (MNHN). The specimen was excavated between 1869 and 1873 and transported from Durfort to Paris where it was first assembled in 1873 in the "giraffe room" of the comparative anatomy laboratory, MNHN. In 1885, it was moved to the Albert Gaudry's museum. In 1898, it finally joined the Paleontology gallery for the inauguration and is still exhibited there. Since its excavation, the skeleton, that was highly fragile, has undergone numerous consolidation treatments, in order to enable his handling and mounting. It is today in poor condition : some parts of the pelvis have broken off; many cracks have appeared; the bones are dark, due to dust and ageing of consolidation materials, etc.

This talk will present an ambitious program initiated at the MNHN to improve the preservation of the specimen, the first step of which consists in establishing a conservation report. A pre-restoration study was conducted in February 2021 in order to pinpoint the different types of alterations visible on the specimen. Several sorts of filling materials and adhesives, with varying UV fluorescence properties, were observed on the mammoth broken pelvis. These materials were sampled and analysed using infrared spectroscopy and gas chromatography . Beeswax, plaster (gypsum), gelatine, pine resins, and polyacrylates resins were detected. This preliminary work gives a better insight into the history of preparation techniques used at the MNHN over a period of approximately 150 years.

The End of the Beginning: When the Risk Assessment is Completed....

Conservator Gretchen Anderson¹, Collection Manager of Mammals Suzanne B. McLaren², Collections Associate Marion A. Burgwin³

¹*Carnegie Museum Of Natural History, Pittsburgh, United States*, ²*Carnegie Museum Of Natural History, Pittsburgh, United States*, ³*Carnegie Museum Of Natural History, Pittsburgh, United States*

In 2017 Carnegie Museum of Natural History (CM) received funding from the Institute for Museum and Library Services (IMLS) to conduct a collection risk assessment. Having already completed two general conservation surveys (1989, 2010) and an environmental survey (2011), each funded by IMLS, the next logical step was a risk assessment.

We worked with R. R. Waller, Protect Heritage Inc., who has a longstanding relationship with CM, dating to the 1989 and 2010 surveys. Waller is an experienced subject matter expert. His Cultural Property Risk Analysis Model (CPRAM) seemed the perfect means of risk assessment for our museum.

Our overall goal was to identify risks to the collections in a quantifiable manner by completing a workbook that documents hazards in each collection unit. The risk assessment workbook links data to the CPRAM. With results compiled, our plan is to prioritize the identified risks and develop reasonable strategies to reduce them, as part of the overall strategic plan currently being developed. Having included a few non-collection staff, the risk assessment serves to promote better understanding and communication of collection concerns across the museum and our parent organization.

After intensive data collection from 30 collection units, covering 22 million specimens/objects; completion of data analysis for individual units; review of unit reports by the Project Manager, Gatekeeper, and collection unit staff; documentation of responsibility for future oversight of each category of risk; and organization of all data into a comprehensive report, the grant project is completed.

The project took just over three and a half years to complete, due in part, to the pandemic. We experienced staff attrition since the beginning of the project, which included administration, exhibition and collections personnel. With these changes, it is a happy coincidence that the final report provides both information on identified risks as well as deep documentation for every collection unit, that will be invaluable to new staff.

This poster reviews the project and incorporates the results of the final report. It takes a critical look at our successes, challenges, and how the culmination of the project will become part of the next strategic plan.

The first stage digitisation standard: What are MIDS-1 and MIDS-1i and how do you use them?

Dr Elspeth Haston¹, Ms Caitlin Chapman²

¹Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom, ²Florida Museum of Natural History, Gainesville, United States of America

(MI) MIDS - A digitisation standard for natural history collections, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Digitisation is one of the biggest priorities facing Natural Science Collections at present, but the word digitisation is a broad term that has different definitions for people. Describing the level of digitisation of specimens in our collections sits at the heart of developing a digitisation programme and ensuring that the digital specimens are fit for purpose for the users.

The development of the Minimum Information about a Digital Specimen (MIDS) standard aims to provide this level of information for the specimens in our collections. The definition of digitisation used within the MIDS standard is the process of making physical objects digitally available in terms of data and/or images. Several 'levels of digitisation' (0-3) represent a simple categorisation of the type and depth of digitisation achieved. A specimen digitised at each level may or may not have an image attached, with the presence of an image indicated by the suffix "i". Each MIDS level has been identified as a generalised stage in the digitisation process, including mass digitisation programmes.

MIDS Level 1 (MIDS-1) is a basic level of information about a specimen and would frequently be the first stage of data capture in a large-scale digitisation programme. This stage of digitisation focuses on capturing a small amount of key information which are common to batches of specimens, whether in a folder, a drawer or other container. This allows rapid creation of a basic record, often called a stub, skeletal or minimal data record with a unique identifier. These records should provide a catalogue of the collection with sufficient information for the curator or researcher to be able to physically locate each specimen. When this basic information is combined with an image, MIDS-1i enables similar search and browsing capabilities online as researchers and curators would have at the cabinets of physical specimens.

The practicalities of implementing MIDS-1 within your institute are presented. The use of MIDS-1 within an institute and more widely are discussed and some use cases are demonstrated.

The fragility of frozen collections and the common and unique considerations for a large-scale collection move

Miss Kirsty Lloyd¹

¹*Natural History Museum, London, UK*

(MC2) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

By 2026 the Natural History Museum will move over 27 million specimens to a ground-breaking new centre for the study of natural history at the Harwell Campus in Oxfordshire. The centre will bring together collections vital to our understanding of environmental change. Part of this colossal move is to relocate the frozen collection of tissue, DNA and cell cultures housed in the Molecular Collections Facility at the NHM. Currently, the facility has the capacity to house over 2 million samples distributed across ultra-cold freezers and in liquid nitrogen tanks. The molecular collection contains samples from a wide range of taxa, and many samples have corresponding voucher specimens in the traditional collection (some of which are moving, but not all). We are now in the planning phase, during which we are drawing on the experiences and lessons learned from a wide range of people and institutions (both in the public and private sectors) to help us determine the most efficient way of preparing and transporting the collection. Many of the considerations we are tackling are universal across collections; investment in digitization, resourcing and reformatting collections to be moved, as well as metadata and location management. However, some considerations are unique to frozen collections, e.g., maintaining consistent ultra-low temperatures and electrical equipment capacities and redundancies. Relocation of the molecular collections to the Harwell site will offer greater connectivity to other departments spatially, as well as proximity to potential collaborating institutions, a huge increase in capacity for sample storage and improved access to the samples for researchers, both physically and digitally, by vastly increasing discoverability. This expansion is happening at a time when large-scale, national, and international sequencing initiatives (such as the Global Biogenome Project) are gaining momentum. Museum collections are a valuable source of genetic material for important projects, but destructive sampling of traditional collections does not always provide the sample quality required. Dedicated molecular collections that parallel and complement traditional collections can manage samples appropriately to support the current research need. Thus, it is important that we get this right, and maintain the integrity of the samples during this dynamic transition.

The future of digitisation-on-demand for natural history collections

Dr Sandra Knapp¹, Dr Vince Smith¹

¹*Natural History Museum, London, United Kingdom*

(VA2) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

Building on the varied presentations in this symposium, we will pull out lessons learned that are common across projects and approaches that can be taken into account as we as a community transition to a broader digital environment for natural history collections use. We will synthesise results from the presentations that can inform the direction of travel, future principles and issues that need to be resolved. We will attempt to arrive at a consensus as to what digitisation-on-demand means, so we can communicate effectively with our potential funders as the activity moves forward. As a final open question to the community at large, we will ask “is digitisation-on-demand” the way to most efficiently and usefully digitise natural history collections?

The herbarium has left the building. Moving 6 Million specimens into a new facility whilst changing to APG IV

Ms Roxali Bijmoer¹, Mr Marnel Scherrenberg¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

After the integration of the four large Dutch herbaria, causing all collections to be placed in Leiden in 2013 in temporary facilities, it was time to move to a permanent facility in 2019. Naturalis built a new museum and converted the old museum into storage space for the herbarium collections. Around 6 million specimens, divided over 170.000 herbarium boxes were moved from one end of town to the other end of town. The actual move started January 14th and ending...

April 1st, 2019. April fools? No, really.

Since the herbarium collection was a result of a merger of four large herbaria, each with their own taxonomic systems (Dalla Torre & Harms, APG II and APG III) it was hard to work with. Because the boxes were handled anyway, we seized the opportunity to change to APG IV during the move.

Apart from this change of systematics, around 7% of our vascular plants were digitized, but not integrated with the main collection. The move was our chance to place these specimens with their respective families, making integrating them within these families much easier.

All 170.000 boxes were given a numbered, color-coded sticker to correspond with one of their twelve new storage rooms. The boxes were numbered in the order they had to be placed in the new situation, according to APG IV. A picklist was created to help the move. Collections managers worked side by side with the movers, planning every step of the way; thinking ahead, solving problems if needed. At least one collections manager was present at all times to oversee the move. Collections went from the old building, to a cold storage facility, to the new facility.

As we were reusing the shelving units, we had to make sure the moment the shelves were emptied, that they were deconstructed, transported to the new building, and rebuilt. As soon as they were set up, boxes were placed on the shelves. One collections manager stayed behind until the very last specimen had left the building. 6 Million specimens, 170.000 boxes, and very tired, but satisfied collections managers.

The historically important lectotype of *Stenopterygius eos* and its conservation and restoration over 166 years

Ms. Cristina Gascó-Martín¹, Dr. Erin Maxwell¹

¹*Staatliches Museum Für Naturkunde Stuttgart, Stuttgart, Germany*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The Lower Jurassic Posidonienschiefer Formation (Posidonia Shale) is famous for its spectacularly preserved assemblage of marine vertebrates. Fossils have been collected from this unit for at least 200 years. Many of the historical finds have since been lost through the effects of time, political upheaval, and conservatorial issues stemming from the high pyrite content of sediments from this formation. The Stuttgart Natural History Museum has the largest collection of fossil material from this Formation, with many historical specimens. One of the most interesting pieces is SMNS 3775, a slab-mounted articulated ichthyosaur 2.6 m in length preserved with a bituminous mass in the abdominal cavity, acquired in 1856. The specimen was first figured in 1891, and was later selected as the lectotype of *Stenopterygius eos*, now a junior synonym of *S. quadriscissus*. From a curatorial perspective, the specimen is of particular interest for two reasons: despite its historical nature and current referral to an abundant species, detailed stratigraphic provenance is known, and a high-quality photo was included as part of the original description, permitting us to monitor the condition of the specimen over longer time periods. The photo indicates that pyrite decay was present in the abdominal region since at least 1890, indicating that the ongoing oxidation of iron sulfide minerals was not a new phenomenon for this object. By 2016-2017, the specimen was becoming unstable and was restored. Although problematic due to the high content of iron sulfide in the abdominal region, some gastric contents were left in situ to preserve palaeobiological data. The restoration work was also fascinating because it provided an interesting perspective of old preparation techniques. The specimen represents an important data point in studies of intraspecific variation and anatomy of ichthyosaurs, and highlights the importance of periodic monitoring and restoration of historically collected fossil material in large collections.

The HUA herbarium collections and their social function in the knowledge of plant diversity associated with indigenous and rural communities in Colombia

Dr. Fernando Alzate¹, M.Sc. Felipe Cardona¹, Dr. Ricardo Callejas¹

¹*University Of Antioquia, Medellín, Colombia, ²Institute of Biology, University of Antioquia, Medellín, Colombia*

The herbarium of the University of Antioquia (HUA), was created in 1969 in the city of Medellín, northwestern Colombia, currently holds 235,000 specimens, (16 thousand fungi, 8 thousand briophytes and ca. 210 thousand Vascular plants) the product of an active and extensive botanical exploration carried out in different regions and ecosystems of Colombia. Some areas of the country are under administration regimes of indigenous, black or rural communities and this sometimes makes it difficult for researchers to access and inventory biodiversity. The HUA herbarium together with researchers from the Institute of Biology and the Department of Anthropology both at University of Antioquia have been accompanying some communities in the knowledge of the diversity of plants found in their environment and the establishment of ethnobotanical relationships. In one of these studies and through a participatory method with shamans of the Emberá ethnic group settled on the border with Panama, a study of the flora of the sacred sites for these reservations was carried out. In rural communities settled in the northern Andes of the department of Antioquia, an inventory of the flora used for medicinal purposes was carried out in a wide area where this community is located. Likewise, the degree of use of plants for medicinal purposes by the peri-urban communities of the city of Medellín has been explored. The biological collections of the HUA herbarium fulfill social functions that help increase the knowledge, conservation and dissemination of the diversity of the biota of northwestern Colombia, particularly in the province of Antioquia.

The meteorite of Barcelona (1704) in the Salvador collection: History and discovery

Dr. Neus Ibáñez¹, Dr. Josep Aurell-Garrido², Dr. Josep Maria Camarasa³

¹*Botanic Institute Of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain,* ²*Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain,* ³*Seminari d'Història de la Ciència Joan Francesc Bahí. Fundació Carl Faust, Blanes, Spain*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

On Christmas Day 1704, at 17 h (UT), a meteorite fell in Terrassa (about 25 km NW of Barcelona). The meteorite fall was seen and heard by many people over an area of several hundred kilometres, and it was recorded in several historical sources. In fact, it was interpreted as a divine sign and used for propaganda purposes during the War of the Spanish Succession. Although it was believed that meteorite fragments were never preserved, we recently rediscovered two fragments (49.8 and 33.7 g) of this meteorite in the Salvador Cabinet collection (Llorca et al., 2020).

The collection of this cabinet of curiosities was formed during the 17th and 18th centuries by the Salvador family, a lineage of apothecaries from Barcelona, who built the collection through exchanges with several European naturalists. This family had their own apothecary shop in Barcelona, and kept this collection in their back-room, where the visit was restricted and only allowed to the most erudite people. Many years later, during the 19th century, it became the first "public museum" in the city. The Salvador Cabinet Collection is the only cabinet of curiosities in Europe that preserves the original library (with more than 1,500 volumes), natural specimens (9,237 recording units, including stuffed animals, shells, minerals, fossils or the oldest herbarium of Spain) and the original furniture in a single space. It is part of the city's heritage and it is preserved in the Botanic Institute of Barcelona (IBB) (a joint venture between the Spanish National Research Council [CSIC] and the Barcelona City Council).

Here, we report that, among all the treasures, the Salvador Cabinet collection also preserved these two fragments of the meteorite that fell in Terrassa (25 km NW of Barcelona) in 1704. These fragments are among the oldest historical meteorites preserved in the world.

References:

Llorca, J., Campeny, M., Ibáñez, N., Allepuz, D., Camarasa, J.M. and Aurell-Garrido, J. (2020), The meteorite of Barcelona (1704): History, discovery, and classification. *Meteorit Planet Sci*, 55: 705-725.
<https://doi.org/10.1111/maps.13455>

The Mineral Susceptibility Database: a new tool for mineral preservation

Miss Kathryn Royce¹

¹*University of Oxford, Oxford, UK*

Minerals are often overlooked in museum conservation due to their assumed stability. While many may be stable under ambient conditions, at least 10% of known mineral species are susceptible within a museum context. While there is a significant lack of quantitative information within museum literature regarding this topic, there is a wealth of relevant research within other sectors, such as materials science and geoscience. Yet findings from these fields rarely enter the heritage sector, as relevant research outputs are not easily accessible or transferable. As a response to this, a new online resource, the Mineral Susceptibility Database (MSD), has been created to provide scientific information relevant for the preservation of minerals under ambient conditions in a single, openly accessible location. The MSD collates and synthesizes data from various fields, and adapts key findings into an easily digestible and usable format tailored for non-scientific audiences. By being a repository of interdisciplinary research, the Database:

- 1.) encourages informed decision making,
- 2.) increases awareness of which disciplines and institutions are performing relevant research,
- 3.) exposes additional research applications, and
- 4.) advocates cross-disciplinary research and communication.

The Natural History Museum of Denmark: a new museum, new exhibitions and new collaborations

Ms Bethany Palumbo¹

¹*Statens Naturhistoriske Museum, Copenhagen, Denmark*

(LT1) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

The Natural History Museum of Denmark, located in Copenhagen, is currently undergoing monumental change. A brand new museum site, located in the Botanical Gardens, is currently under construction with plans to open in late 2024. The new site will merge the existing museums (geology and zoology) and incorporate botanical collections into an exhibition space of approximately 7000 m², with two underground levels and a magnificent glass dome. There are several exhibition streams currently in development, including Biodiversity, Human History and the Fundamentals of Life.

Part of this redevelopment is the creation of a new Conservation unit, responsible for the preparation and conservation of the hundreds of objects going on display. This includes historical museum collections but also new acquisitions and models. This presentation will give an overview of the new museum and discuss the varied work planned for the conservation unit over the next 2 years, including the development of new preparation methods.

The Natural History Museum on the Move: from Bloomsbury via South Kensington to Harwell a 150-year journey!

Ms Clare Valentine¹

¹*The Natural History Museum, ,*

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Enabled through a £181.76m investment from the Department for Digital, Culture, Media & Sport as part of Government wide priority to increase investment in R&D, The Natural History Museum at Harwell is an ambitious new science and digitisation centre which will expand the UK's leading role in tackling urgent global challenges, using solutions from nature to drive solutions for nature.

Through the Natural History Museum at Harwell we will secure the future of the collections, transform the study of natural history through novel analytical technologies and digitisation, and further open up the collections to researchers and partners for scientific innovation.

The modern, sustainable centre will provide leading-edge collections storage and conservation facilities and purpose-built research infrastructure for scientific advancement and collaboration. It will seamlessly bring together historical collections with digitisation and imaging suites, state-of-the-art molecular laboratories, cryo-facilities and collaborative research and training spaces to drive the future of discovery. It will enable NHM scientists, visiting researchers, partners, and collaborators to address urgent questions; tracking genetic responses to climate change or the emergence and spread of infectious diseases.

The Harwell Programme enables us to relocate a very substantial proportion of our collections from substandard and overcrowded stores and cabinetry and consolidate fragmentary collections. The Moves Project will also provide additional benefits from activities required to prepare and track the collection. This includes varied levels of curation, rationalisation, rehousing, better hazard management, stabilising and digitising our collections.

Relocating collections will also unlock space at the Museum's historic South Kensington site to welcome the public, with more opportunities to inspire, inform and engage diverse audiences with the natural world.

The Programme is giving the NHM the opportunity to co-locate collections and re-think how our collections are managed to support our Science at each of our sites in a way we have never had the opportunity to do before.

The New Partnership Between IGSN and DataCite: Leveraging Community of Communities on Physical Specimens and Samples

Dr. Kerstin Lehnert¹, Matthew Buys², Dr. Jens Klump³, Dr. Sarah Ramdeen¹, Dr. Helena Cousijn², Dr. Lesley Wyborn⁴

¹Columbia University, Palisades, United States, ²DataCite e.V., Hannover, Germany, ³CSIRO, Kensington, Australia,

⁴Australian Research Data Commons, Acton, Australia

DataCite and the IGSN e.V. are two international non-profit, community-led organizations that operate services to provide globally unique persistent, resolvable identifiers for a comprehensive variety of physical objects within the overall research ecosystem. These objects include specimens from natural history, astromaterials, archeological and other cultural heritage collections, and samples generated for research (including those from afore mentioned collection specimens) in the broadest range of fields. In October 2021, DataCite and the IGSN e.V. formed a partnership to bring together the strengths of each organization to support and advance the global adoption, implementation, and use of physical sample identifiers.

DataCite provides persistent identifiers (DOIs) for a range of research outputs and supports the efforts of several identifier communities. DataCite develops services that make it easier for researchers to connect and share their outputs and resources across the broader research ecosystem. The IGSN e.V. has a specific focus on globally unique, persistent, and resolvable identifiers (GUPRI) for samples: Since 2011, it has provided a central registration system for users to apply a globally unique and persistent identifier for physical specimens and samples. Its data model is based on ISO 19156:2011 (Observations and Measurements, O&M) and the core purpose of IGSN is to enable transparent and traceable connections between the samples and related instruments, grants, data, publications, people and organizations.

The partnership will enable IGSN to leverage DataCite DOI registration and will provide the IGSN ID registration services and support, which will ensure a sustainable IGSN PID infrastructure and its integration with the global PID ecosystem. The IGSN e.V. will maintain the IGSN Sample Community (IGSN SC) and focus on promoting and expanding the global samples ecosystem to support new research and best practice in methods of identifying, citing, and locating physical samples as well as their connections to any derived observations, images, and analytical data. The IGSN SC aspires to be a collaborative space for multiple, diverse communities that promotes the value and use of specimens and facilitates trans-disciplinary cohesion around the use of IGSN. This will enable greater research discovery, innovation and advancement for specimens and samples.

The Oldest Living Tree in the White Mountains

Ms Erin Berkowitz¹

¹*California Botanic Garden, Claremont, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Pinus longaeva, also known as the Great Basin Bristlecone pine tree, are the oldest known living non-colonel organisms on Earth. Bristlecone pines grow in the arid highlands of the White Mountains, a section of the Inyo National Forest located in east-central California. In 1957 the oldest known bristlecone pine at that time (over 4,600 years old) was discovered by the famous Dendrochronologist, Dr. Edmund Shulman. The tree was found in what is known today as the Methuselah Grove. In recent times, new findings have proven the existence of older bristlecone pines in the national forest. Wood specimens from Shulman's 1957 cross-section were recently deposited at California Botanic Garden's Xylarium. Uncovering the documentation which chronicles the lives of these specimens has reignited the wonder and excitement of this historical collection.

The role of the conservator in construction projects: the Yale Peabody Museum renovation as a case study

Dr Mariana Di Giacomo¹

¹*Yale Peabody Museum Of Natural History, New Haven, United States*

G4: General, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Construction projects in museums and collections generally inspire two opposite reactions: excitement about working in improved conditions and anxiety about the possible negative impacts to the collections. To ease the anxiety, museum staff work together with architects, designers, and representatives from the construction company, looking for ways to make the project run smoothly. One key player in the planning and execution of the construction project is a conservator with knowledge of preventive conservation. The conservator will prioritize the care of the collection before, during, and after the project is completed, so their presence is key from early stages of the planning. The conservator will look at the project in a holistic way and consider aspects such as the move of collections to new spaces, which areas of the museum will be affected by the project, which specimens or objects will remain in place, security, treatment timelines, mount making, integrated pest management, emergency response, design and conservation in exhibition spaces, design and conservation in new storage spaces, and construction schedules and timelines that do not clash with protection of objects remaining in place, among others. At the Yale Peabody Museum of Natural History, we are undergoing a historic renovation, the first comprehensive one since the construction of our building in the early 1920s. Every floor in the museum is affected, along with construction of new areas for collections, exhibitions, and education and outreach. My role as a conservator has been to work with my colleagues in collections, operations, and exhibitions to ensure the preservation of objects and specimens during the project but also into the future. Modifications to the building structure such as uncovering of original windows will have long-term impacts on objects on exhibit. Installation of new beams and ductwork has been preceded by demolition activities, whose vibrations may affect our murals or dioramas. The conservator in a construction project must be a team player, find a balance between preservation and access, liaise with key actors (architects, designers, construction workers), and keep an open mind in order to contribute in making the project a success for all parties involved.

The Royal Horticultural Society Herbarium, in through a door and out through the windows

Mrs Clare Booth-downs¹

¹*Royal Horticultural Society, Rhs Garden Wisley, Wisley Lane, Wisley, Woking, United Kingdom*

For the past few years, the collections staff at the Royal Horticultural Society (RHS), the entomologists, the librarians and the curators have all been quietly going about their normal work but with the looming date of 2020 in their minds. The RHS collections were on the move, from their original home in The Laboratory at Wisley to a new purpose built facility at RHS Hilltop.

Any collections move can be a daunting prospect, but the staff were confident that commitment and hard work would see the collections re housed in late 2020. Until the small matter of a global pandemic.

Suddenly, what had seemed a large but manageable task became a story of Gantt charts re-written, Covid bubbles, delays to the arrival of vital equipment, Zoom meetings and the deployment of an alternative method to aid pest eradication. When the moving day coincided with the arrival of snow, the team wondered what could possibly happen next.

Museums are opening up their collections to the public through digitisation and online portals, but what about their collection spaces? If the first months of the pandemic were about getting the staff and collections safely through the doors of the herbarium, the latter months were spent thinking about the opportunities presented by the windows. For the first time the public could see scientists, plant collectors and curators at work and look into the herbarium itself.

Thanks to support from the National Lottery Heritage Fund this also meant being able to welcome volunteers onto the team from August 2021. Both plant collectors and specimen preparers are now visible to the public and this has really helped to increase visitors' understanding of the work of the Horticultural Taxonomy Department.

After the successful completion of the collections move in early 2021, we can reflect on the lessons learned, decisions made and celebrate the opportunities that lie ahead for the newly named 1851 Royal Commission Herbarium.

The Seven Year Itch

Collections Manager Jeff Stephenson¹

¹*Denver Museum Of Nature & Science, Arvada, Colorado, United States*

Lessons can be learned from planning, building, and moving into a new Collections Facility at the Denver Museum of Nature & Science after seven years of working in and adjusting to our new home. We will go over what we got right, what could have been better, pitfalls and unexpected surprises in the process and how seven years' worth of hindsight can shed light for others in their planning. This hindsight helps focus attention on what really shouldn't be forgotten, what shouldn't be cut, what compromises can be made, and when to stand your ground. Feedback from other institutions is incredibly useful, as well as ensuring representation of collections personnel before, during, and after the project.

The Shell That Started It All

Miss Vanessa Delnavaz¹

¹*Santa Barbara Museum Of Natural History, Santa Barbara, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

S. Stillman Berry (1887-1984) was a prominent north American malacologist who spent much of his life studying and collecting a variety of mollusks including cephalopods, chitons, and land snails. Berry was an independent researcher who described over 400 taxa and published over 200 articles in his lifetime. Approximately 50,000 lots from his personal collection were donated to the Santa Barbara Museum of Natural History (SBMNH) Invertebrate Zoology Department in 1985, putting the Museum on the map as a notable mollusk collection. Included in this acquisition was the first shell in Berry's collection, *Terebra maculata*, also known as a 'marlin spike' shell. This specimen has more sentimental value than scientific significance, as it lacks meaningful geographical or temporal data. However, the story on the back of the original label gives insight into what sparked S. Stillman Berry's interest in mollusks and ultimately the origin of his collection.

The State of the Symbiota Portals: Gateways to digital management and discovery

Dr. Jenn Yost², Ed Gilbert¹, Katie Pearson¹, Laura Rocha Prado¹, Samanta Orellana¹, Dr. Nico Franz¹

¹*iDigBio Symbiota Support Hub, Arizona State University, , United States,* ²*iDigBio Symbiota Support Hub, Cal Poly State University, San Luis Obispo, United States*

Symbiota is open source software for natural history collections management and mobilization. The history of Symbiota spans nearly two decades of development, and it has since matured into a distributed network of theme-based research portals incorporating data from over 1,800 collections. More than 50 portals publish over 9 million images and 70 million occurrences, 12 million of which are published to global data aggregators such as GBIF and iDigBio. Symbiota is the primary collection management system for over 700 collections and Symbiota portals are actively used by over 10,000 users a day.

These portals serve as low- to mid-level aggregators that can help cultivate communities of practice—often focused taxonomically (Bryophyte Portal, etc.), geographically (Northern Great Plains Herbaria, etc.), or both—that jointly improve data quality and promote data use. These communities also benefit from collaborative digitization and active data management enabled by Symbiota tools. Collections that manage their data in other content management systems can also benefit from joining a Symbiota portal, including improved data discoverability and publishing of data to global aggregators (GBIF, iDigBio, etc.).

iDigBio Phase 3, funded for the period of 2021-2026, includes the creation of the Symbiota Support Hub (SSH) as an integrated iDigBio domain and service team to strengthen the portal user, manager, and software developer communities. Our mission includes help desk support for portal needs, scalable development, user training, and promotion of increased digitization and data sharing. The SSH is also developing and promoting community-supported, structured, and interactive documentation and training for Symbiota users. For more information or if you have questions, email us at symbiota@asu.edu.

The Study Gallery: Object-based Teaching through Collaborative Exhibits

Dr Nicole Palffy-Muhoray¹

¹*Yale Peabody Museum Of Natural History, New Haven, United States*

(YS) Year of the Student: Attracting College Students to Campus Museums, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The Yale Peabody Museum is undergoing a transformative renovation, reopening in 2024, and deepening its efforts to provide opportunities for teaching and learning with museum resources, experimenting with creative engagement, and sparking interdisciplinary dialog across the University and beyond. In 2016, the Peabody Student Programs Office piloted the Study Gallery, a set of exhibits on and for Yale courses.

Each semester, faculty are invited to submit proposals for the Study Gallery. Faculty then work with museum staff to select specimens and artifacts important to course curricula, and staff design, build, and install exhibits for 2-4 courses in time for the start of classes. Each installation allows students to study and experience objects necessary for their coursework independently over as many visits as needed and on their own schedule, without the need for museum staff or additional instructor support. This project makes space for students' different learning approaches and allows for self-directed engagement with museum resources.

Even as it supports Yale student learning and faculty teaching, the Study Gallery also provides all visitors to the museum the opportunity to engage with the intellectual life of the University. Over the 8 semester-long pilot period, the Study Gallery quickly became one of the most popular galleries at the Yale Peabody Museum, with visitors of all ages enjoying the diversity of specimens, objects, and themes. It has proven to be a fruitful approach to object study, exhibition design, student engagement, and collaboration between faculty and staff. Consequently, a new, permanent Study Gallery is planned for the post-renovation Yale Peabody Museum, where it will be prominently located just off the new Central Gallery.

This presentation will describe the collaboration between museum staff and faculty to develop Study Gallery exhibits, our approach to layout and design, how students can engage with the exhibitions, and challenges and successes of this model for teaching and exhibition. We hope the Study Gallery can provide inspiration to other institutions for creating successful collaboration with faculty and broadening access to museum and university resources.

The SYNTHESYS+ Virtual Access experiment

Dr Vince Smith¹, Dr Sandra Knapp¹

¹*Natural History Museum, London, United Kingdom*

(VA1) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

SYNTHESYS (Synthesis of Systematic Resources, <https://www.synthesys.info/>) has been facilitating access to European natural history collections since 2004, focusing on the physical movement of researchers to partner collections for individual research projects. In the current iteration of the programme, the DiSSCo SYNTHESYS+ project, funded by the European Commission in 2019, we decided to expand the concept of access to include digital access to participating institutional collections, but with a difference. In the Virtual Access (VA) activity of SYNTHESYS+ broadly defined digital access to collections was requested by groups of scientists, not individuals, across groups of institutions. This meant that in any given VA request, one to several institutions would digitise the same taxon or set of taxa, pooling data for subsequent research use by a community of researchers. We ran two VA calls (2020, 2021) in the programme, both facilitated by the ELViS (European Loans and Visits) platform. In this talk we will summarise the process, the spectrum of requests received and funded, and lessons learned from operating a researcher-led process, rather than a process driven by the needs of individual institutions.

The Task Force - Curatorial Assistants as a Shared, Flexible Asset

Mr Matthew Porter¹, **Miss Amy Trafford**¹, Mrs Wai-Yee Cooper¹

¹*Natural History Museum, London, London, United Kingdom*

Where maintaining the number of specialist divisional Curatorial Assistants has not been possible, keeping a smaller Taskforce of shared Curatorial Assistants has enabled the continuation of project-based support across diverse museum collections. This has been a dynamic method of staffing, allowing a responsive approach to the areas of greatest need across divisions, whilst adapting to available funding.

Since 2016 our team has delivered on projects that have been prioritised by Senior Curators. These projects have improved collections care, access - both physical and digital - and contributed to the development of the collections. The work has involved handling a variety of natural history specimens and carrying out a range of curatorial activities and techniques. In addition to the planning, resourcing and the delivery of projects, we also support routine and one-off activities across the departments. Over time, we have developed a specialism in streamlining project work, unifying curatorial practices across divisions, and a rapport across a wide range of collections staff. With the knowledge and experience that we have developed, we are able to operate with minimal supervision and with projects that would not be appropriate for volunteers.

We will share what we have learned working across the different divisions, the process of selecting and delivering diverse curatorial projects, the challenges we have faced, and how having a team of mobile Curatorial Assistants has been beneficial to the Museum's collections work.

The Trèmols herbarium (19th century), a European herbarium preserved at the Botanical Institute of Barcelona

Mrs Laura Gavioli^{1,2}, Dr Neus Ibáñez¹, Dr Neus Nualart¹

¹*Institut Botànic De Barcelona (IBB, CSIC-Ajuntament de Barcelona) , Barcelona, Spain,* ²*Facultat de Farmàcia (Universitat de Barcelona), Barcelona, Spain*

G5: General, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

In this communication we will show the principal characteristics and most interesting specimens of the Trèmols Herbarium, which is kept at the Botanical Institute of Barcelona. This herbarium is one of the oldest in Catalonia, largely made up of European plants (99%) collected during the 19th century. His creator was Frederic Trèmols (Cadaqués, 1831–1900), originally a chemist that increasingly became interested in botany. Over the years he developed an important herbarium, thanks to the exchanges with other European botanists and his involvement in botanical societies such as the Société Botanique de France, the Société Helvétique pour l'Échange des Plantes (from 1870), and the Sociedad Botánica Barcelonesa (1872–1878). During the 20th century the Trèmols Herbarium has been revised and modified by the technical staff of the Botanical Institute of Barcelona, and a good part of its samples became the core around which the present General Herbarium (BC) grew. This collection finished its computerization process during 2019. Thanks to this works, we can appreciate that the current Trèmols collection consists of 12,943 specimen sheets arranged in 58 volumes, plus four boxes of Hieracium spp., one box of Cryptogams and 90 boxes with additional material. For the largest part, these sheets derive from botanical exchanges (62%) and, excluding Spain's territory, 49% of the total collection localities are from Europe. Indeed, just a few numbers of sheets were collected by Trèmols himself (38%), most of them in Catalonia (86%). The aim of this communication is to cast a glance at Trèmols' Herbarium main features and more interesting specimens, including how is classified, digitalized, documented, revised, and lastly, how is making available a historical herbarium preserved at the Botanical Institute of Barcelona to the scientific community.

The Trenton Meteorite: Deep time and museum science in one object

Ms Patricia Coorough Burke¹

¹*Milwaukee Public Museum, Milwaukee, United States*

The study of meteorites has helped us understand the beginnings of our solar system, how planets and asteroids formed and how the impacts of large meteorites have altered Earth's history and life on our planet.

Scientists study meteorites because they contain a record of our solar system's history going back some 4.6 billion years. However, not all meteorites also record the history of a natural history museum's early science endeavors.

The Trenton Iron meteorites were first discovered in 1858 on the southeastern Wisconsin farm of Louis Korb. The first find of meteorites included four pieces found along a fence line on the farm in Washington County. Adolph Meinecke, a board member of the German Natural History Society of Wisconsin, was among the citizen scientists called in to identify the specimens. The society acquired three of the specimens. A larger piece was discovered and acquired by Increase Lapham, one of Wisconsin's early and prominent scientists and a member of the society.

Over the next several years, more fragments came into the MPM collection and some pieces were shared with scientists in Europe. A revisit of the site in 1952 with a metal detector found two large masses and three smaller ones buried close to the original site. The largest of those pieces is at the Smithsonian.

The UK Barcode of Life project

Dr Ben Price¹

¹*Natural History Museum, London, United Kingdom*

There are approximately 76,000 eukaryote species recognised in the UK, the majority of which are poorly known. From genes to genomes, DNA-based techniques are increasingly used to explore the environment. These methods include the identification of individuals in any life stage, their diet, their interactions with other organisms, the traces of DNA they leave behind; to whole communities analysed at once. While DNA offers a powerful lens to understand the natural world, the biggest challenge to upscaling these new methods is the need to link DNA sequences to species names. To this end DNA barcoding uses a short, standardised segment of an organism's genome for identification by comparison to a barcode reference library of expertly identified specimens and their corresponding barcode sequence data.

The UK lags behind several countries in that we lack trusted, openly accessible reference sequences for key taxa. A recent gap analysis of public data in major DNA reference libraries highlighted that almost half the known UK species lack barcode data. To address this a steering group representing government agencies, national repositories, sequencing centres and citizen scientists was formed to initiate a UK Barcode of Life (UKBOL) project and to sequence priority species. A live checklist of priority species is online and embedded in the project website (<https://www.ukbol.org/>). In this presentation I will outline the project, current progress and how we hope to develop a distributed network of voucher repositories and sequencing centres to complete the open access UK DNA reference library.

The Ulster Museum Natural Sciences collections – past, present and future, here for good.

Dr Helen Barber-James^{1,2}, Hannah Crowdy¹, Dr Damian McFerran^{3,1}

¹National Museums Northern Ireland, 153 Bangor Road, Cultra, Northern Ireland, ²Scientific Associate, Department of Life Sciences, The Natural History Museum, UK, ³Centre for Environmental Data and Recording (CEDaR), National Museums Northern Ireland, Northern Ireland

MO2) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

The natural sciences collections of the Ulster Museum date back to 1821, originating from several natural history societies that joined forces over time. The museum was established as a national institute in 1961, underwent major expansion in 1972, and merged with three other museums to form National Museums NI in 1998. The Ulster Museum's collections focus particularly, but not exclusively, on the botany, zoology and geology of Northern Ireland. We will build on the existing collections and extensive biodiversity databases to further an understanding of the biodiversity crisis that faces Northern Ireland – and the world. National Museums NI will undertake a programme of surveys of the regional biota to assess the current state of diversity here, and compare this with benchmarks set by earlier surveys and recorded in our biological database (CEDaR). This will serve both to augment the existing collections and help to identify changes in species abundance, distribution and other trends over time. The UK has amongst the worst loss of biodiversity globally, and the Ulster Museum, as part of National Museums NI, will continue to play a key role as a resource for exploring and understanding biodiversity, collecting voucher specimens and linking with the Centre for Environmental Data and Recording (CEDaR), the National Biodiversity Network and GBIF. This will involve numerous partners including governmental bodies and NGOs, citizen scientists, volunteers and post-graduate students, with acquisition and examination of new collection material critical to assessing the conservation status of different organisms across Ireland. Climate change and biodiversity are closely linked, and it is envisaged that the museum and partners will contribute to a better understanding of these interactions through detailed species level studies. There will be a strong focus on freshwater species, particularly invertebrates, as these habitats are known to be disproportionately threatened and under-prioritised relative to marine and terrestrial biota globally.

The value of herbarium specimen collections for quantifying the impact of the 2019-2020 bushfire and drought disasters on Australian plant biodiversity

Dr Robert Godfree¹

¹*CSIRO National Research Collections Australia, Acton, Australia*

MO3) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

During 2019-2020 Australia suffered two exceptional natural disasters: the culmination of a severe drought that placed vegetation under extreme moisture stress over large parts of the continent, and a series of megafires that burnt more than 7 million hectares of native forests, woodlands and shrublands along the south-eastern seaboard. The severity of these events have been linked to anthropogenic changes in temperature, rainfall, and fire behaviour. Here I discuss how herbarium specimen collections provide essential, high-quality data for quantifying and predicting the impacts of these and future events on native vegetation at the continental scale. In the wake of the bushfires, species distribution models were constructed for >7,000 species based on location data extracted from >700,000 herbarium specimens and fire maps generated from satellite data. While these data indicated that approximately 800 species experienced fire over >50% of their ranges, habitat information recorded on specimen labels combined with broader trait data indicate that most are fire-adapted and primarily occur in sclerophyll ecosystems. However, for certain widespread and non-fire-adapted taxa the bushfires likely represent an unprecedented singular demographic event and refugial areas are likely to play a key role in their long-term conservation. Similar biogeographical approaches are now being extended to model the impacts of the drought on woody taxa across Australia and to combine data from herbarium collections and historical textual sources to reconstruct similar events over the past two centuries. While handling the large datasets required is a formidable challenge, exciting new opportunities now exist to use artificial intelligence and machine learning to extract and clean specimen data and to generate models capable of predicting the impacts of drought and fire events on biodiversity in the future.

The Van Heurck collection (AWH) at the herbarium of Meise Botanic Garden (BR)

Ms Sofie De Smedt¹, **Scientific Manager of the Herbarium Ann Bogaerts¹**

¹*Meise Botanic Garden, Meise, Belgium*

Henri Ferdinand Van Heurck (°1839 - 1909) was manager of the family paint and varnish factory and professor in chemistry at the Industrial High School in Antwerp. As a self-taught botanist, he started studying, together with other naturalists, the flora of Antwerp. Later on he carried out pioneering work in microscopy, and became famous for his research on diatoms. He convinced the municipality of Antwerp to establish a Botanic Garden and became its director in 1877.

The start of the exploration of the flora of Antwerp in 1858 was also the start of his enormous collection. With great patience and heaps of money he systematically added more specimens to his worldwide collection. In 1867 he bought the famous Sieber - Von Reichenbach herbarium which brings his collection to a total of more than 250,000 specimens from 60,000 different species, one of the largest herbaria in the world at that time.

After his death, his collections and herbarium were purchased by the municipality of Antwerp and in 2006, they were donated to Meise Botanic Garden. In 2021 the collection of his vascular plants were digitized and its importance will be revealed to the public through our virtual herbarium www.botanicalcollections.be

The VERO: An NFT for increasing the production, flow and distribution of information associated with specimens.

Dr Samuel Bolton¹

¹*Florida State Collection Of Arthropods, 1911 Sw 34th St., United States*

A VERO is a type of NFT that is associated with a 3D model of a real object. Only one VERO token can be minted per real object. By converting real-world scientific value into virtual world collectability, VEROs may be able to fund the generation of 3D models from scientifically important specimens, such as holotypes. Under the prevailing taxonomic paradigm there is a need to move specimens over international borders in order to examine them in detail. This requires import/export permits, extensive travel, etc. VEROs might circumvent these obstacles by resulting in a dramatic increase in the production, flow and distribution of information associated with specimens, potentially democratizing the contents of museums while funding the collection and 3D imaging of new species. It is hoped that VEROs will be used to alleviate the costs of describing a high proportion of the world's species before many of them are lost to the sixth mass extinction. However, this will require a flexible and carefully planned approach to how we commercialize the information associated with specimens.

The World Flora Online Taxonomic Backbone, the global controlled vocabulary for plant names.

Dr Roger Hyam¹, Dr Alan Elliott

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

The World Flora Online (WFO) is the collaborative, international initiative to build an online flora of all known plants to meet Target 1 of the Global Strategy for Plant Conservation (GSPC) of the UN Convention on Biological Diversity.

The WFO is addressing this goal by creating an open-access, online compendium of existing resources such as published floras, checklists and revisions.

In order to join together thousands of resources from many different sources it is necessary to have a common vocabulary - a single lookup table for plant names.

This lookup table is referred to as the WFO Taxonomic Backbone. It consists of two parts: A list of names governed by the “International Code of Nomenclature for algae, fungi, and plants” and a consensus classification of plant species.

The backbone is curated by Taxonomic Expert Groups (TENs). There are currently 37 TENs consisting of over 280 specialists. Their work is coordinated by the WFO Taxonomic Working Group and the TENs manager.

2022 has seen a change in technical arrangements for how the backbone data is managed and this poster presents some of the exciting opportunities this is opening up. Previously Missouri Botanic Garden have been providing technical support for all the WFO data but the Royal Botanic Garden Edinburgh (RBGE) is now able to dedicate significant resources to the project and has taken on responsibility for the backbone, freeing Missouri to extend their work on the descriptive content.

RBGE have created a new management system call Rhakhis (Greek for spine and root of the “rachis” used in botany) and this is presented in the poster.

Details are shown of how developers and curators can use the standardised lists and IDs produced by WFO in their projects for greater global data integration. There will be opportunities to discuss with curators and experts how they can contribute data.

The ZooMu Initiative: Enhancing the Value of Zoo Collections to Advancing Biological Sciences by Bridging the Gap Between Zoos and Museum

Mr Gregory Watkins-Colwell¹, Dr. Alexander Shepack², Dr. Steven M. Whitfield⁴, Dr. Sinlan Poo³

¹*Yale Peabody Museum Of Natural History, New Haven, United States*, ²*University of Notre Dame, Notre Dame, United States*, ³*Memphis Zoo, Memphis, United States*, ⁴*Zoo Miami, Miami, United States*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Like museums, zoos and aquariums hold a wealth of biological resources in their collections that are unique to these institutions. As modern zoological institutions transition from exhibits to conservation organizations, zoos are starting to focus on ways to enhance their contribution to the advancement of biological sciences. Driven by this need, in 2021 iDigBio hosted a 3-day workshop bringing together bringing together zoo and museum professionals and researchers in the larger scientific community to discuss plans for improved access to zoo collections and increased collaboration across institutions. Thus began the ZooMu initiative. These efforts catalyzed a much-needed discourse on the underutilization and appreciation for living and preserved collections and the tremendous capacity they hold for scientific research and biodiversity conservation. The similarities between traditional museums of natural history and living collections are numerous; including databases, archiving, biological sample collection and care, as well as the more obvious shared interests in biodiversity conservation and education. The cultures may differ, but zoos and museums share many goals. This presentation will summarize where things are now and what the next steps are.

Title: Dip a toe into wet collection of the National Museum of Ireland Natural History

Dr Amy Geraghty¹

¹*National Museum of Ireland – Natural History, Merrion Street, Ireland*

(NW2) Natural History Wet collections, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 4:00 PM - 5:30 PM

The National Museum of Ireland – Natural History (NMINH) contains a growing collection of over 2 million specimens, around 200,000 of which are preserved in fluid. The Irish Cetacean Genetic Tissue Bank (ICGTB <https://www.museum.ie/en-IE/Museums/Natural-History/Projects/Cetacean-Tissue-Bank>) is a small but active part of our holdings of specimens in fluid. The ICGTB is an island-wide citizen science project that commenced in 2006 and aims at building knowledge on stranded cetaceans in Irish waters.

Ireland's coastline is an estimated 7,500km in length and its waters contain 24 cetacean species. To carry out a stranded cetacean sampling scheme considerable time and resources would be needed. NMINH has always had a small team and so must be strategic with resource use, specimen acquisition and storage. The ICGTB is contributed to by volunteers, its samples are kept in vials of high strength ethanol and refrigerated. Volunteers of the ICGTB are provided with sampling kits, information on the sampling procedure, sample purpose, and uses. The ICGTB now contains over 1,000 samples available for analysis upon request. To date its samples have been used in several studies on cetacean population dynamics and have added Irish data to other European datasets. Citizen science projects like the ICGTB could play a role in highlighting the importance of wet collections in universities and institutions while engaging with the public.

TORCH Digitization Hub: Streamlining Digitization Workflows for Natural History Collections

Mr. Jason Best¹, Mr. Diego Barroso¹, Dr. Brian Witte²

¹*Botanical Research Institute Of Texas, Fort Worth, United States*, ²*Software Developer, , United States*

The TORCH Digitization Hub is a web-based platform designed to support specimen digitization workflows for multiple participants of a larger digitization group as well as workflows of individual organizations. The Hub bridges the gap between initial image capture and dissemination of images and metadata through specimen data portals. It is designed to provide collection managers, data managers, and digitization technicians with tools to simplify the processes of image upload, quality control, data extraction, and derivative image generation. The hub is a platform built on a foundation of open source components, allowing it to be freely distributed and modified and helping to accelerate the digitization workflows of natural history collections.

Although many natural history collections have existing digitization workflows, these may not scale well internally or when multiple institutions must collaboratively digitize specimens across multiple collections. The Hub addresses some of these challenges by providing a solution for participants to upload specimen images into a central workflow platform where images and specimen data undergo multiple steps to ensure image quality, conformity, and completeness. Then, derivative images for dissemination are generated, and the complete end-product is uploaded to a web hosting platform to be used by the specimen portals.

The Hub provides a web-based interface for managing workflows, monitoring progress and performance, and generating reports. It can be hosted in the cloud to support distributed digitization projects, or hosted locally to support workflows within a single institution. While the Hub was designed for the herbarium digitization workflows of the Texas Oklahoma Regional Consortium of Herbaria (TORCH) Thematic Collections Network, it can be adapted for other types of collections and workflows and, due to being open source, can be extended with other image management tools and technologies such as OCR and computer vision. The TORCH Digitization Hub project code and documentation is available at https://github.com/TORCH-TCN/torch_hub.

TORCH Light Box: An Open Source Light Box Design for Herbarium Specimen Imaging

Mr Jason Best¹

¹*Botanical Research Institute of Texas, Fort Worth, United States*

The Texas Oklahoma Regional Consortium of Herbaria (TORCH) Thematic Collections Network (TCN) faced a challenge when the project got underway in 2019: the light boxes specified by many participants were no longer available because the manufacturer went out of business. Other options were too expensive and not ideal for herbarium specimens. To address these challenges, the author designed a custom light box which combines time-tested features of previous designs and new features based on experience and input from the herbarium community.

The primary goals of the design were to create a light box that matched existing basic designs and features but could be built at a low cost, with parts and materials that were readily available using basic tools and skills to fabricate. Secondary goals of the design were to facilitate rapid prototyping with components that were easy to adapt, reconfigure, and customize and a design that can be assembled and disassembled for shipping to other herbaria using roving imaging stations.

The light box is constructed using T-slot aluminum tubing for the frame with white plastic panels to provide an enclosed space which excludes exterior light and reflects internal light from two LED light bars mounted to the underside of the top panel. The light bars each have three strips of LED lights which are powered by an external 24-volt power supply. The top of the box has an opening through which a DSLR camera can capture images of specimens placed on the bottom platform of the box. The box design includes an integrated light stand which supports the camera. A white fabric curtain covers the front opening of the box and allows the operator to raise the curtain to place a specimen and lower it to block exterior light from entering. The materials for the current box design cost approximately US \$750 but could be reduced further with some easy modifications. Alternative light boxes, including the original light box no longer available, cost US \$1,800 or more.

Documentation of the open source hardware design, including material lists, fabrication instructions, assembly instructions, and photographs, is provided at https://github.com/TORCH-TCN/torch_light_box.

Tucson Bee Collaborative: engaging 2-year and 4-year college students in specimen-based research

Dr Wendy Moore¹, Jennifer Katcher², Raine Ikagawa¹, Gene Hall¹, Charles Bradley¹, Dr Kim Franklin³, Amy Dunbar-Wallis⁴, Dr. Lisa Corwin⁴

¹University of Arizona, Tucson, United States, ²Pima Community College, Tucson, United States, ³Arizona-Sonora Desert Museum, Tucson, United States, ⁴University of Colorado, Boulder, United States

(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

People – researchers, educators, students, artists, citizen scientists – in southern Arizona concerned about the environment are coming together in the Tucson Bee Collaborative. Aimed at increasing knowledge of native bees and the importance of pollination writ large, the Tucson Bee Collaborative celebrates biodiversity and empowers community members to be part of regional conservation efforts. Founded on the principle that well-curated natural history collections have always been, and will always be, the foundation of modern biology, the University of Arizona’s Insect Collection (UAIC) plays a central role in the Collaborative. The collection houses over 2 million specimens including 16,000 native bee specimens acquired during the Arizona-Sonora Desert Museum’s long-term native bee survey and monitoring project, as well as 100,000 additional specimens of native bees from collections made throughout the Sonoran Desert Region over the past 60 years. The Collaborative aims to grow the UAIC collection of native bees to represent every species in southeastern Arizona and to reveal the DNA sequence of a portion of the cytochrome c oxidase subunit I gene (the animal “DNA barcode”) for at least one specimen of every species, and then make those sequences publicly and freely available to enable future biotic survey and monitoring projects. By involving college students from Pima Community College and the University of Arizona in the process of obtaining and publishing the data, we are training Arizona’s future workforce. Through our network of course-based undergraduate research experiences (CURES) students build community connections, obtain biotechnology skills and come to understand the importance of specimen-based research and natural history museums.

Twenty-five Years of Anthropology Collection Movement and Management at the Yale Peabody Museum

Dr Roger Colten¹

¹*Yale Peabody Museum, New Haven, United States*

The Peabody Museum of Natural History at Yale University is one of the oldest natural history museums in the U.S. and the museum's collections reflect over 150 years of evolving collection acquisition and management practices. During the past 25 years the Anthropology Division collections have been transformed from being stored in 18 rooms in four buildings with limited climate control and cardboard and wooden storage equipment to being housed in a state of the art storage facility. The physical upgrade in storage has been paralleled by the transition from analog to digital data management. In this presentation I review the processes that made this transformation possible and discuss ongoing activities to improve access to the collections.

Two birds one stone: Between object location and digitisation - the benefits of QR-codes

Frau Heike Straebelow¹, Eileen Westwig¹

¹Museum für Naturkunde Berlin, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany

(MC1) Moving collections: curse, blessing or ...?, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Thanks to the unique investment of the Federal Government of Germany and the State of Berlin, the Museum für Naturkunde Berlin (MfN) has the opportunity to develop a new research campus, including the renovation of existing buildings, construction of new infrastructure and digitisation of the collection.

In the upcoming 3rd construction phase six collection rooms need to be cleared, one of them the so called "bone cellar", where large parts of the fossil vertebrate collection are stored. Specimens in the room were accumulated over the past 120 years. Storage conditions are inadequate, crowded and only small parts are systematically stored. Furthermore, related parts of the collection are stored in different areas and the new in house depot is only an interim solution.

For a pilot project the mammoth tooth collection was used, as the amount, information related to the objects and conservational status was manageable. The approach we used was the ODK Collect app, a mobile device based form to collect basic data and take photographs. It could quickly be adapted for the specific needs of the project and has an easy to user interface. This tool allowed us to connect these records with QR codes for the object and the object location.

With this a standardized dataset was created which fulfills the need of data management in a later stage as well as the need of easy access and object location. The advantage of a mobile device based system enabled us to integrate the digitisation/data collection into the process of physically handling and packing of the objects. Additionally this made it possible for the first time to sort the complete mammoth tooth collection and not just the parts in the „bone cellar“.

(un)Natural Selection: Reflections on Collaborative Digitization Prioritization across Repositories of Natural History Texts

Head, Digital Library And Digitization Jacqueline Chapman¹

¹*Smithsonian Libraries and Archives, Washington, United States*

RE) Reflections on the Biodiversity Heritage Library: Value in Collections and Collaboration (, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The foundation of natural history data mining and data linking activities from published and unpublished texts is the data source itself: the digitized physical works. Without the uploaded digital images – packaged and described and available to users – these metadata projects would not be possible, and research citations would be limited.

The Smithsonian has been digitizing natural history texts for the Biodiversity Heritage Library (BHL) for over 15 years, and in that time has utilized different approaches to selection and prioritization of collections materials for the portal. This presentation will reflect on and interrogate the policies that have resulted in the Smithsonian's current corpus of digitized materials in BHL and shed light on the external and internal influences on the digitization queue.

The BHL's strength is its collaborative collection development, where resources are maximized by deduplicating digitization efforts through selection and ingest of materials from a wide variety of repositories working independently to image and share their physical collections. However, no BHL member library has digitized its entire collection of texts, and all have queues of materials to image and upload. Additionally, not all repositories of natural history texts are digitizing their materials for BHL, and large swaths of materials remain in copyright.

These gaps in the digitized materials available online and in BHL is a concern for basic access as well as for data mining and linking activities. Weaknesses in the BHL's digitized collections include unpublished works, non-English language materials, non-Western materials, and works created in the last 100 years. Digitized materials may be incomplete and/or have differing levels of accessibility (such as: accuracy of machine-readable text from OCR or transcription, descriptive metadata granularity, and so forth).

Discussion will focus on the Smithsonian Libraries and Archives' (SLA) BHL contributions over time, what collection analysis of those over 10 million pages/images reveals about what SLA has contributed so far, and will share potential approaches and criteria SLA and other BHL partners might use when selecting and prioritizing materials for digitization.

Unique Approaches to Packing Vertebrate Paleontological Specimen Loans

Adrienne Stroup¹

¹*Field Museum of Natural History, Chicago, United States*

(BB2) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Loaning specimens is a basic operation of many museum collections, and the Field Museum's vertebrate paleontological (VP) collection is no exception. With roughly one hundred thousand catalogued specimens, the VP collection is not the museum's largest, but is arguably one of the most actively used, especially when it comes to loans.

After a fossil is painstakingly prepared for scientific study or exhibit the last thing any collections manager would want is for a specimen to be damaged in transit. The extreme solution is to not allow any specimens to leave the museum, and require all visitors to study specimens in person, but present-day challenges such as the ongoing COVID-19 pandemic often disrupt travel plans. In reality, the loan program is a vital element in collections work that promotes the use of the collection and provides access of scientific materials to a global audience. The risk of damage to specimens is greatly reduced when packed carefully and thoughtfully.

The Field Museum VP loan program is carried out methodically but inventively. Packing loans requires a creative and adaptable approach to problem-solving because every specimen is uniquely comprised of a myriad of variables that must be taken into consideration. The wide ranges of taxa represented in the collection, the complexity of vertebrate skeletons, and the quality of preservation will affect the choices made in packing the loan. Building off the framework of standard practice, some examples of inventive solutions to complicated specimen requests will be illustrated. Keeping in mind the economic challenges many museums face, examples shown will demonstrate the value of creativity over costly supplies. Overall, the presentation will demonstrate how the Field Museum's VP loan program operates with a staff of one, a lot of creativity, and streamlined workflow to efficiently fulfill the high research demand for its collection.

Updated, collated, recurated - it's the new Herbarium Handbook!

Miss Nina Davies¹, Mrs Clare Drinkell¹

¹*Royal Botanic Gardens, Kew, London, UK*

G10: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 11:30 AM - 1:00 PM

Kew's Herbarium Handbook has been an important reference for herbarium collections care and management since it was first published in 1989. It brings together practical guidance covering aspects of technical herbarium work written by staff within Kew. This includes procedures on practical herbarium techniques such as the preparation, preservation and organisation of collections; fieldwork and collecting; and the management of the building environment. Herbaria worldwide have been able to adapt the guidance to their specific requirements. At Kew we've begun editing the fourth edition of the Handbook. The latest iteration of the Handbook incorporates best practice methods from a wide range of herbaria - small to large, temperate to tropical. The chapters are arranged in a logical structure from field collection, to herbaria, with useful anecdotes, examples and statistics from Kew staff, but crucially partners and collaborators from around the world are playing a key role in contributing to the Handbook. Additional chapters will cover digitisation and herbaria in the wider context of outreach. The resulting book will be a richly illustrated reference tool offering best practice herbarium management from wide-ranging collaborators and informed by best practice from Kew. The Herbarium Handbook 4th edition will help with training new staff, interns and volunteers, share ideas on techniques and workflows and advise on time-saving and cost-effective processes. But we don't want to stop there. As Herbarium procedures are updated, new ideas emerge and techniques evolve; in our presentation we would like to know how best to develop the Handbook as a 'live' resource. We will hold a poll to engage and gather ideas from our audience about how to build upon the Herbarium Handbook. We want to know what a useful development would be to share our understandings and to ultimately ensure the safekeeping of herbarium collections.

Updates on the Natural History Collections Club Network (NHCCN)

Ms. Kari Harris¹, **Dr. Travis Marsico¹**, Mr. Kevin Krajcir¹

¹*Arkansas State University, Jonesboro, United States*

(LT2) Long time no see, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Throughout 2020 and 2021, the Natural History Collections Club Network (NHCCN) was mostly dormant. Workshop and outreach plans for the network were put on hold in 2020, and in 2021 we started working toward bringing the network back together. Early that year, we reached out to network participants and found that some clubs were totally dormant, some were waiting to see what fall 2021 would bring, and a few were still going strong. We were able to send 22 students, 5 faculty members, and 4 curatorial staff members to virtual SPNHC 2021. After the annual meeting, we hosted an NHCCN workshop on Zoom. We have many exciting activities for our Arkansas State University (A-State) Natural History Collections Curation Club chapter, and we are hoping to create some collaborative experiences within the network. Already in 2022 we have hosted an herbarium specimen mounting workshop attended by 11 students, and we have scheduled a “DNA from specimens” show-and-tell panel, a fishes collection reshelving day, and a work day in the mammal and insect collections. A-State club members are already volunteering in collections after curator-directed trainings. In 2022, we plan to leverage renewed enthusiasm at A-State to reach out to network participants and offer support for those that wish to build back their clubs. We encourage interested students and faculty sponsors to contact us so that we can grow the NHCCN. (<https://thenhccn.wixsite.com/nhccn>)

Use of New York Botanical Garden Digitized Herbarium Specimen Data for Biodiversity Conservation

Dr. Barbara Thiers¹

¹*The New York Botanical Garden, Littleton, United States*

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

The William and Lynda Steere Herbarium holds specimens of plants and fungi from throughout the world, with an emphasis those from the Americas. Between 1995 and 2021 more than half of the Gardens' 8 million herbarium specimens were digitized. The digitized subsets of the collection include type specimens; all algae, bryophytes, ferns and fungi; and all specimens from Brazil, the Caribbean, and the United States. All newly accessioned specimens are digitized as received by staff and volunteers. All data and images are available for download from the Garden's Virtual Herbarium website and a variety of other data portals. Biodiversity Conservation comprises a variety of activities, including physical protection of ecosystems, documenting where organisms live now and have lived in the past, and prediction of how organisms will respond to future change. Key to the success of all conservation efforts is increasing public awareness of biodiversity and the importance of maintaining healthy ecosystems. Digitized specimen data from the Steere Herbarium are frequently used in GIS systems for determining the International Union for the Conservation of Nature (IUCN) rarity status of a species, and in species modelling applications to predict the future survival of a species. Current efforts at the Garden to use artificial intelligence and machine learning to enhance plant identification will hopefully increase the amount of data that can be used for these applications. Training programs have brought students to New York from around the world, but particularly from Brazil, to learn techniques of plant collection, identification, specimen preparation and digitization. These techniques have been used in local or national biotic surveys, creation of land reserves, restoration projects and development of wise land use practices. Herbarium specimens have also played a role in the Garden's efforts to increase awareness of plants and fungi and their importance in our lives through inclusion of specimens in Garden-wide exhibitions, through herbarium open house events and tours for school groups. And finally, we have used herbarium specimens and derivative data to teach high school students to analyze species distributions and document rare species.

Using collections data to solve the mystery of the Black-winged Monarch or "To lose a species is tragic; to not know where it is for half of every year when nearly 200 museum specimens exist is careless."

Dr Leo Joseph¹, Mr Paul Sweet, Mr Phil Gregory, Mr Julian Teh

¹Australian National Wildlife Collection CSIRO, Canberra, Australia, ²American Museum of Natural History, New York, USA, ³Sicklebill Safaris, Topaz, Australia

MO1) Mobilizing specimens for factbased conservation in the face of a global biodiversity crisis, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Detective work of locating specimens through online databases and old-fashioned follow-up queries to curators and collection managers can define questions warranting study with genomic data. Exemplifying this is the Black-winged Monarch *Monarcha frater*, a bird mostly of low-mid elevation forests across the island of New Guinea. Of its several recognized subspecies, *M. f. canescens* is migratory, breeding in tropical north-eastern Australia from, broadly, November-March. Where *M. f. canescens* spends its non-breeding season, apart from some individuals overwintering in Australia, remains (January 2022) the complete mystery it has been for >100 years. To address this, we located 168 New Guinean and 18 Australian specimens in museums (Papua New Guinea, Sweden, Netherlands, Italy, Belgium, Germany, United Kingdom, USA (New York, New Haven, Honolulu, Cambridge, Washington DC, Philadelphia, Chicago, Los Angeles, Berkeley), and Australia (Brisbane, Sydney, Canberra, Melbourne, Adelaide)). Some specimens were misidentified as *M. frater* for ~100 years and are actually the similar Black-faced Monarch *M. melanopsis*. The locality on VertNet of one specimen potentially sampled an important geographical gap but was erroneous; the contributing museum informed us that they had corrected their database five years earlier. Curators have generously contributed photographs of almost every specimen. We have not located a specimen of non-breeding *M. f. caniceps* from New Guinea; one specimen was lighthouse-killed on migration in Torres Strait. Resolution of the mystery seems no closer to resolution without further field work in south-western Papua New Guinea where the species (i.e., not identified to subspecies) is known to occur but is still unrepresented by specimens or photographs of live birds. We will describe other findings we have made. These include surprising new information about the taxonomy and biogeography of *M. frater* in New Guinea. Tissue samples for DNA analysis exist of just three specimens. The questions we would like to answer with genomic data across the range are now sharply defined. Field work across the entire range to collect fresh material would be "non-trivial" and would involve permitting systems in three countries. Alternatively, museum curators can be assured we have done "due diligence" before asking for such sampling to occur.

Using Excel Macros for Data Quality Assurance: Lessons Learned from a Coding Beginner

Miss Larissa Welton¹

¹*Natural History Museum, London, United Kingdom*

(BB1) Back to Basics: Museum Techniques Skillshare, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

It is a frequent occurrence for collection managers, digitisers and other museum staff to be faced with large amounts of data that need checking for quality assurance. With many different workflows and Collection Management Systems (CMS) in use across the sector, it is hard to develop universal data checking software. Data literacy among museum staff is increasing, but many museums do not have dedicated software developers or access to complex programs. Microsoft Excel is a widely accessible and understood application, with a large community of users.

As part of a microscope slide digitisation project, the filenames of images contained several pieces of data encoded in a string of numbers which were the basis for creating the CMS records for the specimens. Before importing the images to the CMS they had to be checked to ensure there were no errors or typos. A Microsoft Excel macro tool was developed to check these filenames automatically, which was found to be more efficient and caught more errors than manually checking. The macro can validate data by comparing it to an existing list and can check common errors in data strings, including character length, truncation, duplication, and highlighting missing numbers in what should be a sequential list of barcode numbers.

This talk is aimed at an audience with little experience in coding or technical know-how but with some familiarity with Excel. I will share my experience how, as a beginner with no background in coding, I was able to create a functional and useful tool which has greatly improved our workflow. I will introduce macros in Excel, explain the most useful functions involved, share tips and tricks learned along the way, and show how a beginner will be able to create a custom tool to check their data. Finally, a cost-benefit analysis will be shared that compares the time taken to develop the macro compared to the reduction in time for manual error checking, along with errors that would have been almost impossible to manually check.

Using IIIF to publish your specimen images

Dr Roger Hyam¹

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

Researchers have become accustomed to online access to data about the specimens held in natural history collections. Since the 1990s metadata standards have arisen to facilitate the sharing and aggregation of these data. Aggregators and indexers have driven standards development and taken advantage of the vast number of records made available through this community effort to advance biodiversity research. The vast majority of the data that have been liberated so far have been text based data about specimens. But many institutions and projects have simultaneously been imaging their specimens. Some existing standards have media extensions to accommodate the sharing of these images however these are restricted to metadata about media objects rather than the exchange of the media objects themselves. Projects have relied on transferring high resolution versions of images or cut down, compressed versions. In addition institutions have used a variety of incompatible and expensive to maintain technologies on their own websites to give access to high resolution versions of the images, from Flash and Java Applets in the early days to different incarnations of Javascript viewers today.

The sharing of multimedia representations of objects online is not a problem unique to the natural history community. Scholars in museums and archives of all kinds are facing the same issues. IIIF (International Image Interoperability Framework - pronounced "Triple-Eye-Eff") is a standard that has been used in the humanities for over a decade and is now widely adopted.

This poster summarises the results of an international project (Synthesys+ Task 4.3) funded by the European Commission that ran from 2019 to 2021. The project's purpose was to encourage the use of IIIF as a standard way of sharing images of natural history objects and to link this to the CETAF specimen IDs already in use. It did this by establishing a series of exemplar implementations and documenting lessons learned and best practice.

Viewers of the poster will be inspired to learn more about implementing IIIF at their own institutions from the examples given.

Using OpenRefine for natural history collections data

Erica Krimmel¹, Ms. Lindsay Walker²

¹*DigBio, Florida State University, , United States*, ²*Symbiota, Arizona State University, , United States*

OpenRefine (<https://openrefine.org/>) is a free, open source software for exploring and manipulating text data. As digitization and digital data management become increasingly important aspects of collections management, OpenRefine can be a useful tool to visualize data issues and to clean data efficiently. Its user interface is intuitive and provides an easier learning curve than programming languages like R, Python, SQL, etc. Additionally, because OpenRefine runs locally on your computer, it is ideal for use with sensitive data and/or no internet connection. This demo will show how to use OpenRefine's faceting and clustering tools, which can help you identify and clean up similar values, as well as make bulk edits. The demo will also show how you can use OpenRefine to compare one column of data to another, including from an external webservice. The latter can be particularly useful when you need to reference an external authority—e.g., one that covers taxonomic nomenclature—to verify your specimen data, or when you need to acquire additional information based on the data you have—e.g., you have geographic coordinates and need to know county names.

Using public programs and classroom team-based research to collect, digitize, and study large collections of fossil alligators from Florida

Mr Mitchell Riegler^{1,2}, PhD Student Lazaro Vinola Lopez^{1,2}, PhD Student Rachel Narducci^{1,2}, PhD Student Jeanette Pirlo^{1,2}, PhD Student Maria Camila Vallejo-Pareja^{1,2}, PhD Student Joshua Doby^{1,2}, Museum Preparator Jason Bourque², Vertebrate Paleontology Collections Manager Richard Hulbert², Museum Technician Ngoc-Nhu V. Tran², Undergraduate Intern Sierra Steely², Vertebrate Paleontology Curator Jonathan Bloch^{1,2}

¹University Of Florida, Gainesville, United States, ²Florida Museum of Natural History, Gainesville, United States

(CC3) Connecting Communities to Natural History Collections, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

Florida vertebrate fossil sites have been heavily studied for their abundance, diversity, and preservation. For decades, the Florida Museum of Natural History (FLMNH) has enlisted support from the community to help in the excavation, preparation, and curation of these sites. Since 2015 hundreds of volunteers have participated in the late Miocene (5 - 5.5 Ma) Montbrook fossil dig, producing one of the largest known pre-Pleistocene (before 2.6 Ma) museum collections of fossil alligators, including 16 relatively complete skulls and partial skeletons of young to older individuals, while also filling a critical gap in the late Miocene history of alligator evolution.

While the size and quality of the Montbrook alligator sample provide an incredible opportunity to study an extinct population from the late Miocene, such a project would take a long time using traditional methods. We used a University of Florida course on Paleontological Research Methods as an opportunity to work together as a group to digitize, study, and publish the sample. The course involved undergraduate and graduate students of varying backgrounds, requiring each to apply a research method. Instead of more narrow traditional research methods, the broadening of participants led to the inclusion of diverse methodologies from 3D geometric morphometrics, stable isotope geochemistry, and morphology-based systematics. Additionally, we used X-ray computed tomography (CT) and surface scanning technology to produce a large publicly accessible 3D digital database of crocodylian skulls that will continue to be useful for research and education.

Results from this team-based approach include descriptions of three new fossil alligator species from Florida and a taxonomic reevaluation of a fourth. Results from isotopic analysis of crocodylian and alligator fossils suggest prey exclusivity between the two groups until the extirpation of crocodiles from Florida.

Additionally, our analyses of the CT scans revealed a novel cranial bone not previously documented within Crocodylia. Lastly, the 3D models from our digital collection have been downloaded for artistic, educational and research purposes. These results were only made possible because of the immense contributions made by a diverse assemblage of community members and students and highlight the productive possibilities resulting from total community teamwork.

Using specimen citations to show the impact of natural history collections: metrics, machine learning, and manual annotation

Professor Andrea Thomer¹, Dr Sara Lafia²

¹University Of Michigan School Of Information, Ann Arbor, United States, ²Inter-university of Consortium of Social and Political Research, Ann Arbor, United States

(LI) Liberating Natural History Collections Data in Biodiversity Literature, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Though imperfect, surfacing citations is important for understanding the impact of scholarly products – including natural history specimens. However there are many known obstacles to extracting specimen citations from the scholarly record. First, specimen identifiers are not standardized in format. Second, many papers do not include full records of materials examined. When they do, they're often relegated to appendices and supplementary materials, and therefore less “visible” to citation aggregators like CrossRef. Finally, not all NHM-related literature is digitized or machine readable – particularly papers over 30 years old or in small society journals. Given the long “half-life” of NHM specimens, this makes it challenging to truly understand the impact of collections over the long-term.

In this presentation, we describe our work to surface citations for two collections: the University of Michigan Museum of Zoology (UMMZ) and a subset of the University of Texas, Austin Vertebrate Paleontology (TMM) collections. We started by using machine learning methods to automatically extract specimen identifiers. We manually labeled specimen codes in a sample of 21 academic articles, resulting in a training set of 117 unique specimen identifiers. We then trained a transformer-based Named Entity Recognition (NER) model using this training data. We applied our highest recall NER model to 461 papers known to cite specimens provided by collections managers from the UMMZ Mammal Division and 495 papers provided by TMM.

We found 870 unique identifiers in the UMMZ papers and 3,615 unique identifiers in the TMM papers. Our analysis is still in progress, but our approach surfaces specimen co-citations, allowing us to associate authors' use of fossils from multiple collections, and study context of use (i.e., geographic, temporal). Next steps will likely involve manual annotation of papers and bibliography creation, and the analysis of extended citation networks. We close by discussing the value – and danger – of reporting metrics for collections, and discuss the need for metrics scaled to breadth, lifespan and diversity of natural history collections.

Using Symbiota to establish a global, decentralized model for high-quality data aggregation: Novel concepts and designs to improve the interoperability of occurrence-based biodiversity data

Mr. Edward Gilbert¹, Samanta Orellana¹, Katelin Pearson¹, Gregory Post¹, Dr. Laura Rocha Prado¹, Dr. Jenn Yost², Dr. Beckett Sterner¹, Dr. Nico Franz¹

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G6: General, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

The Symbiota software platform (<https://symbiota.org>) has risen to prominence as an international tool for assembling, networking, and distributing datasets associated with biological collections. The open-source software package distributed via GitHub has been used by numerous research teams to establish data portals based on specific taxonomic and geographic themes. Portals function as Content Management Systems (CMS); occurrence data are managed directly within the portal as "live datasets", though often augmented with the import of data "snapshots" originating from external systems yet otherwise aligned with the portal's community of practice and data focus. In this respect, data portals additionally serve as mini-aggregators, integrating multiple specimen datasets that collectively represent a community-based research perspective.

One could argue that Symbiota's mid-level aggregator functionality compounds the further fragmentation of occurrence data. Rather than conforming to the vision of pushing data from the source to the global aggregators and ultimately the research community, specimen data are distributed across a growing array of mini-aggregators. However, the decentralized approach has been shown to promote the emergence of multiple regionally, taxonomically, or institutionally localized, self-identifying communities of practice. Communities remain empowered to control the social and informational design and versioning of their local data infrastructures and signals. The upfront cost of decentralization is more than offset by the long-term benefit of achieving sustained expert engagement, higher-quality data products, and ultimately more societal impact for biodiversity data.

To mitigate the negative consequences of fragmented datasets across a decentralized network, the Symbiota Support Hub, a new domain of iDigBio, has implemented a number of enhancements that allow distributed portals to function as an integrated network of data aggregators. Improvements in tracking project metadata, data provenance, record annotations, and the establishment of a public Application Programming Interface (API) architecture that regulates machine-to-machine annotation propagation have enhanced interoperability by providing support for real-time transmission of occurrence annotations across the distributed network of Symbiota portals. This enables the platform to continue to be used for establishing decentralized, domain-specific knowledge communities, while also achieving the goals of the centralized paradigm in making data findable and accessible on a global taxonomic and spatial scale.

Vascular plants from North Africa deposited in the BC herbarium

Dr. Noemí Montes-Moreno¹, Dr. Neus Ibáñez¹, **Mrs Neus Nualart¹**

¹*Botanical Institute of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain*

The sub-collection of North African Plants, deposited in the Botanical Institute of Barcelona, is one of the most important collections that offer a great coverage of the Maghreb floristic area, including Morocco, Tunisia, and Algeria. It is scientifically relevant because it covers an important floristic area, the Maghreb, which is considered a hotspot of biodiversity, because of its high taxonomic richness and strong plant endemism.

The core of the North African plants sub-collection started to be built over a century ago by the eminent botanist Pius Font Quer (1888-1964), who carried out important research work on the flora of Morocco, considerably unknown at the early XIX century. Another botanist who made important contributions to the North African sub-collection was Frere Sennen (Étienne Marcellin Granier-Blanc, 1861-1937) who published numerous new nomenclatural proposals for Moroccan taxa. This collection is closely related to the historical interest in Moroccan flora by the Botanical Institute staff, that periodically carry out collection campaigns in Morocco for research projects and it is continuously growing. The accessions increased actively through two important projects: the "Catalogue des Plantes Vasculaires du Nord du Maroc" (2002) and the "Biogeographic study of the flora of Andalusia and its relations with that of the North of Morocco" (2002-2005).

At present, all specimens are catalogued using Herbar application (with some Elysia functionalities), being both applications developed by the Spanish GBIF node. Google Earth was used to assign geographic coordinates to the specimens. Nowadays it includes 36,991 specimens and 1101 nomenclatural types, collected from XIX century to present, and 99.31 of specimens have geographic coordinates.

This communication provides a general quantitative and qualitative description of the North African plants sub-collection and also a general description of the process carried out to make it available to scientific community.

Watching History Repeat Itself: How undergraduate involvement in collections has changed (or not) over the past 200 years at a small liberal arts college.

Ms. Lyndell Bade¹

¹*Colby College, Waterville, United States*

(AU) Authentic natural history museum experiences to prepare students for global challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 11:30 AM - 1:00 PM

Undergraduate liberal arts education in the United States, particularly New England, has a long history with collections, specimen acquisition as a teaching tool, and use of collections in teaching. The current use of collections objects in undergraduate education parallels in comparison to the use of, in some cases, those very same objects after they were collected. While attempting to replace lost inventory and metadata information about our specimens, it was necessary to return to the archives of those professors who founded the college and department. Similarities found between the origins of the natural history collection as a tool for teaching biology between the 1850s, 1930s, and late 2010s included the incorporation of students in collection, preservation, and restoration of an actively used but then neglected collection.

What is a “good” mount? Evaluating the technical quality, pedagogical adaptability, and institutional value of taxidermy mounts.

Wesley "Skip" Skidmore¹, Director Steven Sullivan²

¹Monte L. Bean Life Science Museum, Brigham Young University, Provo, United States, ²Hefner Museum Of Natural History, Miami University, Oxford, United States

A defining feature of museums is the exhibition of authentic objects for learning and teaching. Increasingly, it is desirable to repurpose specimens originally preserved as a simple record of biodiversity into exhibits that illustrate global challenges. Achieving such goals may be complicated if the preservation process distorts specimens in ways that are inaccurate or alienating to visitors, or creates use, storage, or conservation challenges. Museum staff tasked with acquiring, using, valuing, and caring for taxidermy specimens often lack expertise in evaluating and resolving potential issues. Here, we present guidelines for determining the quality of a mounted specimen and its usability in a given context, focusing on six areas: preservation method and materials; archival and pedagogical value; status in the wild; physical condition; accurate representation; ability to be modified without loss of value. These guidelines draw from broad perspectives including conservation biology, competitive taxidermy, commercialization of wildlife, donor relations, and institutional missions to provide practical methods to evaluate specimens.

What next? Taking action to enable natural science collections to be socially engaged: an open discussion

Dr Liz Hide¹

¹*Sedgwick Museum of Earth Sciences, University Of Cambridge, Cambridge, United Kingdom*

(CE) Civically engaged natural history museums: transforming public programmes to address societal challenges, Lecture Theatre 3, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

This session will bring together the themes outlined by earlier speakers in this symposium to identify future priorities and actions for both museums and sector organisations to ensure natural science collections can positively contribute to societal change. With input from both symposium speakers and audience participants, we will discuss:

- How can we as a sector draw on the ideas and research in these presentations to create a more socially engaged approach to our public engagement? How can we make sure we are part of the solution to societal challenges, not part of the problem?
- What are the barriers to our museums and collections delivering this type of work? for example, are they about staff skills & confidence, management support, access to information, links with communities, funding?
- As well as the societal challenges exacerbated by the pandemic, are there also opportunities for us?
- What could we put in place to support and address this work ?

What we did in the shadows: Digitising the London NHM bat collection for the Covid-19 Chiroptera Knowledge Base.

Ms Phaedra Kokkini¹, Roberto Portela Miguez¹, Dr Gábor Csorba²

¹Natural History Museum, London, United Kingdom, ²Hungarian Natural History Museum, Budapest, Hungary

(VA1) Virtual Access – transitioning natural history collections for digital-on-demand, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 2:00 PM - 3:30 PM

One of the most critical questions to answer about SARS-cov-2, the virus that caused the Covid-19 pandemic, is its origin. So far, the most similar coronavirus to SARS-cov-2 was found in the species *Rhinolophus affinis*, a common Southeast-Asian horseshoe bat. Lack of easy access to information on this and closely related species prompted a SYNTHESYS+ Virtual Access project proposal to make a Covid-19 Chiroptera Knowledge Base that could support multidisciplinary research on this group of mammals. This project aims to collect information on the distribution and ecology of the horseshoe bats (Rhinolophidae) and their closely related families Hipposideridae and Rhynonycteridae, also making these collections more discoverable for potential research into zoonotic diseases through genetic sampling. As one of the nine participating institutions, the Natural History Museum, London contributes one of the largest and taxonomically comprehensive bat collections in the world. We audited our collection of over 8,000 bat specimens, parts of which had never been databased before. For each specimen, we examined all available types of preparations (wet specimens, skins, skulls and postcranial skeletal material) and transcribed in detail their label data. Furthermore, we recorded curatorial issues, flagged data discrepancies, as well as cleaned and enhanced our existing records. In addition, we imaged over 180 primary type specimens, specifically capturing the dorsal, lateral and occlusal views of skull material, as well as the dorsal and lateral views of the nose-leaf on spirit material, which can be used for species identification. All data are being made publicly available on the NHM Data Portal and the Covid-19 Chiroptera Knowledge Base. In this presentation I will summarize the data we collected from our bat specimens, consider the idiosyncrasies of digitising specimens split into different preparations, and discuss the issues we encountered with legacy digital data.

What's the use? Physical and digital use of the Naturalis collection

Max Caspers¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

G3: General, Lecture Theatre 2, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 9:30 AM - 11:00 AM

Worldwide there are thousands of repositories housing natural history collections (NHC), commonly striving to preserve biological and geological objects and to improve accessibility for current and future use. The importance of NHC to discover, inspire and teach has been highlighted in many ways, especially recently in the light of environmental and biodiversity crises. Initiatives like DiSSCo and iDigBio, which aim at digitally aggregating NHC, further expand the impact and relevance of NHC. Their critical role in our society also becomes evident from the steady flow of researchers visiting NHC, papers being published based on NHC and funding being awarded every year for their maintenance.

Despite our efforts as a community to manage these incredibly important NHC's, answering simple straightforward questions can be very challenging. For example: how big is your collection, how many species do you have or to what extent is your collection used? Part of the challenge is getting the definitions ironed out; for example what units are used to count your collection, what do you consider a valid species and how do you measure use? Applying a more data driven approach to the valorisation of NHC helps to substantiate their role in society, for example by zooming in on physical and digital use.

This presentation elucidates how use has been measured historically at Naturalis and what we can learn from both the results achieved and the methods used. Seemingly straightforward at first, consistent gathering of comparable data on collection use is quite demanding. Challenging aspects are defining the right categories for measurement, the availability and willingness of collection staff to follow strict administrative protocol and finding the right balance between time invested and effectiveness of the data in relation to the goals of measuring. Considering the ongoing digitization of NHC the presentation exemplifies the potential of detailed and consistent knowledge on collection use for all kinds of purposes, ranging from strategic policy to measures for collection conservation.

When Butterflies Don't Migrate Voluntarily: A 4,000-mile Moving Story

Kayla Kramer¹, Collections Technician Kelsey Falquero¹, Assistant Registrar Cailin Meyer¹, Collections Manager Floyd Shockley¹, Maru Losada¹, Curator of Insects Derek Sikes²

¹Smithsonian Institution - National Museum Of Natural History, Washington, D.C., United States of America, ²University of Alaska Museum, Fairbanks, United States of America

G12: General, Lecture Theatre 4, Appleton Tower, 11 Crichton Street, EH8 9LE, June 8, 2022, 9:30 AM - 11:00 AM

In Fall 2019, the Department of Entomology at the Smithsonian National Museum of Natural History (NMNH) in Washington, D.C. sent a four-person team with the Collections Manager to prepare and ship approximately 45,000 Arctic Lepidoptera (butterflies and moths) stored at the University of Alaska in Fairbanks, Alaska at the Museum of the North. This collection was moved to the University after the death of the owner, Dr. Kenelm Philip who left it to NMNH. The team spent two weeks examining and stabilizing pinned specimens in entomology drawers, before palletizing stacks of drawers for sea and land transit to D.C. This presentation explores the practical details of stabilizing, packing, shipping, unpacking, and incorporating a large collection of extremely fragile specimens, with the aim of providing technical advice and lessons learned from the experience.

Where Did You Find That!?

Ms Amy Covell-Murthy¹

¹*Carnegie Museum Of Natural History, Pittsburgh, United States*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

The Anthropology Collection of The Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, USA holds approximately 1.4 million objects, including archaeological material from the Upper Ohio River Valley. Accession Number 6395 is a large and unusual effigy pipe that was found in a field in Washington County, Pennsylvania. It was uncovered first by the blade of a farmer's plow. This pipe appears to be Adena, which refers to the mound building cultural group who occupied much of Ohio from approximately c.800 BCE.- c.1CE Though there are a few Adena archaeological sites in Western Pennsylvania, the exact origin of this pipe is unknown. This pipe is often used to illustrate the importance of the relationship artifacts have to each other and the situation in which they are found in an archaeological site. Since this pipe was found in a field and not in the context of an excavated site, we cannot say for sure where it originated. It may have been traded, or it may have been part of a larger site that was destroyed. There is no way of knowing how long it had been in the field. It could have been there for over a hundred years or someone could have put it there a month before it was hit by the plow. Using the spotlight format, people can quickly understand how valuable this object is to education, not because of its cultural significance but because it can be used to magnify the importance of good record keeping and proper excavation techniques.

Why cultivated plants matter: how chance and plants have collided through the ages enabling scientists to develop medical treatment.

Mrs Lydia Walles¹

¹*Royal Horticultural Society, Woking, United Kingdom*

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

Specimen: Petunia 'Night Sky'

"Are there hidden cures in your garden?" asks an exhibition in the Royal Horticultural Society's (RHS) new Hilltop building at Wisley. We all know that plants have always been, and continue to be, an essential feature of traditional and modern medicine - from the use of foxgloves (*Digitalis lanata*) in heart medication through to the use of St John's Wort (*Hypericum perforatum*) in the treatment of depression.

So where does the humble (and some might say slightly divisive) Petunia 'Night Sky' come into the story? It was awarded the RHS Award of Garden Merit and is certainly unique in the world of flower patterning due to every flower having a different speckled pattern. Its colour also responds to the air temperature - no other petunia is quite so distinctive. But its story starts in 1990, 25 years before it was bred, when scientists Mapoli and Jorgensen were breeding petunias to try and achieve the deep indigo colour that is so well represented by Petunia 'Night Sky'. What they inadvertently discovered through their experiments was a new understanding of genetics that would trigger a revolution in medical science and result in Nobel Prize winning technology.

This specimen spotlight will explore how, from a personal perspective, 'Night Sky' converted me to the benefits of cultivars, and how the pursuit of more variety in petunias not only resulted in the breeding of this award winner but, more importantly, made extraordinary contributions to the world of medicine.

Why not use RFID's in natural history collections?

Mr Luc Willemse¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

(ID1)Identifiers and labels in natural history collections: new technologies, challenges and opportunities for linking objects and data, Lecture Theatre 1, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 2:00 PM - 3:30 PM

In most repositories with natural history collections, unique object identifiers are commonplace. The introduction of unique digital identifiers was necessary to link data and information to objects and via objects eventually to storage locations. Unique digital identifiers developed, after their initial introduction more than twenty years ago, from a linear, 1-dimensional (1D) barcode system, to 2-dimensional (2D) Data Matrix or QR codes. The next step in the evolution of registration codes in natural history collections could be the inclusion of RFID chips in labels carrying the registration codes. RFID chips nowadays can be produced with a lifespan and at a size and cost that makes incorporation at a large scale in natural history collections become feasible.

Results are shared of a small pilot applying registration labels with built in RFID chips to digitize 1000 specimens of Hymenoptera. An example of a scanning device will be presented that is able to flawlessly scan all RFID's in boxes with hundreds of RFID chipped Hymenoptera specimens in seconds. Based on use cases, advantages of RFID chips for insect collections are highlighted while at the same time pointing to some of the challenges that need to be addressed still before a large-scale introduction of RFID can be considered.

Natural history collections worldwide share many challenges like the balancing act between work volume and available resources and optimizing accessibility. The introduction of RFID's could be an important step to further improve accessibility and increase efficiency in a number of the work processes in natural history collections.

Window to the Past

Jessica Lane¹

¹Fort Worth Botanic Garden | Botanical Research Institute of Texas, Fort Worth, United States of America

(SS) Specimen spotlight, Lecture Theatre 5, Appleton Tower, 11 Crichton Street, EH8 9LE, June 7, 2022, 4:00 PM - 5:30 PM

At the Botanical Research Institute of Texas Philecology Herbarium, staff discovered two palm specimens collected by Alfred Traverse in 1960. These specimens are unusual because of their associated photographs, not often seen mounted on specimens this old. These photographs depict the living palm tree in situ on a roadside in suburban Houston. In the background, viewers see the history that surrounded the trees: cars, buildings, powerlines. The photographs add context to the specimens, and allow the viewer to frame the specimens in a place and time. A first-time herbarium guest might not understand the significance of a specimen, but seeing these photographs can help connect the threads of history, nature, science, and art that are present in every natural history specimen. The photographs become more significant when we look at that same roadside today. The landscape has changed dramatically, and the palm trees are no longer present. These specimens and photographs document their lives, just like every specimen does, but in a way that is readily visible to the casual observer.

WSY HERBARIUM- OUR DIGITAL FUTURE

Mrs Mandeep Matharu¹, Mrs Lydia Walles¹, Mrs Sian Tyrrell¹

¹*Royal Horticultural Society Gardens, Surrey, United Kingdom*

In 2011 with a capacity of 60,000 specimens, a herb scan and one staff member, the Royal Horticultural Society's herbarium (now known as The 1851 Royal Commission Herbarium, and with the official abbreviation WSY) started its digitisation journey with the goal of creating a 'Virtual Herbarium'. In the Winter of 2020-2021, amidst a pandemic, the team moved the collection to a state of the art facility based in our new building 'RHS Hilltop – The Home of Gardening Science'. The new facility includes a space for 400,000 herbarium specimens in a temperature and humidity controlled environment and a digitisation suite with a high spec camera. All rooms within the herbarium suite have windows through which our visitors can glimpse into our fascinating collections and the herbarium's curation and research work.

With around 90,000 (and growing) digitised specimens, thanks in part to sponsorship by the Society's members, the 1851 Royal Commission, the Mellon Foundation and the National Lottery Heritage Fund, the herbarium is ready to share the world's largest ornamental plant collection with a wider audience through the Libnova Open Access online portal. The RHS has adopted the Libsafe digital preservation platform for the long-term preservation and public sharing of its digital herbarium and library collections. This new platform will safeguard the digitised herbarium specimens and their metadata in a cloud based solution whilst allowing the team to share specially curated collections and themed sets with the public alongside items from the RHS's botanical art, photography and library collections.