



**SPNHC &
ICOM NATHIST**
VIRTUAL 2020
8–12 June

The Role of Natural History Collections in Global Challenges

Managing Collections in Crazy Times

Abstracts



Organizing committee

Liath Appleton, [Andrew Bentley](#), [Emily Braker](#), [Mariana Di Giacomo](#), Phaedra Fang, [Elspeth Haston](#), [Shelley James](#), [Talia Karim](#), Amanda Lawrence, [Paul Mayer](#), Cindy Opitz, Rebecca Newberry, [Deborah Paul](#), Christel Schollaardt, [Barbara Thiers](#), Debra Trock, Dorit Wolenitz, [Breda Zimkus](#)

All content in this document is Creative Commons Attribution License 4.0 (CC BY 4.0)
<https://creativecommons.org/licenses/by/4.0/>

CONTENTS

CONTENTS	2
PROGRAM	3
Monday, 8 June 2020	3
Tuesday, 9 June 2020	4
Wednesday, 10 June 2020	4
Thursday, 11 June 2020	4
Friday, 12 June 2020	6
PLENARY SESSION	7
SYMPOSIUM ABSTRACTS	8
Tuesday, 9 June 2020	8
Wednesday, 10 June 2020	9
Thursday, 11 June 2020	10
Friday, 12 June 2020	10
ORAL PRESENTATIONS	13
POSTERS	57
VENDOR Q&A	66
SPONSORS	68



[@www.spnhc.org](http://www.spnhc.org)
[@NathistCOM](https://www.facebook.com/NathistCOM)



[@SPNHC](https://twitter.com/SPNHC)
[@IcomNathist](https://twitter.com/IcomNathist)

PROGRAM

Times are provided as **UTC+0** – you can determine these times at your location using the handy website <https://timeanddate.com>.

All sessions have been recorded and are available on the [SPNHC YouTube Channel](#).

Online Detailed Daily Schedules [[Tuesday](#)] [[Wednesday](#)] [[Thursday](#)] [[Friday](#)] [[Posters](#)]

Monday, 8 June 2020

SPNHC Committee Meetings

Unless otherwise specified, committee meetings are open to all attendees.

Zoom SPNHC Channel	Zoom KU Channel
12:00-13:00 Best Practices	
13:00-14:00 Legislation and Regulations	
14:30-15:00 Conservation	13:30-14:00 Biodiversity Crisis
15:00-15:30 Emerging Professionals	International Relations
15:30-16:00 Professional Development	Theft/Security Monitoring
16:00-16:30 Web and Social Media	Bylaws
Break	Grants and Recognition
21:00-22:00 Conference	Membership
22:00-23:00 Publications	Education
23:30-01:00 SPNHC Council Meeting (closed session)	

ICOM NATHIST Working Group Meeting

The working group meeting is open to all attendees, but room capacity is limited.

Google Channel

14:30-16:00 What is a museum? About the new museum definition

Tuesday, 9 June 2020

Zoom SPNHC Channel

12:00-14:00 Plenary Session: Reopening Collections

Break Vendor Q&A - [Delta Designs](#)

14:30-16:30 Symposium: History matters! The Value of the Humanities in Natural History Museums

21:00-23:00 Symposium: Natural History Collections in Latin America

Break Vendor Q&A - [EarthCape Research and Collection Data Management System](#)

21:00-1:30 Symposium cont.: Natural History Collections in Latin America

Wednesday, 10 June 2020

Zoom SPNHC Channel

12:00-14:00 ICOM NATHIST Annual Business Meeting

14:30-16:30 SPNHC Annual Business Meeting

21:00-23:00 Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

23:30-01:30 General (Potpourri) Session 1

Thursday, 11 June 2020

Zoom SPNHC Channel

12:00-14:00 Symposium: Managing and Mobilizing Collection Data with Specify Software

Break Vendor Q&A - [Specify Collections Consortium](#)

14:30-16:30 [Education Share Fair](#)

21:00-23:00 General (Polyphyly) Session 2

23:00-23:30 Vendor Q&A - [Tru Vue, Inc](#)

23:30-01:30 General (Mixed Collection) Session 3

Friday, 12 June 2020

Zoom SPNHC Channel

12:00-14:00 Symposium: MIDS and MICS: Minimum Information Out of Digitisation

Break Vendor Q&A - [Picturae](#)

14:30-16:30 General (Miscellany) Session 4

21:00-23:00 Specimen Spotlights; and Storage Techniques for Art, Science, and History Collections (STASH)

23:30-01:30 Emerging Professionals Event

Zoom KU Channel

14:30-16:30 Symposium: Anthropocene in Natural History Museums

Online Detailed Daily Schedules

[\[Tuesday\]](#) [\[Wednesday\]](#) [\[Thursday\]](#) [\[Friday\]](#) [\[Posters\]](#)

PLENARY SESSION

Reopening Collections

Tuesday, 9 June - 12:00-14:00 UTC

The Post-Pandemic Future of Museums

Dr. Elizabeth Merritt

Vice President, Strategic Foresight & Founding Director, Center for the Future of Museums, American Alliance of Museums

Collections Emergency Management in the COVID-19 Era

Samantha Snell

Collections Management Specialist, Smithsonian National Collections Program, Smithsonian Institution, Washington DC, United States

Caring for Heritage Collections during the COVID-19 Pandemic: Focus on Reopening

Dr. Tom Strang, Irene Karsten, Janet Kepkiewicz, Simon Lambert, and Crystal Maitland

Canadian Conservation Institute (CCI) COVID-19 Task Force, Ottawa, Canada

COVID-19 Impacts on Biodiversity Science Collections: A Preliminary Look

Dr. Barbara M. Thiers

Patricia K. Holmgren Director, William and Lynda Steere Herbarium, Vice President, and Curator of Bryophytes, New York Botanical Gardens, New York, United States

Re-opening Archives, Libraries and Museums (REALM) Information Hub (A COVID-19 Research Project)

Dr. Scott Miller

Deputy Under Secretary for Collections and Interdisciplinary Support, Smithsonian Institution, Washington DC, United States

SYMPOSIUM ABSTRACTS

Tuesday, 9 June 2020

History Matters! The Value of the Humanities in Natural History Museums

Heumann I², **Wolenitz D**¹, Hermannstdter A²

¹ICOM NATHIST, Ramat-gan, Israel, ²Museum für Naturkunde, Berlin, Germany

Tuesday, 9 June - 14:30-16:30 UTC

Natural history museums are hybrid and multi-layered institutions. Using a wide range of specimens, they investigate natural history and life on Earth and shape our perception and understanding of nature. In addition, natural history museums are embedded in changing political systems and social transformations and thus articulate and transport cultural values. Given this cultural, historical, and political dimension, natural history museums constitute an exciting research field for the humanities.

Recently, some natural history museums have established humanities departments while others undertake or facilitate individual research projects with a focus on cultural, historical and social issues and contexts. This session aims to present some of these approaches and projects in order to discuss the potentials and values of integrating the humanities within a science institution.

Natural History Collections in Latin America: A Central Piece in the Puzzle of the Discovery and Conservation of Global Biodiversity.

Diaz A¹

¹Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt, Villa De Leyva, Colombia

Tuesday, 9 June - 21:00-1:30 UTC

Curiosity of humankind and its natural tendency to collect, treasure, and describe the unknown, are powerful reasons that explain why nowadays our world has one of the most important resources for the documentation of biodiversity: natural history collections. They constitute the physical repository of the natural world and are invaluable treasures thanks to which we are able to discover new species, reconstruct their evolutionary history and patterns of distribution, track changes in species composition and morphology over time, prioritize areas and taxonomic groups for conservation, and lead education programs, just to name a few of their uses. In other words, biological collections are crucial for the discovery and understanding of the natural world. Latin America is a vast area that runs from Mexico to Argentina and includes six of the ten most biodiverse countries in the world (Brazil, Colombia, Mexico, Perú, Ecuador, and Venezuela) and six biogeographic regions identified as Biodiversity Hotspots because of accelerated habitat destruction: Mesoamérica, Atlantic Forest (Brazil, Paraguay, Argentina), Cerrado (Brazil), Valdivian temperate rain forests (Chile, Argentina), Tumbes-Chocó-Magdalena (Panamá, Colombia, Ecuador, Perú), and Tropical Andes (Venezuela, Colombia, Ecuador, Perú, Bolivia). This means that in Latin America, species are being discovered at a higher rate than in other regions of the world, and at the same time it requires urgent efforts of conservation to prevent extinction in such biodiverse parts of the planet. Natural history collections in the region are key in the achievement of this goal and persist in their mission, some of them even facing isolation, political, and economic challenges. With this symposium we will provide an overview

of the current state of natural history collections in Latin America, their contributions to the knowledge of biodiversity and world change, challenges, and opportunities to connect and collaborate with collections and researchers around the world.

Wednesday, 10 June 2020

Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

Paul D², McCuller M¹, Hogue G¹, **Krimmel E**², Livermore L³, James S⁴, **Marshall C**⁵

¹*iDigBio, Florida State University, Tallahassee, Florida, United States*, ²*North Carolina Museum of Natural Sciences, Raleigh, North Carolina, United States*, ³*Natural History Museum, London, England*, ⁴*Western Australian Herbarium, Perth, Australia*, ⁵*Oregon State University, Oregon, United States*

Wednesday, 10 June - 21:00-23:00 UTC

The role of collections management in the biodiversity data lifecycle has been dramatically affected by worldwide specimen digitization programs. Institutions looking to support a visionary future for collections-based biodiversity data need to cultivate a culture of lifelong learning as the expectations of collections management evolve. This symposium will highlight key challenges and opportunities involved in designing and driving such a vision that can address impending global challenges.

Reviewing actual and potential uses for data generated by digitization programs reveals a rich resource, with significant promise to address critical needs for humans and the planet. Furthermore, groups like the Biodiversity Collections Network envision an “extended specimen network” that would go beyond basic specimen digitization and include complexities parallel to those in the physical world, e.g., trait data, linked data, expanded metadata, etc. Identifying the skills, tools, and personnel roles that could realize such a network and take advantage of its potential highlights challenges on all organizational levels and includes diverse stakeholders. From researchers desiring richer datasets, to collections staff looking for streamlined workflows, to curators interested in sharing knowledge generated from specimen-based research, to museum directors highlighting data assets, the list of stakeholders expands along with our vision for the future potential of biodiversity data.

Stakeholder communities have put considerable effort into capacity-building aligned with producing and managing biodiversity data throughout its lifecycle. That said, skills development is a constant need, and the tools that would complement these skills in an extended specimen network require significant enhancement. Concurrently, the personnel roles typically associated with different aspects of the biodiversity data lifecycle (e.g., collection, digitization, mobilization, management, publication) are constantly being refined. As this happens, the people responsible for these roles, and the institutions that house them, may need to re-evaluate capacity, infrastructure, and behavior at an organizational level.

Thursday, 11 June 2020

Managing and Mobilizing Collection Data with Specify Software

Beach J¹

¹*Specify Collections Consortium, Lawrence, Kansas, United States*

Thursday, 11 June - 12:00-14:00 UTC

Specify (www.specifysoftware.org) is an open source collections management platform developed and supported by the Specify Collections Consortium (SCC). The Consortium, comprising 80 collection institutions in 13 countries, represents a cooperative long-term, international investment in governing, innovating, and sustaining open-source cyberinfrastructure for natural history museums. Member institutions have authority and influence in the Consortium with representation in SCC's Board of Directors and Advisory Committees for Science and Technology, and have direct access to technical support services. Together, the SCC is building on the strength of 20 years of biological collections software engineering to expand the impact of our members' digital footprint in increasingly integrative global research data systems.

In this symposium, SCC institutions will describe their collections data initiatives and how they are supported with Specify software. Presentations will show how the Specify 6 desktop application and Specify 7 web platform can be used independently or concurrently to accomplish data management and publishing goals. Among the capabilities to be highlighted are Specify's ability to customize user interfaces, labels, fields, vocabularies, permissions, and the software data model according to individual collection workflows. Specify's ability to import data from external files enables inspection and validation before inserting data into the database, and exporting data in Darwin Core (DwC) Archive files through the IPT (Integrated Publishing Toolkit) or directly to aggregators offers the flexibility for participation in broader computing efforts. Specify users will also show how web portal interfaces expose data for public use in various contexts and how web linkages can maintain the network connection between specimen records and associated images, tissues, or DNA samples deposited with external aggregators. Recent revisions in the data model offer new integrative capabilities, and software enhancements promote data collaboration and engagement with user and stakeholder communities.

Friday, 12 June 2020

MIDS and MICS: Minimum Information Out of Digitisation

Haston E¹, Hardisty A², Addink W⁴, Groom Q⁵, Petersen M³

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*, ²*Cardiff University, Cardiff, United Kingdom*, ³*Museum für Naturkunde Berlin, Berlin, Germany*, ⁴*Naturalis Biodiversity Center, Leiden, Netherlands*, ⁵*Meise Botanic Garden, Meise, Belgium*

Friday, 12 June - 12:00-14:00 UTC

Information on the state of digitisation within an institute is essential for efficient curation and budget management of a collection. It also helps decision-makers at all levels to evaluate a collection's importance. Yet there are no community-wide guidelines for which data should be gathered and in what format. The Minimum Information about a Digital Specimen (MIDS) and the Minimum Information about a Digital Collection (MICS) specifications define the expected and optional information elements that are recommended to be present when publishing digitised information about specimens and collections respectively at various levels of digitisation. This symposium will present work accomplished so far and

explore how adopting minimum information standards can help to improve the quality of published collections data.

Specimen Spotlight

Coorough Burke P², **Mayer P**¹

¹The Field Museum, Chicago, Illinois, United States, ²Milwaukee Public Museum, Milwaukee, Wisconsin, United States

Friday, 12 June - 21:00-22:15 UTC

This symposium consists of short, lightning-round type talks on one special specimen found in a collection. Something that has an amazing story to tell. Presenters will share why that specimen is a favorite or is critical to science or education. Why does it matter? Why is it important? What makes it important? What work has been done on it?

Storage Techniques for Art, Science and History Collections (STASH): Storage Tips STASH Flash Symposium

Abraczinskas L¹

¹Michigan State University Museum, East Lansing, Michigan, United States

Friday, 12 June - 22:30-23:00 UTC

Recent reports from the International Council of Museums Committee (ICOM), the Organisation for Economic Co-operation and Development (OECD), the U.K. Museums Association, and the U.S. Institute of Museum and Library Services (IMLS) document the benefits and impacts that museums and collection-holding institutions provide worldwide. In order for users to fully benefit from collections, museums must be able to adequately access materials in storage. Recent reports also indicate that overcrowding and poor storage environments are a global challenge.

The SPNHC Storage Tips symposium is designed to highlight creative approaches to storing natural history collections, thereby facilitating their use for research and programming. The symposium will utilize a lightning round or “tips” format to highlight a broad range of short (5-10 minute) presentations on the following themes:

- Storage mounts or support systems that demonstrate ingenuity and utility. These can be scenarios related to disaster preparedness, impacts of changing regulations, moving collections, new solutions to old problems, public access to collections, sustainability, use of new materials, or collections digitization.
- Multi-function supports serving more than one purpose, such as storage, examination, travel, and/or exhibition purposes.
- Creative storage solutions for collections large and small.

Solutions are shared for all natural history disciplines:

- Zoological specimens (all types of preparation)
- Botanical specimens (all types of preparation)
- Geological specimens
- Vertebrate and Invertebrate Paleontological specimens (including microfossils and nannofossils)
- Paleobotany specimens (including appropriate microfossils, nannofossils, cyanobacteria, and fossil palynology materials)
- Ethnography and archaeology

The presentations will be formatted for inclusion on the Storage Techniques for Art, Science and History Collections (STASHc) website www.STASHc.com. The STASH website includes the original content of the SPNHC publication "Storage of Natural History Collections: Ideas and Practical Solutions" and the interdisciplinary editorial board is composed of representatives from a range of allied organizations, including SPNHC.

The Anthropocene at the Museum of Natural History

Kramar N¹

¹*Musée De La Nature Du Valais, Sion, Switzerland*

Friday, 12 June - 14:30-16:30 UTC

The idea of integrating the increasing/growing influence of human activities on the environment in Earth's history dates back to the 19th century. Yet it was not until the dawn of the 20th century that a real development of this idea became visible in academia through the notion of the Anthropocene. Museums of science and technology, art, history, or anthropology, have produced exhibitions about this topic since 2013. Natural science museums started to address this issue in 2016. Beyond the geological debate, the Anthropocene offers the opportunity to take a step back on any particular environmental problem, as it sheds light on planetary conditions in a comprehensive way. Thus, this session aims, through examples of research or exhibition projects, to discuss the interest for our institutions and our visitors in using this concept.

ORAL PRESENTATIONS

STASHc.com: A Collaborative Online Resource

Abraczinskas L¹, Goldberg L², Perkins Arenstein R³

¹Michigan State University Museum, East Lansing, Michigan, United States, ²Goldberg Preservation Services, LLC, Corning, New York, United States, ³A.M. Art Conservation, LLC, Scarsdale, New York, United States

Friday, 12 June - Symposium: Storage Techniques for Art, Science, and History Collections (STASH)

The [STASHc.com](https://www.stashc.com) (Storage Techniques for Art, Science and History collections) online resource was created to share well-designed storage solutions and has grown annually to include innovative and creative solutions from a wide range of allied collections care professionals. The resource catalogs storage support solutions for art, history, and natural science collections and gives museum professionals from institutions of all types and sizes access to a bank of ideas designed to provide better collections care. The site can be used to find solutions to emergent and recurrent storage problems, prompt the development of new ideas, or build upon what others have accomplished to solve storage conundrums. Unlike some other aspects of preventive care, there are few right or wrong answers in creating storage supports, and a successful solution is the result of numerous choices regarding materials, techniques, skills, and time. The site crowd-sources community driven solutions and creates a platform for connections and commentary between collecting institutions, individuals involved in collections care, and preservation vendors. Entries are vetted by an interdisciplinary editorial committee composed of representatives from a range of allied organizations, including the Society for the Preservation of Natural History Collections (SPNHC). STASHc.com was launched in 2014 by the Foundation for Advancement in Conservation (FAIC) in collaboration with SPNHC as a way to digitally gather, organize and solicit new storage ideas. The project was generously funded by the Samuel H. Kress Foundation and is based on the understanding that the best ideas for safe and sustainable storage and support come from collaborative solutions. STASHc.com includes the original content of the foundational SPNHC volume “Storage of Natural History Collections: Ideas and Practical Solutions” (edited by Carolyn L. Rose and Amparo R. De Torres). The FAIC initiated STASHc.com as part of a cluster of collections care initiatives targeted at addressing concerns shared by collecting institutions. This presentation provides an overview of the STASHc.com website’s structure and features. The editorial committee is eager to increase the number of published articles and to encourage site activity through assistance from the preservation community worldwide.

The European Loans and Visits System, ELViS

Addink W¹, Islam S¹, van Dongen W²

¹Naturalis Biodiversity Center, Leiden, Netherlands, ²Picturae BV, Heerhugowaard, Netherlands

Friday, 12 June - General (Miscellany) Session 4

During 2020-2021 the European Loans and Visits System (ELViS) will be developed within the SYNTHESYS+ project (Smith et al. 2019 <https://doi.org/10.3897/rio.5.e46404>). The system is developed as a service towards smoother, faster and better access to natural history collections across Europe. ELViS will facilitate the placement, assessment, prioritisation and monitoring of requests for visits, loans and digitisation.

Initially it will support access to the facilities participating in SYNTHESYS+. After the project ELViS will be handed over to the DiSSCo (Distributed System for Scientific Collections) consortium to become the first operational core service of the DiSSCo Research Infrastructure. It will then be scaled up to provide access to all European collections in Europe participating in DiSSCo.

We will demonstrate the initial developments to support the first Virtual Access call (ELViS Minimum Viable Product), reflect on the results of the first usage of the system for the call and we will present the design for the further development towards a fully operational ELViS version 1 at the end of 2020.

MICS-ing Collection and Specimen Descriptions in the European Collections Index to Provide Better Access to Collections

Addink W¹, Islam S¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

Friday, 12 June - Symposium: MIDS and MICS: Minimum Information Out of Digitisation

As one of the core services in DiSSCo, the new pan-European Distributed Infrastructure of Scientific Collections, a European Collection Index (ECOI) will be provided as a catalogue to the DiSSCo natural scientific collections. This service will make use of Minimum Information on Digital Collections (MICS) to describe collections and will combine that with Minimum Information on Digital Specimen for collection items that have been digitized already to the specimen level. Both can make use of the Biodiversity Information Standards (TDWG) Collections Descriptions (CD) standard under development (<https://github.com/tdwg/cd>) to describe collections.

The European Loans and Visits System (ELViS) is a service developed within the SYNTHESYS+ project (Smith et al. 2019 <https://doi.org/10.3897/rio.5.e46404>) to improve access to natural history collections across Europe. It will make use of ECOI to enable discovery of collections for loans, visits and digitization on demand, at the most granular level possible. It will make use of collection level descriptions for non-digitized collection items and will combine that with specimen level descriptions for items in the same collection that have been digitized.

In the presentation we explain the initial design of ECOI and how the service is going to be used in ELViS. A first version of ELViS is planned to be operational at the end of 2020, which means that a pilot version of ECOI will also be in place at that time, as a micro service within the ELViS services.

Looking Ahead: Perspectives for the Future of Museu Paraense Emílio Goeldi Collections

Akama A¹

¹*Museu Paraense Emílio Goeldi, Belém, Pa, Brazil*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The Goeldi Museum is the oldest Brazilian research institute in the Amazon and holds a large collection of animals and plants. The Museum is listed as being within the top 5 largest Brazilian collections for mammals, birds, plants, insects and spiders, and herpetofauna. Moreover, the collections are rapidly growing; for example, the fish collection had 4,000 lots in 2014 and now has more than 40,000 lots to date. The rapid growth rate and the harsh Amazon climatic conditions pose a difficult task on storage and maintaining millions of specimens. Therefore, to face the future, the museum is under modernization including new buildings, collections moving to compact shelving, and installation of an inert gas fire suppression system. Improvements also include a new data center and a project for improved scientific communication, which is based on virtual environments, to disclose scientific reports, and share images and 3D models for the general public.

With the recent advances in DNA studies, all collections are moving towards preserving tissue samples that are kept in 96% alcohol at -18 °C. The Goeldi Museum has a large collection of tissues (about 100,000) from

all taxonomic groups. The Museum will operate a cryogenic facility able to hold more than 110,000 samples starting in 2020, becoming the first Brazilian biological depository dedicated to cryogenic preservation of the Amazon Biodiversity.

Despite all these favorable improvements, which enable the Museum to face the 21st century challenges, the institution is now facing an impending threat. Our lack of personnel is a major obstacle to the curatorial needs for all collections. As many of the technicians and curators are retiring in the next five years, a serious problem for management of the collections is soon to start.

HUA: A Very Active Herbarium in Colombia, Working on the Knowledge of Biota and its Conservation in One of the Most Diverse Regions of the Planet

Alzate F¹, Cardona F¹, David H¹, Murillo J¹

¹*Institute of Biology. University of Antioquia, Medellín, Colombia*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The HUA Herbarium, founded in 1969 at the University of Antioquia, located in the city of Medellín, northwest of Colombia, currently has about 230,000 specimens, mainly from groups such as Angiosperms with 160,000, Ferns 20,000, Mosses 15,000 and Fungi with 13,000. The collection includes 1,745 type collections, 88.5% of these being from plants occurring in Colombia and 59% (1,027) from the department of Antioquia. Parallel to this collection, the herbarium has a growing tissue bank with about 2,000 specimens, which have been used in the definition of phylogenetic relationships, evaluation of regional biogeographic hypotheses, character evolution and barcoding. The scientific activity of the herbarium has promoted the exploration of unknown geographical areas which, due to the armed conflict that Colombia has experienced, had not been explored. This biological collection has a high research activity focused on specimens and the generation of new results combining classical taxonomy and current phylogenetic methods, a process in which a considerable number of students and professionals participate. Purposes and tasks of the herbarium include the determination of conservation states for the species occurring in the department, the exploration of strategic ecosystems such as the paramos and the dry forest, the conduct of systematic studies that include evolutionary hypotheses and taxonomic developments, exploration of the potential of biological collections in ecology and conservation studies, and community work to promote the conservation of regional flora and ecosystems. Transcending the basic activities of a biological collection, this herbarium has also participated in developing environmental policies, and in joint work with other institutions and botanists both nationally and internationally. The challenges of recent years have allowed research on floristic diversity to be financed from productive capital funding campaigns and the results are mutually beneficial for the generation of knowledge and the conservation of resources that historically have been little valued in one of the megadiverse nations of the planet.

The Poppy that Means I'm Home

Barteau P¹

¹*New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, United States*

Friday, 12 June - Symposium: Specimen Spotlight

What does it mean to belong somewhere? For me, nothing evokes the feeling of belonging more than the sight of an *Argemone* poppy. My favorite specimen in our herbarium is Herb 2881, which is an *Argemone* poppy from Catron County, like me, and like me, it has a complicated relationship with home. They are a native plant where I grew up, and the altitude at which they grow makes the transition into their range

distinct. They are, however, an aggressively invasive plant in many parts of the world, yet one species is so private that it is only known to live in a single canyon where its gene pool has become so minute that it will soon disappear. As hyperaccumulators, they possess the potential to treat contaminated soil, but due to this property are highly toxic and have caused many cases of human and animal poisoning. Partial to disturbed soil, they create a brilliant visual record of overgrazing and overexpansion. The multifaceted existence of this genus of flower elegantly illustrates the complexity of what it can mean to belong in the Anthropocene.

A History of Successful and Productive Collaboration Between Avocational and Professional Paleontologists

Bauer J¹, Topor M²

¹University of Michigan, Ann Arbor, Michigan, United States, ²Friends of the University of Michigan Museum of Paleontology, Ann Arbor, Michigan, United States

Wednesday, 10 June - General (Potpourri) Session 1

The University of Michigan Museum of Paleontology (UMMP) as it currently stands was established in 1926. This departmental unit is a research museum with curatorial faculty and collections staff that provide insight for exhibits, secure funding for the collection, and provide curatorial expertise. The Friends of the University of Michigan Museum of Paleontology, referred to as the Friends, was founded in 1971 by R.V. Kesling, R.B. Chilman, and J.D. Wright as a local group to engage the community with fossil collecting and paleontological knowledge. Since its origin, the Friends have been closely connected to the UMMP with faculty and staff being greatly involved. The Friends have donated countless specimens, purchased or financially supported specimens, been co-authors on 20+ papers, been acknowledged 15+ times in publications, have supported 5+ graduate student theses, have 25+ taxa named after them, and have been recognized for national awards.

Furthermore, the Friends donated specimens to the UMMP to help the grand re-opening of our public facing Natural History Museum. These are exquisite specimens that they have chosen to share with not only the Ann Arbor community but with everyone who visits the University of Michigan. Over the past 25 years, they have contributed funds to preserve and procure fossils for display. In the recently established exhibit space, the Friends were granted a special display case that will rotate out with their own specimens that they are allowed to select and curate. This partnership has persisted for 49 years and has been a rewarding and productive relationship for both the Friends and the faculty and staff at the UMMP. The total impact is immeasurable. I hope others can learn from us to make science and collections more accessible.

The Chiapas Digitization Project 1 Year On

Benson L¹

¹Independent/The Chiapas Maya Project, Bath, Maine, United States

Thursday, 11 June - General (Polyphyly) Session 2

The original idea of The Chiapas Digitization Project was to create an all-encompassing virtual archive of objects, images, recordings, and written records to document a rapidly changing culture. Existing material of culture collections had not been sufficiently documented or were readily accessible. The scope of the project was initially deemed impractical and should be scaled back. After rethinking the project, a new plan was presented to the first partners, Museo Na Bolom, and the weaving cooperative, Sna Jolobil, with formal memorandum of understanding documents. Due to prior miscommunication, we feel these agreements were critical to moving forward. The Project Lead in the US is investigating Mukurtu (<https://mukurtu.org/>) as the database for collections in Mexico not currently digitized or imaged. It is affordable, open-source,

scalable, and websites can provide access to specific communities. The last criterion is essential to one of our collection partners, concerned with access and intellectual property rights. Once chosen, necessary fields will be mapped to the existing Mukurtu data fields, a test collection entered, standards developed, and the resulting data entry procedure guide translated into Spanish. A lexicon will be developed by project collaborators using standardized fields and conventional terminology for partner collection use. A project website, www.chiapasmayaproject.org, is in development. Initially, it will contain the test collection, blog posts by collaborators, project prospectus, lexicon, and a digital exhibit.

CDP continues to face problems with the lack of infrastructure and equipment, technical support, and funding. Collaborators are exploring the steps needed to apply for nonprofit status in both the US and Mexico, a necessary step for grant funding. In the meantime, we are looking for a financial sponsor. The Science Museum of Minnesota, our US partner, recently applied for a grant to digitize their collection as their part of this project. Once funding is found for needed infrastructure and staffing, we will continue digitizing collections and move to Phase II. Phase II of the project includes internships and training in documentation, curation, and conservation for indigenous and local students. We hope to establish connections with collections and conservation communities in the Americas and worldwide.

A Multifaceted Museological Commitment to the Anthropocene

Bernardi M¹, Caliarì S¹, Caola A¹, Giovannini A¹, Maiolini C¹, Tombolato D¹, Lanzinger M¹

¹Muse - Science Museum, Trento, Italy

Friday, 12 June - Symposium: Anthropocene in the Natural History Museum

This presentation provides an overview of the projects and activities promoted by MUSE Science Museum, Trento (Italy) in recent years on the overarching topic of the Anthropocene. The theme is the pivotal foundation of the museum strategy: all the departments are committed to support it – exhibition & events development, naturalistic research, communication, corporate membership & fundraising – to highlight the questions, incongruences, and emergencies but also to underline the revolutionary power of the current, unique time we are living in.

A number of examples will help to provide an understanding of the wide range of activities made by the museum team, including staff training, traditional natural science exhibitions about the extinction of biodiversity, political lobbying activity to support SDGs, creation of events and exhibitions intertwining philosophy and science of the Anthropocene. The ultimate goal for the museum is to play the activist role society calls for.

A complete digitization of German herbaria is possible, sensible and should be started now

Borsch T¹, Stevens A-D¹, **Häffner E¹**, Güntsch A¹, Berendsohn W¹, Appelhans M², Barilaro C³, Beszteri B⁴, Blattner F⁵, Bossdorf O⁶, Dalitz H⁷, Dressler S⁸, Duque-Thüs R⁷, Esser H-J⁹, Franzke A¹⁰, Goetze D¹¹, Grein M¹², Grünert U⁶, Hellwig F¹³, Hentschel J¹³, Hörandl E², Janßen T¹⁴, Jürgens N¹⁵, Kadereit G¹⁶, Karisch T¹⁷, Koch M¹⁰, Müller F¹⁸, Müller J¹³, Ober D¹⁹, Porembski S¹¹, Poschlod P²⁰, Printzen C⁸, Röser M²¹, Sack P¹⁰, Schlüter P⁷, Schmidt M²², Schnittler M²³, Scholler M²⁴, Schultz M¹⁵, Seeber E²³, Simmel J²⁴, Stiller M¹², Thiv M²⁵, Thüs H²⁵, Tkach N²¹, Triebel D^{9,26}, Warnke U³, Weibulat T^{26,29}, Wesche K²⁷, Yurkov A²⁸, Zizka G^{8,30}

¹Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin, Berlin, Germany, ²Department of Systematics, Biodiversity and Evolution of Plants, University of Göttingen, Göttingen, Germany, ³Landesmuseum Natur und Mensch, Oldenburg, Germany, ⁴Universität Duisburg-Essen, Essen, Germany, ⁵Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) Gatersleben, Gatersleben, Germany, ⁶Universität Tübingen, Institute of Evolution & Ecology, Tübingen, Germany, ⁷Universität Hohenheim, Stuttgart, Germany, ⁸Senckenberg Museum Frankfurt, Frankfurt am Main, Germany, ⁹Staatliche Naturwissenschaftliche Sammlungen Bayerns, Botanische Staatssammlung München,

München, Germany, ¹⁰Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany, ¹¹Universität Rostock, Lehrstuhl Allgemeine und Spezielle Botanik und Botanischer Garten, Rostock, Germany, ¹²Übersee-Museum Bremen, Bremen, Germany, ¹³Friedrich Schiller University Jena, Institute of Ecology and Evolution, Department of Systematic Botany with Herbarium Haussknecht and Botanic Garden, Jena, Germany, ¹⁴Humboldt-Universität zu Berlin, Institut für Biologie, Späth-Arboretum der Humboldt-Universität, Berlin, Germany, ¹⁵Institut für Pflanzenwissenschaften und Mikrobiologie, Herbarium Hamburgense, Universität Hamburg, Hamburg, Germany, ¹⁶Institute for Molecular Physiology, Johannes Gutenberg-Universität Mainz, Mainz, Germany, ¹⁷Museum für Naturkunde und Vorgeschichte, Dessau, Germany, ¹⁸Technische Universität Dresden, Dresden, Germany, ¹⁹Christian-Albrechts-Universität zu Kiel, Botanisches Institut und Botanischer Garten Kiel, Kiel, Germany, ²⁰University of Regensburg, Regensburg, Germany, ²¹Martin Luther University Halle-Wittenberg, Halle, Germany, ²²Stadt Frankfurt am Main - Palmengarten, Frankfurt am Main, Germany, ²³Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Germany, ²⁴Staatliches Museum für Naturkunde Karlsruhe, Karlsruhe, Germany, ²⁵Staatliches Museum für Naturkunde Stuttgart, Stuttgart, Germany, ²⁶Staatliche Naturwissenschaftliche Sammlungen Bayerns, SNSB IT Center, München, Germany, ²⁷Senckenberg Museum of Natural History Görlitz, Görlitz, Germany, ²⁸Deutsche Sammlung für Mikroorganismen und Zellkulturen, Braunschweig, Germany, ²⁹GFBio - Gesellschaft für Biologische Daten e. V., Bremen, Germany, ³⁰Goethe-Universität Frankfurt, Frankfurt am Main, Germany

Thursday, 11 June - General (Mixed Collection) Session 3

Plants, fungi, and algae are important components of global biodiversity and are fundamental to all ecosystems. They are the basis for human well-being, providing food, materials and medicines. Specimens of all three groups of organisms are accommodated in herbaria. The large number of specimens in herbaria provides an ample, permanent and continuously improving knowledge base on these organisms and an indispensable source for the analysis of the distribution of species in space and time critical for current and future research relating to global biodiversity. In order to make full use of this resource, a research infrastructure has to be built that grants comprehensive and free access to the information in herbaria and botanical collections in general. This can be achieved through digitization of the botanical objects and associated data.

The botanical research community can count on a long-standing tradition of collaboration among institutions and individuals. In the spirit of this collaborative history, 51 representatives from 30 institutions advocate to start the digitization of botanical collections with the overall wall-to-wall digitization of the flat objects stored in German herbaria. Germany has 70 herbaria holding almost 23 million specimens. 87% of these specimens are not yet digitized.

Making full use of the data gained by digitization requires the set-up of a digital infrastructure for storage, archiving, content indexing and networking as well as standardized access for the scientific use of digital objects. A standards-based portfolio of technical components has already been developed and successfully tested by the Biodiversity Informatics Community over the last two decades.

Herbaria constitute a large part of the German botanical collections that also comprise living collections in botanical gardens and seed banks, DNA- and tissue samples, specimens preserved in fluids or on microscope slides and more. Once the herbaria are digitized, these resources can be integrated, adding to the value of the overall research infrastructure. We have compiled nine scientific use cases of immediate societal relevance for an integrated infrastructure of botanical collections. We propose to start this initiative now in order to valorize German botanical collections as a vital part of a worldwide biodiversity data pool.

‘Animals Brought from Every Part of the Globe’: A Study of the Imperialist Aspect of the First Generation of Zoological Societies in the Nineteenth Century

Broekhuis W¹

¹*Artis Royal Zoo Amsterdam, Amsterdam, Netherlands*

Tuesday, 9 June - Symposium: History matters! The Value of the Humanities in Natural History Museums

This thesis is an inquiry into the imperialist and nationalist aspect of nineteenth-century zoological societies. The aim is to get a full view on how these institutions were connected to the colonies and whether embodying an imperialist ideology was an aspect of the early zoological societies. Subjects of research are the Zoological Society of London (1826), Amsterdam’s *Natura Artis Magistra* (1838) and The Antwerp Royal Society for Zoology (1843).

This inquiry starts with the founding of each Society. Their mission statements aimed to contribute to the establishment of collective pride, related to national commercial and political successes and royal patronage. The view on nature was utilitarian. Next, the ways in which these societies gained their collections (and whether a colonial network existed) are explored. In general, the animals were donated by members or benefactors: members of royal houses, foreign politicians or nobility and colonial officials who were members of the societies. The majority of animals in each garden came from the colonies of the respective country. The act of giving helped construct a sense of collectivity. Together with the status of the animals as a colonial commodity, this strengthened the ideological element of these institutions.

The way the collections were presented and experienced in the gardens of the societies is next addressed. Attention is paid to architecture, the animals, cases in which exotic humans were showcased, and the public. Zoo buildings often had strong exotic influences. The animals were seen and presented as representatives of their colonized homelands. The presence of indigenous keepers helped add an exotic dimension. Experiencing all this colonial splendour in the city, provided self-affirming pride to the visitors.

The conclusion is that there was definitely an imperialist element to these institutions, at least because of the way animals were brought to the zoo either as diplomatic gifts or gifts from colonial officials. Zoos were not purely a ‘tool of the empire’, but this aspect of their history is not to be ignored either. Could further study on the significance of this colonial past be incorporated in the educational mission and conceptual vision of modern day zoos?

The Story of Jack: Life and Legacy of the First Elephant of *Natura Artis Magistra*

Broekhuis W¹

¹*Artis Royal Zoo Amsterdam, Amsterdam, Netherlands*

Tuesday, 9 June - Symposium: History matters! The Value of the Humanities in Natural History Museums

In 1839, the Amsterdam Zoological Society *Natura Artis Magistra*, founded only a year earlier, acquired her first elephant. The bull Jack was originally brought to Europe from Ceylon and ended up in Amsterdam as part of the travelling animal collection of Cornelis van Aken. Once bought by the Society, the elephant became one of its main showpieces. From 1847 onwards, however, Jack proved to be increasingly unmanageable. He was eventually shot in 1849. His skeleton was thereafter displayed in the museum of the Society (Groote Museum), amidst other skeletons and stuffed animals.

With this paper an attempt was made to uncover and describe as much of Jack's life as possible, by examining municipal archives, the archives of Artis, the inventory of van Aken's travelling menagerie, nineteenth-century newspaper articles, as well as old photographs and artworks. Writing a biography about a non-human being may be unconventional, but works well within the contemporary tendency of the Humanities to take an interest in the natural world.

This episode in the history of Artis not only appeals to the imagination. It can tell us a great deal about the spirit of the times with regard to the relationships between man and nature, the West and the colonies and the development and shifting role of zoological parks since their inception up to this present day. Jack's skeleton and story is of both natural- and cultural-historical importance and relates a valuable tale about our changing way of looking at and interacting with nature. What can be done with the information gathered about Jack nowadays and how can it contribute to the story that Artis as a modern zoo wants to tell in this current day and age?

Cretaceous World TCN: Digitizing the Western Interior Seaway Collections at the Yale Peabody Museum Final Report

Butts S¹, Sorojsrisom E¹, Norris C¹

¹*Peabody Museum of Natural History, Yale University, New Haven, Connecticut, United States*

Friday, 12 June - General (Miscellany) Session 4

As a participant in the Cretaceous World TCN (Thematic Collections Network - US NSF Award #DBI-1601884), the Yale Peabody Museum (YPM) digitized invertebrate, vertebrate, and microfossil collections from the Western Interior Seaway, including iconic fossils like Archelon, Hesperornis, Xiphactinus and the Karl O. Waage invertebrate collection. The Western Interior Seaway (WIS) was a shallow sea that covered the western United States in the Late Cretaceous during a greenhouse climate. The goal of the project is to completely digitize our collection and make it available for researchers via iDigBio and GBIF. These data will allow scientists to answer fundamental questions about this changing ecosystem, which are relevant to the modern challenges of our changing climate.

Over three and a half years, we have digitized over 107,000 lots (over 161,000 specimens). Most are georeferenced with multiple images of each specimen. To achieve this, we developed high throughput digitization protocols using Inselect (Natural History Museum, London). Inselect, available on GitHub, was developed for digitization of pinned insects. We have modified the protocols to digitize concretions, microfossil slides, and specimen lots. This project builds on the successes of the iDigPaleo data aggregator, funded by the Fossil Insect Collaborative (FIC) TCN (idigpaleo.org). The data model and front-end of iDigPaleo was skinned as the Cretaceous World site, which hosts the aggregated educational portal Cretaceous World (cretaceousworld.org). Both the FIC and Cretaceous World TCNs are in the process of ingesting data directly from iDigBio, which includes data from our partners: YPM, University of Colorado, American Museum of Natural History, the University of Kansas, the Los Angeles County Museum of Natural History (submitted PEN), Oklahoma Sam Noble Museum, Fort Hays-Sternberg Museum, South Dakota School of Mines and Tech, University of Texas at Austin, the Paleontological Research Institute, and the US National Museum of Natural History. We have produced 3D scans of 48 YPM specimens, archived morphosource.org (project name Western Interior Seaway). Eleven undergraduate students have been trained in specimen digitization techniques. Four high school students, participants in "EVOLutions" the Yale Peabody Museum after-school program, interned on the Cretaceous World TCN.

Kronosaurus and the Woman in the Red Dress

Byrd C¹

¹*Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, United States*

Friday, 12 June - Symposium: Specimen Spotlight

Today, *Kronosaurus queenslandicus* is the logo for the Museum of Comparative Zoology (MCZ) at Harvard University and a visitor destination for the MCZ's exhibits in the Harvard Museum of Natural History in Cambridge, Massachusetts. This extinct marine reptile from the Cretaceous of Australia made a splash at the museum after it was brought to Massachusetts and prepared by Dr. Alfred Romer and his team of fossil preparators. When the fossil was fully prepared, reconstructed, and ready for exhibit, it received its day in the spotlight with the lady in the red dress. The resulting image, originally used for a Museum postcard, became an icon that is widely recognized today. Join me on a brief trek through time to explore this iconic image, learn about the lady in the red dress, and the influence of this image in the museum and paleontology communities.

Are Those Teeth?: An Oreodont's Story From New Mexico

Cantrell H¹

¹*New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, United States*

New Mexico Museum of Natural History and Science stores a unique and fascinating specimen of *Merychys major*, a member of the Oreodontidae family, which is an extinct group of browsing ungulates endemic to North America that lived 35 to 7 million years ago (Ma). The specimen was discovered in 2008 by two geologists of the New Mexico Bureau of Geology and Mineral Resources as they were mapping in Bosque del Apache National Wildlife Refuge, just 18 miles south of Socorro, New Mexico. After a permit was obtained for excavation, New Mexico Museum of Natural History and Science (NMMNHS), New Mexico Bureau of Geology and Mineral Resources, and the US Fish and Wildlife Service (USFWS) worked together to collect the fossil. The specimen included a nearly complete skull, mandible, and partially articulated postcranial skeleton. To make the story even more interesting, the skull was found on one side of a fault line while the rest of the skeleton was found on the other, about one meter higher than the skull. This individual is significant for numerous reasons, the first being that it possesses an ossified larynx. The presence of an ossified larynx is extremely rare among mammals and is related to sound production. An example of a mammal alive today with an ossified larynx would be the Howler Monkey, so it is believed that this species of oreodont was able to produce loud vocalizations. Secondly, this individual was the first and remains the only one of its kind to be found in the Poptosa Formation, part of the Santa Fe Group. In addition to this oreodont being the largest of the genus *Merychys* currently known, a nearby radioisotopic date indicates a late Miocene age of about 10 Ma, making this the youngest oreodont known from New Mexico.

What Happens When You Let an Ecologist Loose on Your Specify Database: Semi-Automated Data Cleaning Using R

Carper A¹, **Karim T**¹

¹*University of Colorado Museum of Natural History, Boulder, Colorado, United States*

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

While there is a push to digitize more and more specimens, less attention has been paid to the tremendous task of verifying primary and associated digitized specimen data after it has been created. Batch processing has increased the speed and accuracy of data generation, but it has also created additional needs for quality

control, as user error and/or other issues during automated processes may be magnified when applied through high throughput processing. Moreover, with millions of records in need of verification, individually checking each one is impractical, if not impossible. Thus, mechanisms to identify errors and automate identification and removal of those errors are needed to ensure higher quality data. Here, we describe our method for verification of image attachments in our Specify 6 database and discuss its potential application to other institutions.

The Invertebrate Paleontology section at the CUMNH has imaged over 60,000 fossil terrestrial arthropods since 2013 as part of the Fossil Insect Collaborative TCN (Thematic Collections Network). Images were batch uploaded into Specify using the Import Attachment Mapping File option. In order to verify that attached images are associated with the correct specimen record, we created a query in Specify to return the catalog number, comments, and the entire original file name of the image. These data were exported as csv files in batches of 20,000 records or less and merged in R, resulting in a file containing information about 61,096 image attachments. Data were initially summarized in Excel and explored using pivot tables and other formulas to understand, for example, how many attachments were associated with a single specimen record and whether the catalog number in the original file name matched the catalog number of the record to which it was attached. These types of queries enabled us to narrow down the number of records that need individual checking from over 60,000 to just a few hundred. Lastly, this workflow was standardized and made into an R script so that the same series of QC steps could be repeated periodically (e.g., when new large image datasets are imported), and more easily adapted to meet the needs of different collections.

No Môr Plastic: Utilising the Permanent Natural History Displays at Amgueddfa Cymru - National Museum Wales to Support Youth Led Climate Activism

Carter J¹, Younan S¹

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

Thursday, 11 June - General (Mixed Collection) Session 3

No Môr Plastic (a play on words where ‘môr’ means ‘sea’ in the Welsh language) was a pilot project for Amgueddfa Cymru’s ‘Hands on Heritage’ programme supporting the format of the creative ‘museum intervention’; a fast-paced and temporary way to bring contemporary topics into the museum and provide young people with a platform.

Such youth-led intervention projects can provide opportunities to reassess and raise awareness of museum practices and to enable young people, and wider audiences, to influence displays and interpretation in the museum environment. These projects also open up the wealth of objects and specimens found in museum collections and enable a widened active participation in highlighting key issues around our environment, culture and heritage.

The ‘No Môr Plastic’ intervention used the permanent marine displays in the Natural History galleries to highlight the growing impact of plastic waste in the marine environment. The ideas around the intervention were led by the Museum’s Youth Forum, who in keeping with the museum format of showing authentic materials, decided that ‘real’ beach plastic should be brought into the museum and used. For this the collections and exhibitions team played an active role in supporting the intervention through their knowledge of materials, collections and the display environments, whilst keeping the overall control of the project with the Youth Forum itself.

This presentation will explore the collaborative work that occurred to develop the ideas, the process of collecting and conserving the waste to enable it to be safely used in the museum gallery environment, and the reaction and impacts of the project on visitors, staff, and the Youth Forum alike.

New Museum Guides by the Swedish National Heritage Board Concerning Human Remains and Repatriation

Chef Holmberg I¹, Eldh K¹

¹*Swedish National Heritage Board, Visby, Sweden*

Thursday, 11 June - General (Polyphyly) Session 2

All over the world, we see movement of objects. Many objects require repatriation back to countries or groups of origin, particularly human remains. In a joint presentation, we will present two newly written guides for Swedish museums published and produced by the Swedish National Heritage Board. The first one is about museums work with the return of objects. Return of objects relates to all types of categories. Human remains, objects with colonial context, objects stolen during Nazi times, objects belonging to indigenous peoples, etc. The other is about handling human remains in museums and describes collection management specifically based on human remains. The focus is on the processes themselves, collection, documentation, storage, research, display, deaccession, and disposal. The importance of ethical stances, communication and putting into context is emphasised.

Both guides have been written in consultation with the Swedish Central Museums and the Sami Parliament. We have encountered many questions and discussions regarding the work of both of these guidelines that we like to share. The guides have been jointly developed as many parts affect both guides. Both are intended to be read and used by museums and to inspire internationally. The guides do not create legal obligations or establish mandatory rules for museums. Museums do not have to follow the advice, as they are rather intended to facilitate the ability to act ethically and legally, through case-by-case basis. In the first part, we want to present the process in the preparation of the guides. We will focus on the process in developing the guides and how they can be used. The second part is about human remains. The presentation discusses two questions based on the experience of working with the second guide: What distinguishes human remains from other museum objects? What to consider when displaying human remains?

Building an Online Catalogue for a Marine Invertebrate Collection Using Combined Data Sources

Chin C¹, Mills S¹, Wood B¹, Robbins J¹, Macpherson D¹

¹*National Institute of Water and Atmospheric Research, Wellington, New Zealand*

Wednesday, 10 June - General (Potpourri) Session 1

The National Institute of Water and Atmospheric Research (NIWA) holds one of New Zealand's nationally significant collections - the NIWA Invertebrate Collection (NIC), which has an extensive collection of marine invertebrates collected since the 1950s from New Zealand, the Ross Sea region of Antarctica, and the South West Pacific. NIC uses two separate data management systems to manage their data: 1) Specify Software, a database for retaining collection records; and 2) AtlasMD, an online digital asset management tool for storing marine specimen images with embedded metadata.

NIC is currently developing an online portal: an open access catalogue that provides researchers quick and direct access to information from the NIC Specify database and AtlasMD. The online portal will provide

mapping tools to visualise species observations, high resolution specimen images, full search queries from selected fields available in the Specify database, and the ability to download data and images.

There are two key challenges of the online portal development: 1) linking specimen images from AtlasMD to their corresponding records on the Specify database; and 2) pre-grooming and extracting collection data for a public portal. We will discuss how we link AtlasMD images to Specify, the SQL query and taxon hierarchy table created in Specify that allows us to extract data to our portal specifications, and our experience of building the NIC Portal framework using the two combined data sources.

Extending the use of Specify Software in South African Natural Science Collections

Coetzer W¹

¹*South African Institute For Aquatic Biodiversity, Grahamstown, South Africa*

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

The South African Institute for Aquatic Biodiversity (SAIAB) has been using Specify Software with great success for 20 years. In 2018 we launched the Biodiversity Information Management Platform, through which we make Specify7 web servers available to other South African natural science institutions (seven museums are currently using the Platform). Support requests are coordinated by the Platform Manager and relayed to the team in Lawrence, Kansas, when necessary. Users have expressed their satisfaction with the Specify7 software and the Platform. Having a central Systems Administrator (who is the SAIAB Systems Administrator), to administer the web servers of several museums, is a good way to keep up with evolving technology in the context of South African natural science museums. Many of these museums face decreasing budgets and other institutional challenges that would prevent them from adopting the Specify7 platform independently.

We manage samples of tissue and DNA using the collectionrelationship table to link to voucher specimens. All records of genomic samples are imported using the Specify Workbench. We have a central tissue workbench spreadsheet that reflects a series of consecutive slots in the freezer boxes. Records are imported as batches from this spreadsheet. This allows us to give each sample a freezer location as its record is created.

We have successfully re-used the Specify schema and Workbench application to manage data that do not represent physical specimens (structured biodiversity inventories: human observations of fish recorded in underwater videos, or invertebrates in underwater photoquadrats). Another way in which we have used the Specify schema is by creating a typical annotated checklist of taxa. The resultant data are formatted as a Darwin Core archive and published to the GBIF (Global Biodiversity Information Facility) Data Portal as a checklist. The taxon, taxoncitation, and referencework tables have all the necessary fields to record literature citations, and distinguish between nomenclatural and other citations. Recording species-level information, such as country distribution and associated species in Specify (e.g., host-plants and parasites) is not possible, but we got around this by linking Specify records to records in a MS Access database. This is an area that could potentially be enhanced in future.

A Lysorophian from the Mazon Creek Lagerstätte: A Story Brought to You by Citizen Scientists

Coorough Burke P¹

¹*Milwaukee Public Museum, Milwaukee, Wisconsin, United States*

Friday, 12 June - Symposium: Specimen Spotlight

VP 359229.1 and VP 359229.2 arrived at Milwaukee Public Museum along with thousands of other Mazon Creek concretions in a donation from an ambitious and energetic collector named Robert Kallas. As some of you may know the late Carboniferous (Pennsylvanian) Mazon Creek Lagerstätte, Illinois, USA, is exceptional for the diversity and abundance of preserved fauna and flora found within siderite concretions. The flats of concretions collected by Mr. Kallas waited years before attention was given to cleaning, sorting and labeling them. In 2016 a group of knowledgeable volunteers and MPM staff began the great sorting. Hundreds of specimens were processed and a few treasures discovered, including this aquatic tetrapod, a likely Lysorophian. The specimen is currently on loan to Carleton University, Ottawa, for study by doctoral student Arjan Mann, who specializes in Permo-Carboniferous tetrapod evolution, with a focus on Mazon Creek tetrapods.

The Discoloration of Plants in Botanical Fluid Collections: A Challenge for Research and Conservation

Dangeon M¹

¹*He-arc, Neuchâtel, Switzerland*

Friday, 12 June - Symposium: Storage Techniques for Art, Science, and History Collections (STASH)

Fluid plant preservation has been and still is a method used by botanists for research purposes. Fluid conservation offers advantages that go far beyond those of herbarium and dry jar conservation: ease of use, rapidity of preparation, preservation of volumes (3D) and tissues, possibility of implementing it directly at the moment of plant harvest (also during field campaigns). As a result, these collections are a great resource for vegetal biodiversity.

University of Zurich's Botanical Collection is an academic collection built since the end of the 19th century to the end of the 20th century. The fluid collection, fallen into oblivion since 1976, presents significant degradation, very representative of the alterations encountered on this type of artefact. The main problems lie in the leaks in the jars and the aging of the joints. Another, more specific problem is the discoloration of the specimens in fluids. From this problem arose a research project titled FLUIDIS, which aims to explore different conservation solutions and their impact on the discoloration of plant specimens.

The plant discoloration leads to modification of the color of the preservative fluid. This event is clearly linked to the presence of specific dyes inside certain plant species. However, the involved mechanisms have not yet been completely clarified. The main problem with the coloring of the preserving fluid is related to the research value of the artefact as well as its exhibition value for museums. Indeed, the specimen is completely masked by the color of the fluid and it cannot be correctly observed. This phenomenon can go up to the total opacity of the fluid.

With the FLUIDIS project, we want to understand the mechanisms and phenomena related to the discoloration of botanical specimens preserved in fluid. We aim at determining the influence of the traditional recipes and modern proposals for fluid preservation. We also seek for different procedures or new liquids for the correct preservation of colours in botanical fluid collections.

What Do You Get When You Mix Filipino Silversmiths, President Taft, and a Giant Shell? A Massive Punch Bowl!

Di Giacomo M¹

¹*Yale Peabody Museum of Natural History, New Haven, Connecticut, United States*

Friday, 12 June - Symposium: Specimen Spotlight

At the Smithsonian National Museum of Natural History, it is not rare to find treasures in the collections. However, some treasures are more puzzling than others. One morning, the conservation team was called to do an assessment of a set of objects that had been rediscovered in the Invertebrate Zoology collection. To our surprise, they consisted of a massive punch bowl made of a *Tridacna gigas* shell with a highly decorated silver base with fish and mermaids. In addition to the punch bowl and its ladle, a skillfully decorated 30-piece coffee and tea set is included. After initial assessment, research began. Two trays are the only pieces that have inscriptions. These point towards when and where the set was made, Manila, Philippines, 1903. More importantly, they point to the maker, Fernando Zamora. Further research revealed that it was likely that the silver and gilt set was made by brothers Fernando and Tomás Zamora, members of an award-winning family of silversmiths from Manila. Collections catalogs determined that the set, USNM 1454928, was transferred to the Smithsonian on January 13th, 1906 from the War Department, more specifically, from then Secretary and future President William H. Taft. It was then transferred from Anthropology to Invertebrate Zoology on May 3rd, 1965. The set was brought to the United States to be exhibited in the St. Louis World Fair in 1904, in the Louisiana Purchase Exposition. William H. Taft was Governor of the Philippines 1900-1903, and given that the Philippines had a prominent place in the exhibit, it is likely that after the Fair ended, the set was transferred to the War Department, where he was Secretary. The set was later exhibited in the Lewis and Clark Exposition in 1905 and the Alaska-Yukon-Pacific Exposition in 1906. After its transfer to Invertebrate Zoology, the punch bowl became a feature in the Department until for some reason, it was forgotten. After our assessment and initial cleaning, the punch bowl has recovered its popularity within the Department of Invertebrate Zoology, becoming once again an important piece of the history of the collection, the Smithsonian, and the USA.

Taking Care of Ground Sloths and Glyptodonts: Conservation, Research, and Outreach at the Arroyo Del Vizcaíno Collection in Uruguay

Di Giacomo M^{1,3}, Batallés M^{2,3}, Tambusso S^{2,3}, Varela L^{2,3}, Fariña R^{2,3}

¹*Yale Peabody Museum of Natural History, New Haven, Connecticut, United States*, ²*Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay*, ³*Servicio Académico Universitario y Centro de Estudios Paleontológicos, Universidad de la República, Sauce, Uruguay*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The Arroyo del Vizcaíno collection in the locality of Sauce in Canelones, Uruguay, houses nearly 2000 fossils of Pleistocene mammals, mainly ground sloths and glyptodonts, but also carnivores like *Smilodon* and notoungulates like *Toxodon*. All the fossils collected were obtained from the same site: the bottom of the Arroyo del Vizcaíno stream. The collection began informally in 1997, when a summer drought forced farmers to use water from the stream for their crops. As the bottom of the stream was exposed, hundreds of bones became visible. Teachers and students from the local highschool went to the rescue, extracting over 300 bones and storing them in the school premises. In 2011, our team of paleontologists began excavating the site and the collection was formally established. Since then, the fossils have been relocated several times. In October 2018, construction of new collection and lab spaces was finished, and the collection was moved one last time. After the February 2019 field expedition, recently excavated fossils were brought into the new spaces and shelving was installed. The last move was an opportunity to rehouse

the collection using appropriate materials and to create cavity mounts for delicate fossils. Planning of the spaces was done with expansion of the collection in mind and current monitoring will allow for future environmental controls. Preparation of the fossils now occurs in a separate lab space, avoiding the generation of dust in the clean collection space. Outreach activities by the team started early in the collection's history and now occur on a more regular basis, with didactic and exhibit materials especially created to engage the local community and also those who cannot visit through websites and social media. Research on the fossils has produced several papers in peer-reviewed journals and digitization has contributed to both research and outreach. The collection is now part of the Universidad de la República and an official educational institution in the country. Many fossils remain to be collected, ensuring a decade of future excavations. The collection will face new challenges as more fossils are collected, while continuing to preserve and showcase the paleontological heritage it holds.

Facing Environmental Challenges in the Midst of Megadiversity: How are the Natural History Collections of the Colombian National Biodiversity Institute Contributing to This Goal?

Díaz A¹, Acevedo-Charry O¹, Borja-Acosta K¹, Díaz J¹, DoNacimiento C¹, Espitia D¹, Lozano-Florez J¹, Neita J¹, Ocampo-Rincón D¹, Mendoza-Cifuentes H¹, Tovar-Luque E², Acosta-Galvis A¹, Gomez-Posada C¹

¹*Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt, Villa De Leyva, Boyaca, Colombia*, ²*Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt, Palmira, Valle del Cauca, Colombia*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The world is currently facing some of the most accelerated and hard environmental challenges, which are putting at risk our sources of energy, food, and water. Loss of biodiversity, impacts of climate change, and over-use of natural resources, are among these devastating factors whose effects are particularly serious in megadiverse areas of the planet, such as the tropics, where the total biodiversity is still unknown and threatened. In the particular case of Colombia, the country with the second-highest biological diversity in the world, a recently ended internal armed conflict was an additional cause that kept vast areas of the country unexplored for a long time, while facing threats like deforestation, urbanization, and mining. In the face of this dual necessity of documenting local diversity and conserving it, natural history collections of Colombia's national biodiversity institute, the Alexander von Humboldt Institute, have played a key role during their 25-year history. What started as five collections of the main biological groups, with the solely mission of storing vouchers of the National Biodiversity Inventory, today constitutes one of the biggest repositories in the country with seven open, systematized core collections (amphibians, birds, fish, herbarium, insects, mammals and reptiles) that contain the largest representation of specimens from protected areas of the country, and four extended collections whose novel data seek to provide tools to respond to local environmental challenges: the Environmental Sounds Collection, which started in collaboration with Cornell University, providing acoustic data of Colombian biodiversity; the Seed Collection, part of the Millennium Seed Bank Partnership with Kew, contains germplasm of endemic and endangered plant species from strategic ecosystems; the Tissue Collection, provides fresh material, ready to be sequenced, of all biological groups, and the Egg Collection, with eggs from 1871 until today and harbors more than 25,000 eggs with valuable information on reproductive biology of ca. 2,000 bird species worldwide. All the data, statistics, and particulars that come from the collections are coupled with the labor of researchers and curators, who bring this information beyond the concept of biodiversity libraries to practical scenarios into fields like education, conservation, and decision-making.

Shifting a Collection Data Paradigm: Data Migration Between BG-BASE and Specify

Drinkwater R¹, Cubey R¹, Haston E¹, King S¹

¹Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

BG-BASE and Specify have fundamentally different ways of constructing collection data. In BG-Base the physical collection event and herbarium specimen have a one-to-one relationship; in Specify a collecting event is associated with an abstract collection object, to which all specimens are attached in a one-to-many relationship.

In BG-BASE altering taxonomic or geographic attributes for a particular specimen has no effect on other specimens. In Specify, the tree structure that is utilised for taxonomy and geography means that any change has global impacts across all specimen records. This has significant implications for both the mapping and migration of collection data and the physical curation of herbarium collections. We will discuss the processes that were undertaken to successfully navigate these significant differences as part of our data migration between these two collection management systems.

“Blast to the Past”: A Historic Walking Tour Organized by a Natural History Museum

Fang H¹, Lin Y¹

¹National Taiwan Museum, Taipei, Taiwan

Tuesday, 9 June - Symposium: History matters! The Value of the Humanities in Natural History Museums

The National Taiwan Museum, established in 1908 during Japanese colonial period, is the oldest natural history museum in the country dedicated to natural studies. It has been considered a monument of the Japanese colonial power that was used to market Taiwan as a bountiful colony. As a result, how the Museum seeks to leave behind the colonial impression and emphasizes a reflexive view on Taiwan’s cultural communities became a major issue. In 2004, the Museum initiated the “Taiwan Museum System Plan” based on four modern architectures in downtown Taipei from Japanese period, each representing a pivotal part of Taiwan’s modern history. With the Plan, the Museum extended its space by renovating and utilizing culture heritage sites, bringing close the citizens to the heritage and terminating the building’s long standing reputation as a structural symbol of authoritarianism. By organizing a walking tour of old Taipei, “Blast to the Past”, that connects all museum branches that scatter in the old walled city area, the Museum finds a new way to interpret its history and turns the old Taipei City constructions into an atypical roofless museum that incorporates the historic buildings as a category of museum collections direct-coupled with outreach.

In Taiwan, the enforcement of cultural heritage preservation, environmental movements, and human rights movements were climaxing in the 1980's, and more or less resulted from or were connected with Taiwan’s democratization movement. Revisiting the modern history of Taiwan during the walking tour allows both the staff and the audience to reflect on the role of the Museum in the society, and to consider the sustainable development of the institute, the different ethnic groups in the society and the environment of the island.

Werner Wildlife Museum: Fifty Years and Counting

Finkle P¹, Innella Maiers V¹

¹Casper College Museums, Casper, Wyoming, United States

Tuesday, 9 June - Symposium: History matters! The Value of the Humanities in Natural History Museums

The Werner Wildlife Museum at Casper College began as a hunter's trophy collection and has grown to over 400 birds, fish and mammals. As we celebrate an important milestone, we are taking the opportunity to look back over the museum's last 50 years. What started out as an impressive collection located in a basement is now a growing museum focused not only on the mounts themselves but also on their habitats, behaviors, and ranges.

Dr. Innella Maiers and I have been working on the stories of both Mr. Werner, the museum's founder as well as the history of the collections to determine where these mounts came from and which were original to the museum. Unfortunately, the records from the earliest days have been lost, leaving us with only grainy newspaper photographs and vague stories. As the collections grew, and the museum changed, donations came in from all around the state. We have a large collection from polar bears to bison, and from quetzals to chickadees.

We are working to piece together the history of the collection and to determine what actually belongs to the museum and what is on "long term loan". We also seek to find how the collections were gathered, who donated what, and who might be interested in donating to the museum in the future.

Together we have begun researching the history of collections practices at other museums and universities, and hope to learn more about the college/ museum relationship. At Casper College, the museum is actively seen as both a public facing institution and a research space for students. While we strive to be both, the educational aspect for students working on a degree is limited by the current presentation of the collections and the museum's space restrictions. With this in mind we must work to determine what the next 50 years will look like and how we can facilitate these roles in the future.

Better Together: Merging our Knowledge About People, Places, Collections, and Taxonomies with Wikidata

Fichtmueller D¹, **Güntsche A**¹, Paul D³, Bourgoïn T², Agosti D⁴, Häffner E¹

¹Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin, Berlin, Germany, ²ISYEB, UMR 7205

MNHN-CNRS-Sorbonne Université-EPHE, Paris, France, ³Florida State University, Tallahassee, Florida, United States,

⁴Plazi, Bern, Switzerland

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

In recent years, biological collections worldwide have begun to rethink their local data management and to open up the possibilities for inter-institutional cooperation in data management. There are opportunities for cooperation at various levels, e.g., in the joint creation and maintenance of controlled vocabulary, or the complete abandonment of locally stored data in favour of a central database. In the context of the EU initiative DiSSCo (Distributed System of Scientific Collections, <https://www.dissco.eu/>), a debate is currently underway on the extent to which a radical opening of specimen data into a freely accessible and editable centralized system would lead to a considerable increase in efficiency in data maintenance and at the same time open up completely new integration possibilities for collection data.

Wikidata (<http://www.wikidata.org>) and the underlying Wikibase system offer valuable functionality that is difficult and costly to implement and maintain in traditional collection systems. These are, for example, the

possibility of annotating data on the web, the use of uniform controlled vocabularies, versioning of data, the assignment of stable identifiers for collection objects and the linking of textual information (e.g., personal names and geographical units) with existing semantic resources. In our presentation we will explain various examples of cross-institutional data management and discuss the potential of collaborative data management.

A Juniper in a Carolina Forest

Flannery M¹

¹*St. John's University, Jamaica, New York, United States*

Friday, 12 June - Symposium: Specimen Spotlight

The A.C. Moore Herbarium at the University of South Carolina, Columbia has the largest plant collection in the state including material collected by Henry William Ravenel, a noted 19th-century botanist. Born near Charleston, he later farmed in Aiken, South Carolina, an inland community near Georgia. While he had been interested in botany his entire life, he returned to it seriously after the Civil War when his farm was no longer profitable, and he needed to find other sources of income. Ravenel sold the remaining sets of his five-volume *Fungi Caroliniani Exsiccati* as well as many of his botanical books. He also wrote for horticultural publications, collected specimens which he sold, and attempted to start a nursery business. Through all this he maintained a keen interest in the plant world around him and collected on his walks near Aiken as well as in more coastal areas where he had first lived and where many of his relations remained. Yet Ravenel notes in his journal that the specimen I discuss here was found, not by him, but by his son, Henry St. Julien Ravenel, known as "Harry," who collected it in what is now known as Hitchcock Woods. Ravenel identified the specimen as *Juniperus cammunis*, now *Juniperus communis* L. *depressa* Pursh. The botanist wrote in his journal that "this spot is in virgin forest of Pine, Oak, etc. and there are no signs of clearing or of former cultivation, by which their introduction may be traced to hand of man. . . . Strange that the Alpine form of a tree which grows 1000 mi north, should be found here." I consider this specimen interesting because I too am a northerner living in Aiken. More importantly, the story of Ravenel's botanical work and his continuing links with botanists in both northern and southern states is part of the history of attempts by Southerners to rebuild their professional lives after the Civil War. In addition, the fact that over 2,100 acres of Hitchcock Woods are preserved today, suggests the continuing importance of the natural world to the people of Aiken.

ABS Implementation in the Museum für Naturkunde Berlin and its Collection Database

Giere P¹, Glöckler F¹

¹*Museum für Naturkunde Berlin, Berlin, Germany*

Thursday, 11 June - General (Mixed Collection) Session 3

Compliance with the Nagoya Protocol and its legal implementations is mandatory for institutions located in countries that are party to the protocol — countries that signed and legally acknowledged this international agreement. This entails the need to establish institutional procedures for compliance as well as for the documentation of activities such as access to and utilization of genetic resources (i.e., biological samples). For institutions within the EU, this is required for genetic resources collected in countries of origin that are party to the protocol after 12 October 2014. The related information is part of the metadata for the specimen or sample and it is required to hand on this information to subsequent users or when the specimen is handed on. Thus, linking up this information with the collection database is essential for keeping this data connected to the respective specimens. This, however, is difficult as ready-made collection management systems are limited in supporting institutions' individual workflows and requirements for the

proper documentation of ABS related information. Furthermore, in many cases the metadata needs to be stored and curated by administration staff even before there are any specimens collected. In this case using the collection database might be unsuitable for storing the ABS core metadata in the first place.

To solve this issue, Museum für Naturkunde Berlin (MfN) uses an instance of the Generic Data Module (GDM). It has been developed by MfN in the DFG funded project German Federation For Biological Data (GFBio, <https://gfbio.org>); in order to overcome the challenges of connecting additional research data and metadata with existing collection management systems. It allows for extending data models by attaching arbitrary additional data. Additionally, it can be used as a standalone tool for data curation and is so flexible that it can be used for samples, associated documents and also to manage metadata even in a non-museum research context. This presentation will outline the procedures implemented at MfN and provide insights to the application of the GDM for ABS compliance and how it ties in with the existing collection management system at the MfN.

Photographs as a Complement of Herbarium Vouchers: Implementation of “Photo Voucher” and “Fusion Voucher” Methodology in BC Herbarium

Gómez-Bellver C², Ibáñez N¹, López-Pujol J¹, Susanna A¹, **Nualart N¹**

¹*Botanic Institute of Barcelona (IBB, CSIC-Ajuntament de Barcelona), Barcelona, Spain,* ²*Unit of Botany and Mycology, Department of Evolutionary Biology, Ecology and Environmental Sciences, Faculty of Biology, University of Barcelona, Barcelona, Espanya*

Thursday, 11 June - General (Mixed Collection) Session 3

In the herbarium of the Botanic Institute of Barcelona (BC) we have begun implementing a standardised protocol to complement traditional specimens with photographs. Although the use of photographs to complement specimens has been used in some herbaria, here we propose for the first time an international standard that should regulate the use of photographs; such standard has been recently published in *Taxon* (<https://doi.org/10.1002/tax.12162>). Standardized images allow us to have a record of a field occurrence, and therefore must meet a series of technical requirements. The photographs should allow the precise identification of the plant and should reflect the size, habitat, and details of the main organs or other elements that can help the correct determination of the taxon. As an additional suggestion, we recommend the use of a ruler and, if it is possible, a standard color chart. In a “Fusion voucher” the sheet contains, in addition to the plant sample, one or several photographs. This method for vouchering is useful in plants that may present certain difficulties at the time of their collection, due of the type of material (phototoxic or very spiny plants) or the excessive size of the specimen (e.g., palm trees and tree ferns), or because drying may have a negative effect on some taxonomic characters (such as orchids). In a series of cases, however, it may be impossible to collect material and, thus, photographs may be the only option to document the presence of a plant in a given locality. A “Photo voucher” is exclusively a set of standardized pictures and, therefore, represents a solution for plants protected by law (e.g., threatened or endemic species) for which there is no collection permit or in cases where it is not possible to access the collection site (e.g., specimens located on cliffs). Standardizing and incorporating these kinds of vouchers in herbaria and plant collections represents a significant improvement in order to solve the underrepresentation of those species more difficult to collect, such as plants that would result in very large specimens, spiny, thorny or prickly plants, or threatened species.

Chief Red Cloud's War Shirt

Harding D¹

¹*Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, United States*

Friday, 12 June - Symposium: Specimen Spotlight

Red Cloud was a very important chief among the Lakota Sioux. The wearing of these special war shirts was restricted to only four men within a band. This shirt is a symbol of Red Cloud's character and standing among his people.

Ka'apor [Amazon] Ritual Necklaces

Harding D¹

¹*Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, United States*

The Ka'apor people of the Amazon Basin do amazing work with feathers, bones, and other organic materials. Their ornamentation is specialized for different ritual activities. These feather and bone necklaces are made from five different bird species, and are part of a ceremony for naming children.

Introduction to MIDS and MICS Minimum Information Standards

Hardisty A¹

¹*Cardiff University, Cardiff, United Kingdom*

Friday, 12 June - Symposium: MIDS and MICS: Minimum Information Out of Digitisation

Digitization is the process of converting analog data about physical specimens to digital representation that includes electronic text, images and other forms. Yet the term is understood diversely among natural science collections professionals and especially from one digitization initiative to another, the outputs can be quite different.

Digitization can lead to digital data for collections as a whole (i.e., an overview), for sub-parts of collections (inventories of trays of insects or boxes of herbarium sheets, for example) and to digital data for individual specimens. The first two categories contribute towards providing coverage information about the assets of a collection-holding institution, in terms of scope and extent. Digitization of individual specimens provides explicit and precise details about each object curated in a collection, that can be used for varied purposes. Even so, digitization of individual specimens is based on diverse aims, the needs of specific projects and the specific practices and workflows in different institutions. Capturing and presenting such data from future digitization in standard forms is essential so that data can be more easily understood, compared, analysed and communicated via the Internet. By harmonising a framework that clarifies what is meant by different levels of digitization (MIDS level, MICS level), as well as the minimum information to be captured at each level, it becomes easier to consistently measure the extent of digitization achieved over time (e.g., collection digitization dashboard) and to set priorities for the remaining work. Similarly, ensuring that enough data are captured, curated, and published with specified quality is essential so they are useful for the widest possible range of future research, teaching, and learning purposes.

The Minimum Information about a Digital Specimen (MIDS) specification, and its companion specification for information about collections – the Minimum Information about a Digital Collection (MICS) specification – aim to address these problems. MIDS/MICS are 'minimum specifications', by which is meant that the information specified as necessary at a specific MIDS/MICS level are the minimum expected to be made digitally available following each major stage of digitization. More is not precluded.

The Trials and Tribulations of a Hardy Geranium

Harvey Y¹, Booth-Downs C¹

¹Royal Horticultural Society, Wisley, United Kingdom

Friday, 12 June - Symposium: Specimen Spotlight

In April 2010 Horticulture Week reported that a Dutch grower had been forced to stop growing *Geranium* 'Jolly Bee', after DNA testing showed it to be exceptionally close to another cultivar. Devastated by the decision, the Dutch grower estimated that the battle had cost him in excess of €200K. *Geranium* ROZANNE ('Gerwat' PBR) was the cultivar that caused his loss.

In the Summer of 1990 the Waterers, keen horticulturists based in Somerset, UK, spotted the deep blue summer flowering *Geranium himalayense* and the autumn flowering *G. wallichianum* 'Buxton's Variety' flowering (and setting seed) together. The following summer, Donald Waterer noted the potential of one of the seedlings and called it Rozanne, after his wife. He passed the new cultivar to Blooms of Bressinghams Nursery and by 2000 they had enough stock to officially launch the 'sensational new Geranium' at the Royal Horticultural Society (RHS) Chelsea Flower Show with the trade name of ROZANNE, and its cultivar name 'Gerwat'. Blooms also obtained 'Plant Breeders Rights' (PBR) for the new plant.

Around the time of the launch of ROZANNE a Dutch grower also discovered a new cross. His plant, 'Jolly Bee', was granted protection by Plant Variety Rights (PVR) in 2003. In the UK, 'Jolly Bee' became publicly available via Thompson & Morgan, an independent seed and plant supplier. Unbeknown to them, their 'magnificent new cultivar' matched ROZANNE.

In 2006 the RHS ran a Trial of hardy geraniums, and both cultivars were entered. The judges unsurprisingly reported that 'these entries were found to have no characters which could be used consistently to distinguish them and are therefore described together'. Together they achieved the 'Award of Garden Merit'. The RHS herbarium, specialising in UK ornamentals, has specimens of both taxa, made during their launches, and also specimens from the plants Trialled in 2006. Although no longer available alive, everyone can view 'Jolly Bee' online via [rhs.org.uk](https://www.rhs.org.uk) or in person at RHS Garden Wisley.

'Yours and a Crowd'

Harvey Y¹, Paterson L²

¹Royal Horticultural Society, RHS Garden Wisley, England, UK, ²Royal Botanic Garden Edinburgh, Edinburgh, Scotland, UK

Thursday, 11 June - General (Polyphyly) Session 2

Formerly viewed as the almost exclusive territory of an elite band of plant enthusiasts, large public gardens such as the Royal Botanic Garden Edinburgh (the Botanics) and the Royal Horticultural Society's (RHS) Garden Wisley, are being rediscovered by new audiences who now view them more as living museums/immersive experiences. Custodians of the gardens are sparking the imagination of a much wider audience by the use of innovative interpretation: using stories of the plant collectors, tales of how the plants were found, their societal uses and more besides. In so doing, they are discovering new ways of reaching, and interacting with a wide-range of visitors.

There can't be a single garden that isn't touched in some way by George Forrest, the Scottish plant hunter. The Botanics and the RHS share his archives, living and dried plant collections and these have, and are being used in ways to inspire, inform and involve their new audiences. As a botanic garden, the Botanics has a

large number of plants of wild origin. Specialising in ornamental horticulture, RHS Garden Wisley contains thousands of cultivars whose origin lie with Forrest's introductions.

When Forrest's plant introductions were made in the early 20th century, horticulturists and scientists were terribly excited by his new finds. Today we too marvel at his discoveries, but we see them with an enlightened eye. We are able to use our collections (living and dead) to explore numerous topics including some of our current concerns such as conservation, climate change, and decolonisation.

How Many Specimens Have We Digitised and What Can We Do With Them? Well it Depends What You Mean by digitised ...

Haston E¹, Hardisty A², Petersen M³, Groom Q⁴

¹Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom, ²Cardiff University, Cardiff, United Kingdom, ³Museum für Naturkunde Berlin, Berlin, Germany, ⁴Meise Botanic Garden, Meise, Belgium

Friday, 12 June - Symposium: MIDS and MICS: Minimum Information Out of Digitisation

The priority to digitise our collections has become more accepted by natural science institutes and funders and the majority of institutes are now actively digitising their collections. This has resulted in the current number of 168,228,196 preserved specimen records in GBIF which can be considered as digitised to some extent. However, there is a wide range in the amount of data present in each of these records and the term 'digitised' cannot encapsulate this variation. For collection managers who are reporting on their digitisation programmes, for researchers who will be using the resulting data, and for bioinformaticians who will be including the digital specimens in processing pipelines, there is a need for additional clarity regarding the level of digitisation of the specimens. The proposal for a Minimum Information Standard for Digital Specimens (MIDS) is intended to provide that information for these users. This presentation describes the need for this system and an outline of the structure that such a system could take.

Mediasphere for Nature: A Model Example for a Media Application Lab Promoting Collaboration of Institutions Holding Attractive and Diverse Media Content Originating From Research and Scientific Collections With SMEs of the Media - and Creative Industries

Hoffmann J¹, Dobberthin J¹, Schneider T¹, Hoffmann A¹, Tata N¹

¹Museum für Naturkunde Berlin, Berlin, Germany

Thursday, 11 June - General (Mixed Collection) Session 3

Application Labs are places for transferring research results into products, processes, and services. They represent a powerful interface between science and industry. As integrated infrastructure units they build on the scientific and technological expertise of the respective research institution reaching out to Small and Medium-sized Enterprises (SME), in particular. The innovative approach of a media application lab is to promote the collaboration of institutions holding attractive and diverse media content originating from research and scientific collections with SMEs of the media- and creative industries. Such an approach creates an environment for publication, exchange and re-use of object related multimedia and (scientific) domain knowledge through online search portals and other digital tools. It also fosters the creation of technological or non- technological prototypes and products, such as applications and services for end-users, in close collaboration with the content holding institution.

One example of such an open lab infrastructure is the Leibniz Application Lab, Mediasphere for Nature. Its vision is to become the first place to go for Start-ups, SMEs, industry and society to develop

knowledge-based products and services relevant for nature and society at the Museum für Naturkunde Berlin (MfN). Through this open lab infrastructure the MfN partners with about 20 different SMEs in the region in designing, testing, and implementing prototypes, e.g. demonstrators, show-cases, and feasibility studies, and products, e.g. applications and services, in a collaborative, non-customer/contractor approach. Furthermore, it sustains a partner network of almost 40 interested start-ups, SMEs, associations, and individuals. A number of prototypes and products in the area of VR (virtual reality), AR (augmented reality) and interactive design were already developed. Mediasphere for Nature supported a number of innovative initiatives, e.g. the hackathon Coding da Vinci, and provides regular network meetings and workshop formats for improving its partner network. The success of this media application lab hints towards the potential need for such an infrastructure for content and knowledge exchange as well as technology transfer also at other research museums. Furthermore, it provides a rich reservoir of lessons learnt and established processes and showcases, which can be compared to other, similar initiatives at GLAM (galleries, libraries, archives, and museums) institutions.

The Dynamic Role of Collections Managers

Hogue G¹, McCuller M¹

¹North Carolina Museum of Natural Sciences, Raleigh, North Carolina, United States

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

The basic definition of collections management seems straightforward — preserve and develop collections for their long-term sustainability while fulfilling the institutional mission statement. However, while this definition still forms the foundation for collections managers, the services that are expected have increased exponentially in depth and breadth. Assumed responsibilities currently include, but are not limited to: taxonomic expertise, numerous digitization methods, data and software management, outreach, personal research, supervisory and mentorship responsibilities, grant writing and management, maintaining the applicability of the collection for current and future research needs, and showcasing the relevance of the collection to the public. Nested within these expectations are multiple, time-consuming sub-tasks. For example, outreach can encompass myriad platforms such as social media, non peer-reviewed publications, museum events, tours, and workshops. The knowledge requirements usually far surpass the available institutional support, leaving staff feeling over-burdened and under-prepared. In addition, while the job duties increase for those already in collections management positions, new hires are usually expected to have all of the necessary skills up-front. Despite the ever-increasing responsibilities, collections management work is very gratifying and dynamic. The future promises a lot of excitement and possibilities as we work towards the implementation of extended specimen networks and the increased use and applicability of collections. We intend to discuss the role of collections managers and the services that we provide. We will also discuss possible solutions for the prioritization of those services within the greater context of the collection's needs, available institutional support, and time in the position.

Citizen Science as a Tool for Connecting Cultural Heritage and Natural History Collections: Providing Valuable Opportunities for Enrichment, Linked Data and FAIRness

Huybrechts P¹, Böttinger P³, Fabri R¹, Hanquart N¹, Koch G⁴, Mergen P¹, Rainer H³, Gordon M²

¹Meise Botanic Garden, Meise, Belgium, ²Rundfunk Berlin-Brandenburg, Berlin, Germany, ³Natural History Museum Vienna, Vienna, Austria, ⁴Angewandte Informationstechnik Forschungsgesellschaft, Graz, Austria

Wednesday, 10 June - General (Potpourri) Session 1

Natural History collections often contain objects of cultural heritage value and vice versa. These objects can be linked through the use of simple vocabularies and machine-readable metadata which allow for the clustering of objects beyond their source collections. One platform to achieve synergies between natural history and cultural heritage is Europeana.

Europeana is the EU digital platform for cultural heritage, but also contains over 9 million biodiversity objects mainly described by scientific data. Europeana has the aim of being as open and FAIR (Findable, Accessible, Interoperable, Reusable) as possible by involvement in the development of open web APIs, Linked Data and the International Image Interoperability Framework (IIIF).

One of the projects working on accomplishing the connection between Natural and Cultural heritage is LinBi (Linking Biodiversity and Culture Information) which has a focus on Europe's biodiversity content. LinBi provided new content to Europeana, a large portion of which was first enriched via the crowdsourcing platform DOEDAT. Furthermore LinBi has built infrastructure to produce content clusters which are used to connect digital objects of a common theme.

The quality of the metadata of digitized objects is vital to the reusability and interoperability of a collection, and subsequently allows for the publication of the enriched digital objects with a reach beyond their own source collection. These contributions by citizen scientists are incredibly valuable and both allow a broader audience to engage with the materials as well as unlock information that was previously unobtainable.

The efforts invested in connecting the Natural and Cultural heritage can lead to new research possibilities on existing and future collections, and allows the data hidden in these collections to be more accessible for both research and non research user groups.

One Tooth, Numerous Questions

Lawrence A¹

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

Friday, 12 June - Symposium: Specimen Spotlight

This specimen spotlight shows how one Mammoth tooth sparked many questions from a group of high school students resulting in changes to the Archaeobiology tour at the National Museum of Natural History.

The Faculty of Sciences Collections, Rennes, France (1840-1914)

Lemaire M¹

¹Université De Rennes 1, Rennes, France

Tuesday, 9 June - Symposium: History matters! The Value of the Humanities in Natural History Museums

« Without collections, without laboratories, [faculties] are for the government only a charge, of which utility is becoming contestable ». That is how Simon Sirodot, Professor of Zoology, Dean of the Faculty of Sciences of Rennes (Brittany, France) spoke out in 1872. This assertion reveals the prominence given to collections for the activities of the faculties during the 19th century. At the beginning of this institution, the collections were indeed a regular subject of concern for the professors. What should be acquired ? What premises and what furniture should be chosen to present them and to whom ? What financial allowance should be provisioned for these acquisitions?

For that purpose, the Infant faculty could benefit from intermittent contributions from the municipality of Rennes, then from the government. Since 1880, as a result of the defeat of the 1870 War which raised awareness of the french backlog of education, these grants became permanent.

Nowadays, this heritage still remains by the university of Rennes 1. It was completed by material from the ancient natural history museum of Rennes which was damaged at the end of the Second World War. Some items are still used for education or research. In the past 3 years, an intense documentation work has brought some elements about the history of these collections.

In this presentation, a review of the archives of the university of Rennes (annuals reports, account books...) is proposed. We analyze the data with the help of historical elements of french higher education system, which enlighten the context and the intentions that supported the constitution of scientific collections at the early stages of Rennes University.

Earthquake “Proofing” Mismatched Cabinets

Levitt-Bussian C¹, Krishna J¹

¹Natural History Museum of Utah, Salt Lake City, Utah, United States

Friday, 12 June - Symposium: Storage Techniques for Art, Science, and History Collections (STASH)

The Natural History Museum of Utah moved into a new building on the side of a mountain in the Wasatch Range in 2010. The Wasatch Fault runs through the valley, so seismic mitigation was an important consideration. In preparation for the move, all collections applied for grants to get full build-out of compacting cabinetry. Unfortunately, Paleontology was unsuccessful acquiring grant money like some other collections. We, instead, received a mismatch of cabinets from various other departments. These were all various heights, widths, and depths. Unlike our Delta cabinets which had been installed on carriages for seismic mitigation, these cabinets were stacked on top of each other, not bolted together, resulting in instability and an unsafe environment. When, 9 years later, the Collections Manager attempted to pull out a drawer from a cabinet high-up and the entire cabinet almost fell on her, we knew that measures had to be taken. Working through the University and with structural engineers and installers, we were able to develop a plan to safely and permanently install the cabinets to the concrete floor and the cabinets to each other. Bolting the cabinets to the floor required steel tubing cut to the exact size of the cabinets, 2-inch diameter holes drilled into the concrete floor, epoxy filled in these holes and a 9-inch bolt put in these holes. Bolting the cabinets to each other without destroying the integrity of the sealing cabinets proved to be a challenge. The eventual solution involved epoxy, caulk and washer spacers. Nothing about this installation went as planned. It necessitated 700 fragile Pleistocene and Eocene fossils be removed from their secure cabinets and placed on wheeled-rack-shelving for 33 days. The tubing for the flooring was not measured correctly by

the structural engineers and was therefore cut to incorrect lengths. The bolts were also cut to the wrong lengths due to unclear directions by the structural engineer. This resulted in wasted money, wasted time and put the fossils at more risk. The structural engineer cost an enormous amount of money. Money that could have been used to buy brand new cabinets.

History of the Cartagena Botanical Garden Herbarium (JBGP): The Most Important Plant Collection from the Caribbean Region of Colombia

Londono V¹, Madriñan S¹

¹*Cartagena Botanical Garden, Turbaco, Colombia*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

Regional herbaria provide a detailed vision of the local vegetation and its historical changes. The most important plant collection of the Colombian Caribbean is the Cartagena Botanical Garden Herbarium (JBGP) and has been the leading institution in the research on plant diversity of that Colombian region since its foundation in 1978. During its first decades of operation, it received several Neotropic explorers which contributed significantly to its collection, becoming the most important herbarium in the Colombian Caribbean, a status that it still aims to conserve. In 2003, after a long separation process from its main funder, Colombia's central bank, the collection fell into a state of abandonment. Due to the importance of its collection, different public and private institutions tried to recover it. The main objective of this presentation is to share the experience of the restoration process of a collection and to exalt the historical value of the JBGP herbarium, as well as communicating our current advances. The most important effort in the restoration process was done in 2009 – 2010 when the Medellín Botanical Garden with support from private and public institutions completed a restoration process of the plant material. Since 2015, the current botanical team has kept the collection active. However, the lack of resources for herbarium materials and for the hiring of personnel dedicated exclusively to the herbarium has limited the systematization process. Nonetheless, specific project financing between 2016 and 2017, has allowed for the JBGP herbarium to publish about 25% of its data on the SIB Colombia portal (<https://sibcolombia.net/>) and to digitize about 10% of the collection. Thanks to these efforts, the actual collection houses more than 13,000 specimens of about 4,700 species. The restoration of the collection has resulted in the description of new species based on specimens collected in the 1980s and 1990s since many of the duplicates of that time were sent to other important herbaria worldwide. Many of these specimens have great historical value since they were collected in areas and ecosystems that have since been highly modified, like the tropical dry forest, the most endangered ecosystem in Colombia.

A Window to the Future: Saving an Orphaned Herpetological Collection

Marques M¹, **Ceríaco L²**

¹*Museu Nacional de História Natural e da Ciência, Universidade de Lisboa, Lisboa, Portugal*, ²*Museu de História Natural e da Ciência, Universidade do Porto, Porto, Portugal*

Wednesday, 10 June - General (Potpourri) Session 1

The Instituto de Investigação Científica Tropical (IICT), Lisbon, Portugal was a former state laboratory that was dedicated to various fields of tropical research in the former Portuguese colonies in Africa and Asia. Its herpetological collections represent the richest and most diverse collections of amphibians and reptiles in the country and have a considerable international relevance. For some of the former Portuguese colonies, these collections are amongst the largest available collections in the world, with a good number of unique specimens. During the 1940's to the 1970's these collections were studied by several naturalists, who used them to describe and catalogue the herpetofauna of those areas. Although, after the independence of the

colonies (1973-1975), the research nearly halted, and the collections became orphaned and endangered, without proper curation and lacking accessibility.

In 2015 we started a process to recover the herpetological collections, providing basic specimen curation and collection management (e.g., cataloguing, cleaning and substituting jars and fluid preservatives). The taxonomic identity of each specimen was carefully reviewed, and all nomenclature updated. Specimens were also linked to its bibliographic data, and rare and important specimens (e.g., type specimens) were flagged. All collection was digitized and georeferenced, and currently available through the Global Biodiversity Information Facility (GBIF). The herpetological collection is now completely accessible to the international community, and it is being used by researchers and students around the world. Some results have already been published including the description of new species to science, new country Atlas and checklists, International Union for Conservation of Nature (IUCN) Red List assessments.

This presentation aims to provide an overview of the recovery process and discuss the value and the new uses of the collection, emphasizing the important role of historical collections in the study and preservation of biodiversity.

What's in a Name? David Dale Owens' *Ammonites opalus* Nomen Oblitum

Mayer P¹

¹The Field Museum, Chicago, Illinois, United States

Friday, 12 June - Symposium: Specimen Spotlight

David Dale Owens collected this Cretaceous ammonoid specimen during his expedition in what was then the Nebraska Territory (today South Dakota) near the Great Bend of the Missouri River. Owens used this specimen to describe a new species of ammonoid in his 1852 publication, "Report of a Geological Survey of Wisconsin, Iowa and Minnesota; and Incidentally of a Portion of Nebraska Territory". This specimen was designated the holotype of *Ammonites opalus*. In 1983 paleontologist A. C. Riccardi re-examined these ammonoids and decided that *Phylloceras halli* and *Ammonites opalus* were the same species. Despite the fact that the *Ammonites opalus* was published first by four years and had precedence it was declared nomen oblitum because *Phylloceras halli* was in common use. No one had used the name *Ammonites opalus* since 1899. Based on the code of the International Commission on Zoological Nomenclature, Riccardi was able to preserve the commonly used *Phylloceras halli* name and invalidate the older but forgotten name *Ammonites opalus*. Owen did everything right in describing his new species: he included an illustration of it and a trace of the suture pattern, For whatever reason the name was not used by the scientific community and now passes into obscurity.

Data Management Strategies for the Extended Specimen

Mayfield-Meyer T¹

¹Arctos, Albuquerque, New Mexico, United States

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

Managers of natural history collections generally chose this field because they are interested in the natural world and have backgrounds in a related subject such as biology, ecology, paleontology, geology, museums, preservation, or even taxidermy. Very few, if any, chose this profession because they wanted to manage data, yet that is what many of them are doing (or trying to avoid). Many museums and research institutions have failed to recognize collections as the unique resource that gives their institution value, much less the

reality that digital collection data is a new collection that provides even greater value but needs proper management. This is especially true given the emphasis on the importance of tracking the “extended specimen” beyond the boundaries of traditional museum holdings into the realm of interconnected specimens and data repositories. Collection managers have ventured out, often on their own time and expense with little formal IT support, to gain an entirely new set of skills and double their workload to create and maintain digital collections. These same people are facilitating the global initiatives to support museum digitization efforts and data sharing. According to Oracle, “a robust data management strategy is becoming more important than ever as organizations increasingly rely on intangible assets to create value.” Do natural history museums understand the value their digital collection assets create? Are they properly supporting this important resource? The Global Biodiversity Information Facility reported that 675 peer-reviewed research papers used aggregated collections data in 2018 and expects that number to rise in 2019. As a profession, we should be calling for changes in museum staffing that include the addition of a Collection Data Manager and changes in collection policies that provide adequate resources for the maintenance of collection data. It is only by giving both the physical collections and their digital derivatives appropriate attention that museums can make a positive impact on research and in their communities. This presentation will include personal experience and ideas for how we can give physical collections proper care while increasing the quality and value of their associated data to advance the model of the extended specimen.

The First Striped Dolphin on the Isle of Man, Working Collaboratively to Preserve it for the Manx Museum and Public

McCoy L¹

¹*Manx Museum and National Trust, Douglas, Isle of Man*

The first ever Striped Dolphin (*Stenella coeruleoalba*) stranded on the shores of the Isle of Man just before Christmas in 2017. Volunteers tried to re-float it, but it stranded again and died not long afterwards. How do you get a marine mammal from the sea to a wall in a museum? This is a story of death, preparation, communication, partnership, science, education, and bad smells on a small island in the Irish Sea.

Living Collections: So Much More Than an Eye Catcher in the Landscape

Mergen P¹, Bellefroid E¹, Reynders M¹, Engledow H¹, Stoffelen P¹, Vandeloek F¹, Bogaerts A¹

¹*Meise Botanic Garden, Meise, Belgium*

Large natural history associations like CETAF (Consortium of European Taxonomic Facilities) and related projects and activities, had so far their main focus on preserved collections in addressing biodiversity and geodiversity. Most of the tools, assessment methods or standards developed over the last decades are designed for preserved collections and fail when trying to apply them directly to living collections. However, most European botanic gardens are members of CETAF, and more recently also of DiSSCo (Distributed System of Scientific Collections). They often manage large indoor and outdoor living plant collections, as well as seed banks. To a lesser extent zoological gardens or living animals form part of museum exhibitions are also involved in these initiatives. Living plant collections not only play an important role in the design, perception and interpretation of botanic gardens by the general public, but also play a prominent role in research and conservation. They are a reservoir and conservatory of endangered plant species or even species extinct in the wild. Extensive living collections, e.g. of Crop Wild Relatives, kept in botanic gardens are crucial in biodiversity research. In Meise Botanic Garden this is the case on for example bananas, beans and Rubiaceae, including coffee. Trait, genetic and chemical analyses are conducted on samples of living plant material with interesting results for taxonomic and evolutionary biology.

While Associations like BGCI (Botanical Gardens Convention International) and EAZA (European Association of Zoos and Aquariums) address living collections, the purpose of this presentation will be to look into further collaborations with CETAF and DiSSCo. What are the minimal metadata and metrics needed so that the living collections are properly recorded, described and discoverable in the currently developed tools such as the DiSSCo Dashboard, loan system ELVIS (European Loans and Visits System) or the definition of an Open Digital Specimen. Data standards of Biodiversity Information Standards (TDWG) such as ABCD (Access to Biological Collections Data) taking living specimens directly into account in their specifications would be inspirational to bring living collections further into DiSSCo.

The Invertebrate Collection at de Museo Nacional de Historia Natural (MNHN): Enhancing the Collection Status with a Limited Budget

Merino-Yunnissi C¹, Martínez A¹

¹*Museo Nacional De Historia Natural, Santiago, Chile*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

In many countries, publicly funded museums were established over 100 years ago to house and study biological collections. In this context, the Museo Nacional de Historia Natural (MNHN) in Chile was founded in 1830 under the legal mandate to be a "reference center" for biodiversity. As a result of limited resources, the Invertebrate Department has been set aside for many years, most of the collections were kept in poor conservation and environmental conditions. Due to this, the incoming staff developed a project to improve the status of the collections considering a limited budget.

The project began in 2015 by making a diagnosis of the collections and future projections. Some priorities were established such as: 1) improving the storage environment gradually considering its expansion; 2) training people to collaborate digitizing, curation and research; and 3) initiating with the Type Material and then covering larger collections.

The working time per lot was calculated to estimate how much could be worked per person and then the materials needed were carefully planned to optimize the budget. In four years 8,800 lots were treated, including wet and dry specimens, belonging to the collections of Echinoderms, Crustaceans, Mollusks and new collections are being created during this process. All the information obtained has been digitized, along with the replacement of containers, fixative, and labels. The storage area and the storage units were improved, the temperature and humidity are being monitored and protocols have been developed. The data obtained began to be shared through the Global Biodiversity Information Facility (GBIF) and catalogues. New investigations are being performed bringing these new data together with others from Natural History Collections, e.g., a study of large-scale distribution patterns of Echinoderms in the Southeast Pacific, which has not been investigated until now.

As a result of this work, collaboration with other museums in the country is being developed to improve the status of their collections. Despite the limited resources it is important to make a good planning of the work, distributing resources, generating small projects and above all, sharing data. Upcoming activities include improving data quality and upgrading the exhibition of invertebrates at the Museum.

Rediscovering the Collections and Correspondence of the Ward's Natural Science Establishment at the University of Rochester

Minckley R¹, Mead M¹, Romphf J¹

¹*University of Rochester, Rochester, New York, United States*

Friday, 12 June - General (Miscellany) Session 4

Ward's Natural Science Establishment (Ward's) was founded in 1862 by Henry A. Ward in Rochester, New York, USA. Called the "Museum Builder of America," the company was pivotal in the worldwide growth of natural history collections through the 19th century. Ward's staff were leaders in the conservation movement and articulated biodiversity awareness.

Ward's had three principal activities: collecting natural history specimens, preparing them, and supplying them to educational institutions and natural history museums. The first large sale of specimens from Ward's was made to the University of Rochester making it at the time the third largest natural history museum in the United States behind Harvard University and the Smithsonian Institution. Today the collection, although removed from public display and partially disbanded, remains at the University of Rochester along with the entire correspondence, business records and other ephemera of Ward's and the Ward family.

A collaborative project is underway to make this material broadly available by digitizing the archival material collections that record the business and specimens; preparing the documents and extant specimens by adding harvestable metadata and descriptions, and disseminating them through wardproject.org, downloadable 3D scans, and freely available digital curricula. This presentation will provide an overview of the project and invite the broader community to participate.

Finding Fo' Fossils

Nakano J¹

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

Friday, 12 June - Symposium: Specimen Spotlight

For my specimen spotlight, I have chosen a trilobite, an extinct marine arthropod, in the Smithsonian National Museum of Natural History (NMNH) - Department of Paleobiology (Paleo) collection. This particular fossil invertebrate specimen is special because the trilobite is a fake. The specimen was purchased with the intent for display, but upon receipt, it was determined to be manipulated and modified by combing real trilobite elements to form a single specimen. Then to the discomfort of any collections management (CM) professional, it was too many years in the museum's possession to be un-recorded. This made it a perfect first task for a new bright eyed registrar to pull the item out of undocumented limbo.

My instinct CM reaction took me down a rabbit hole of discussions with long-standing Paleo Collections staff. Do we have documentation of ownership and how it got here? What do we want to do with it? Does the curator want this in the collection? Wait, we do? And we have a collection of pseudo fossils? Tell me more, please.

At that moment, I was enthralled by what I was hearing. We had documentation for the acquisition and the curator in charge wanted to add this to the collection, knowing full-well it was false. Once added to the collection, this specimen stuck in my mind. It sparked a bigger personal and professional curiosity. How do natural history museums manage fakes and forgeries? Do all museums knowingly have these in the collection? What purpose do known manipulated and adapted specimens serve for scientific research? Could these be reference items and teaching tools for non-scientists? This specimen spotlight talk aims to

elaborate on “fo’ fossils” in collections and how our decision to keep these fakes and forgeries may reflect a greater purpose and awareness in the scientific and museum worlds.

The Birds and Eggs Collections at the Humboldt Institute as a Tool to Explore and Conserve Avian Biodiversity in Colombia

Ocampo D¹, Sierra-Buitrago S¹, Soto-Patiño J¹, Pérez-Peña S¹, Borja-Acosta K¹, Gómez-Posada C¹

¹*Humboldt Institute, Villa De Leyva, Colombia*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

Natural history collections document global biodiversity and contribute to understanding diverse aspects of organisms in space and time. Particularly for Latin-American countries, it is an important and huge challenge to develop high-quality biological collections with a wide taxonomic cover given the vast biodiversity found in Neotropical regions. In Colombia, the Humboldt Institute bird collection (IAvH-A) houses 15,839 skin and fluid preserved specimens that represent 70% of the Colombian bird biodiversity (about 1,920 spp.) collected since 1950, with an important strengthening in collections during the last two decades, including several expeditions to unexplored regions (after the peace agreement), embracing different areas around the country. The Oological collection (IAvH-CJM) is one of the largest in South America. It was donated by Professor Cornelius J. Marinkelle, who collected and interchanged eggs from species all around the world, especially from countries such as Canada, Chile, France, Holland, Indonesia, England, Italy, Japan, and South Africa. The collection has 25,000 eggs of approximately 2,000 bird species distributed across 95 families that were collected mainly before 1900, and there are eggs even from 1871. Currently, we are actively collecting eggs, focusing on Neotropical species with the aim of answering a variety of evolutionary and ecological questions. The vast majority of Colombian bird specimens were collected over 60 years ago, and are housed in museums overseas. Those specimens, although historically important and irreplaceable, have relative limited information and reduced access for Colombian researchers. Today, Colombia is building its own capacity to uncover the mysteries of its extraordinary biodiversity through biological exploration and collection-based research with high quality standards. To establish a long-term scientific legacy, we are collecting multimodal bird specimens, consisting of a round skin, tissue samples, a spread wing, the carcass, and nest/eggs, and vocalizations or behaviors captured on audio or video. All these linked preparations are fully accessible to the researchers and properly saved for all, with the aim to be useful in a common dialogue between science, education, and conservation of biodiversity.

Internet Friends: Fostering Online Collaboration Between Professional and Amateur Paleontologists Through myFOSSIL

Ocon S¹, Mills S¹, Heim B², Bauer J³

¹*Florida Museum of Natural History, Gainesville, Florida, United States*, ²*The FOSSIL Project, Gainesville, Florida, United States*, ³*University of Michigan, Ann Arbor, Michigan, United States*

Wednesday, 10 June - General (Potpourri) Session 1

Fossils are fascinating relics of natural history that attract people across a wide variety of paleontological backgrounds, from professional to amateur. Despite this common interest, however, there is a wide boundary that often proves insurmountable between these two groups. Amateur paleontologists, or those who have not pursued a paid career in paleontology, are often avid collectors of fossils and are able to offer unique insight into their favorite collecting sites and taxonomic specialities. Additionally, amateur fossil collections can reach great sizes; however, these collections are not always accessible to professionals, who may gain important scientific insight by working with these amateur paleontologists to study their collections.

myFOSSIL, a US National Science Foundation funded initiative (NSF-DRL 1322725), sought to reduce this boundary between paleontologists of all backgrounds by creating an online community of practice. Through a mobile app and a website (myfossil.org), users can interact in online forums, post photos of paleontological activities, and upload specimen images to the myFOSSIL eMuseum. This eMuseum is a digital natural history collection that allows users to photograph their personal fossil specimens and virtually contribute them to a publicly accessible collection. Other myFOSSIL users and designated eMuseum curators are then able to comment on uploaded specimens, fostering collaboration between paleontologists of all backgrounds. This is beneficial because it unobtrusively opens personal collections to professional paleontological researchers, whilst teaching amateur users the process of curating and identifying fossils in their collection. Likewise, paleontology students can also learn these processes by using the eMuseum in a classroom setting, which adds value to the platform for professional paleontologists.

Currently, amateur paleontologists have contributed more than 3,100 fossil specimens to the myFOSSIL eMuseum. Close to 2,000 of these have been curated, and 241 are considered high quality occurrences that can be shared with iDigBio for increased accessibility and visibility to the worldwide paleontological community.

Collection Management in a Changed Digital Landscape: Progress and Challenges for the US Herbarium with a Newly Digitized Collection

Orli S¹

¹*Smithsonian Institution, Washington DC, United States*

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

In 2015, the United States (US) Herbarium at the Smithsonian Institution embarked on an ambitious plan to fully digitize its collection of 4 million pressed specimens by 2022. The digitization of the herbarium is now 80% complete, and the effects of this level of digital accessibility can already be seen in the daily demands of the collection management staff. Specimen loan requests are down 66% from 2011, as online specimen data queries are up 350%, showing a direct correlation between the decrease for the need for a physical object when a digital record is available. But other demands have risen significantly due to the high visibility of the botanical collection. For instance, requests for destructive sampling for genetic research are higher than ever. Requests for more/better/high resolution imaging of the collection now come as more sophisticated types of analysis, such as computer learning algorithms, become more commonplace. Taxonomy is more often scrutinized remotely by botanical professionals, and name changes are often requested online instead of in house. The data and images are now being held accountable at unprecedented levels, and expectations of researchers exceed the abilities of the staff to manage the requests. What does the future hold for collection management in this digital age? Can a digital asset replace a physical object for researchers, or does it bring about more complex ideas that require new skills from collections professionals? This presentation will explore this issue as it relates to the world of natural history collection management.

Ex Situ Conservation of the Chilean Flora in the INIA's Seed Bank: Current State and Future Challenges

Pañitrur C¹, Ibáñez S¹, León M¹, Martínez K², Sandoval A¹

¹*Instituto De Investigaciones Agropecuarias Inia, Vicuña, Chile*, ²*Independent Researcher, La Serena, Chile*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The geographical singularity in which Chile is located in the South American continent makes it usually known as a "biogeographic island". This particular condition has contributed to the formation of a unique flora in the country. In fact, Chile records 4,655 native plant species, with 46% of them being endemic, and the second highest endemism in South America. Despite the unique value of these species, a large number of them are threatened and, therefore, ex situ conservation measures are key to their preservation. The "Instituto de Investigaciones Agropecuarias" (INIA) is the main curator of the plant genetic resources in Chile and, through its Seed Base Bank (SBB), has the mission to preserve the biodiversity of the native flora. The main aim of the present work is to report the current ex situ conservation status of the Chilean flora and future conservation challenges of the SBB of INIA. The analysis showed that 3,040 seed accessions of native species are preserved in the SBB, belonging to 1,256 different species, i.e. 27% of the Chilean flora. The zone with the highest number of seed accessions collected, is the north-center regions of the country (85% of the collection), which is relevant considering that this area is classified as one of the main hotspots worldwide. Nevertheless, it also indicates that other important geographical reliefs of Chile have been ignored, like those located in the insular territory (0.07% of the collection), such as the Juan Fernández Islands (Biosphere Reserve). A quarter of the Chilean threatened plants not conserved in the SBB, correspond to seedless vascular species, which cannot be protected in the long term under our traditional conditions. Additional efforts are necessary to reduce the current gaps in the SBB collection, in particular of endemic and threatened plant species.

Human and Infrastructure Evolution for 21st-Century Collections

Paul D¹, Krimmel E¹, Neumann D², McCuller M³, Hogue G³, Livermore L⁴, James S⁵, Marshall C⁶

¹*DigBio, Florida State University, Tallahassee, Florida, United States*, ²*Bavarian Natural History Collections, Munich, Germany*, ³*North Carolina Museum of Natural Sciences, Raleigh, North Carolina, United States*, ⁴*Natural History Museum, London, England*, ⁵*Western Australian Herbarium, Perth, Australia*, ⁶*Oregon State University, Corvallis, Oregon, United States*

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

Societies, institutions, and individuals can support a visionary future for both physical natural history collections and associated digital data by recognizing the need for organizational evolution in knowledge, workforce structure, and culture related to digitization. We provide an introduction to this symposium by highlighting the "knowns and unknowns" that are fundamental to such a future.

The nature of biodiversity data is evolving rapidly. Building on incredible progress in digitizing specimens, there is a constant push for rich(er), tidy(er), and more data. The concept of the "extended specimen network," which describes digital specimen data with complexities parallel to those in the physical world, exemplifies this push and foresees a near future where digitization goes beyond simple transcription of labels or imaging of specimens. Such future digitization includes translating physical traits, relating resources with research data, providing attribution to people associated with important work such as taxonomic review, etc.

We present survey results demonstrating that achieving an extended specimen network will require an extended human network, as well as early attention at an organizational level in order for digitization to thrive as a standard-of-practice activity. Meanwhile, few museums have a professional development policy or workforce strategy, so many staff actively digitizing collections have independently evolved skills. Capacity development should be addressed on an organizational level, and should involve planning for collections management software that supports efficiency and the expansion of tasks related to collections management. Our survey results demonstrate that changes are needed in software, skills, and automation to realize richer data. These changes are exemplified by the implementation of the Nagoya Protocol, where the research value of specimens is improved by increasing traceability through richer data and proper documentation.

We hope this symposium contributes to a framework for discussion on how leadership can envision and implement capacity-building solutions in natural history collections. Furthermore, we intend to provide commentary and encourage discussion on how our community might propose coherent collection metrics and effective citation/attribution practices to provide evidence for collections advocacy, critical evaluation of decisions, and future planning.

Insights Into the Amphibian Biodiversity Crisis From a Small Collection's Perspective

Peña J¹, Rivero-Vega R^{1,2}, Ackerman J¹

¹*Museo De Zoología De La Upr-rp, San Juan, Puerto Rico*, ²*University of Michigan, Ann Arbor, Michigan, USA*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

Our planet has undergone dramatic changes across time. However, global climate shifts during the last century are occurring at a faster rate than previously recorded. Although organismal responses to these recent developments vary, there is an overwhelming amount of evidence showing declines and extinctions of populations as a direct effect. This is especially relevant for a group of vertebrates such as amphibians, whose physiology can be sensitive to subtle changes in microhabitats and will suffer drastic declines if those changes are beyond their ability to cope. According to the IUCN Global Amphibian Assessment, the world's tropical forests harbor the greatest diversity of amphibians and, as such, keeping historic collections of specimens from these regions is especially important for conservation purposes. This is doubly so for Caribbean specimens, given the insular nature of island habitats and limited natural history collections available. Our Museo de Zoología contains numerous amphibian specimens from Puerto Rico as well as other Caribbean and Central American countries, the overwhelming majority of which belong to the genus *Eleutherodactylus*. These collections include all 14 extant species on the island and two of the three species that have become extinct since the 1980s. These past records have proven valuable for elucidating historic ranges and habitats as well as offering actionable data on why some populations disappeared while others remained resilient. Additionally, these collections have allowed researchers to isolate a potential first appearance of the epizootic chytrid fungus embedded in the skin of one of our extinct species—a pathogen that has caused one of the greatest recorded losses of biodiversity in the world. Therefore, we stress that our and other small, local collections represent an as of yet untapped resource and anticipate that they may yield invaluable data regarding species discovery, resilience, and extinction in the future across Latin America and beyond.

Enabling a Structured and Standardized Disclosure: The Development and Implementation of Purpose-Oriented Collection Specimen Descriptions

Petersen M¹

¹*Museum für Naturkunde Berlin, Berlin, Germany*

In natural history collections, specimens are accompanied by countless information, ranging from (taxonomic) names to details about their collection event to associated resources such as labels, literature, collection permits or even other collection objects. As part of a comprehensive collection disclosure and digitization initiative at the Museum für Naturkunde Berlin, all this information should be consistently structured and standardized within the institution. Therefore, elements currently recorded in single collections and management systems, elements used for publication, and that information about specimens located on labels or in analogue collection catalogues were gathered and arranged into thematic groups. In addition, lists of controlled vocabularies and links to existing external references where useful are likewise considered. Out of this plethora of elements, application-driven subsets can be generated to meet the requirements of different purposes.

A minimum extent of information needs to be provided for all objects, including ID, type of object, and title. This minimum information standard can be extended to a level important, for example, type specimens (adding author, year, citation, type etc.) or for other applications like the description of particular sub-collections.

In this talk, the idea of a minimum extent of information and examples of different purpose-oriented levels will be presented. Furthermore, it will be assessed whether this approach coheres with the “Minimum Information about a Digital Specimen” concept, defining the expected and optional information elements about specimens at various digitization levels for publication purposes.

Information Infrastructure for Global Challenges: Libraries and Archives in the Development and Support of Natural History Sciences

Rinaldo C¹, Smith J², Iggulden D³

¹*Ernst Mayr Library and Archives of The Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, United States*, ²*Library and Archives, Natural History Museum, Cromwell Road, London, United Kingdom*, ³*Library and Archives, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, United Kingdom*

Friday, 12 June - General (Miscellany) Session 4

The Biodiversity Heritage Library (BHL) is a digital library and a data resource supported by an international collaboration of over 40 natural history and botanical libraries, archives, and research institutions. Library and archives' physical collections continue to be developed and used alongside specimen collections. A key driver for embracing digitisation and technology is to meet the needs of scientists who rely on historical and current content to complete their research. The BHL is a multidisciplinary, virtual collaboration with a mission to improve research methodology by opening up biodiversity literature. BHL content is international in scope and the member collections are complementary. As well as widening access to physical collections, BHL offers digital representations of those collections exposing the data within them thereby enabling text and data mining to support digital scholarship approaches. BHL content can be linked to museum specimens; transcription and OCR tools enable extraction of embedded taxonomic data.

What does digital availability mean regarding longer term physical collections, open access and open science principles? Sharing standards for metadata, digitisation and discussions about managing the future of the

physical collections, includes the potential for collaboration on disaster planning and solutions for long term preservation and stewardship of collections. BHL forms part of a community in which all players have benefitted by making original materials accessible and contributing data as an integrated part of global biodiversity initiatives and organizations.

BHL is more than a digital library but also a key data resource. As digitisation of specimen collections escalates to support open science research and big data approaches through institutional and collaborative initiatives such as DiSSCo, unlocking the data within the associated library and archives collections is increasingly important. BHL already provides access to nearly 58 million pages of literature with tools and services that support discovery, use and reuse of the taxonomic intelligence within those pages. The need now is to increase the addition of original manuscripts and field notes. BHL is a facilitator and partner in (new) taxonomic research and has a direct impact on current global challenges and the scientific enterprise.

The Mexican Fossil Heritage: An Overview of the Colección Nacional de Paleontología at Instituto de Geología, Universidad Nacional Autónoma de México

Romero-Mayén V¹, Alvarado-Ortega J¹

¹*Colección Nacional De Paleontología, UNAM, Ciudad De México, Mexico*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The fossil record is a limited and irreplaceable source of data resulting after the patterns and processes experienced by the Earth's biological and environmental diversity along the deep geological time. The preservation of this witness of life evolution is crucial to boost and improve the integral research on life. In this framework, Paleontological Collections play a fundamental role in this task. These entities are required to constantly improve technologies to guarantee the permanence of fossils, promote the systematization of data and facilitate the exchange of information between institutions and potential users around the world. With full awareness, the Universidad Nacional Autónoma de México has undertaken these functions through the Colección Nacional de Paleontología (CNP), based at the Instituto de Geología. The CNP is the richest and most diverse fossil collection in Mexico. Its heritage includes materials from all regions and geological ages represented in the Mexican sedimentary record. Currently, the TC is going through a digitization program. This program is making the information of all these specimens available worldwide. This presentation describes the CNP with an overview of the taxonomic, geographic and temporal diversity of the Type Collection (TC).

The TC houses 420 holotypes and nearly 10,000 voucher specimens. Invertebrates of the TC belong to 32 classes, and Cephalopoda, Bivalvia and Gastropoda are the best represented. Vertebrates are grouped in 15 classes, with Mammalia, Osteichthyes and "Reptilia" having the most representatives. The geologic era best represented for invertebrates is the Mesozoic and for vertebrates the Cenozoic. The states of Oaxaca, Puebla and Sonora hold the largest number of localities with type material. Additionally, we identified problematic issues related to a non-standardized taxonomic and chronostratigraphic system that should be addressed.

This is a first approach to the diversity housed in the TC and its management. The current status of the TC is the result of several people's work that have resulted in a well curated collection. However, at this point where the scientific community claims for more quality information, bigger efforts are required, including best management tools as well as regular assessment of it. This will raise and support the scientific value of CNP.

The University of the West Indies Zoology Museum: An Anglo-Latin American Collection

Rutherford M¹

¹*Self-employed, Innerleithen, United Kingdom*

Tuesday, 9 June - Symposium: Natural History Collections in Latin America

The natural history collections of The University of the West Indies Zoology Museum (UWIZM) represent a significant resource for the Caribbean but also potentially for South America. Based at the St. Augustine Campus in Trinidad and Tobago there are more than 80,000 specimens covering all major animal taxa. Biogeographically most of the specimens are part of the Orinoco Bioregion and the Neotropical Ecozone areas which are predominately Latin American.

The collection grew from those of the Imperial College of Tropical Agriculture, focused initially on agriculturally important insects then expanding to other groups. In 2012 the CABI (Centre for Agriculture and Bioscience International) collection of insects and the CAREC (Caribbean Epidemiology Centre) collections of mammals, birds, reptiles, amphibians, and various invertebrates were transferred to the UWIZM. In 2014 the National Museum of Trinidad and Tobago's off-display natural history specimens were transferred as well making the UWIZM the de facto national zoological collection. Recent work has seen many of these specimens added to the museum's electronic database with over 20,000 of these records then uploaded to the Global Biodiversity Information Facility (GBIF) as part of a regional project.

The University of the West Indies campus in Trinidad was host to the inaugural Latin America and Caribbean Congress for Conservation Biology (LACCCB) in 2018, highlighting the growing connections across the region and promoting collaboration. In comparative taxonomic studies conducted by Latin American institutions having samples from Trinidad can provide useful comparisons with mainland species. Specimens and/or tissue samples from the UWIZM have recently been sent to researchers from Argentina, Brazil, Chile and Venezuela as part of a variety of biodiversity studies.

Although there are staffing and resource issues, as is the plight of most natural history collections in the region, the UWIZM can still be a valued partner for future biodiversity studies in the region. Cultural differences between the human inhabitants of the region are not observed by the wildlife that lives there and researchers need to remember this when conducting studies.

What Does the Perfect Database for Collections Management Look Like?

Singer R¹, Rabeler R²

¹*University of Michigan Museum of Zoology, Ann Arbor, Michigan, United States, ²University of Michigan Herbarium, Ann Arbor, Michigan, United States*

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

Arctos? Specify? (K)EMu? FileMaker? Symbiota? So many database platforms to choose from! How do we decide which to use? Which one is the best? What does the "best" database even look like? For the many managers of natural history collections these are questions are the subject of countless discussions and debates. Choices for which database system to use seem to be determined by: data formatting needs, support and price. In addition to these core factors, legacy use, institutional decisions/loyalty, and cross-collections cohesion factor into this decision as well. While there are nearly infinite possibilities for the type and format of data stored in databases across the many collection types, there are still many core fields and features that are wanted across all collections. So is it possible, with enough discussion and planning, to create a set of principle fields and features to create the "perfect" database? Here, we plan to

share responses from the collections community with regards to what is necessary for collection management software in order to better direct how the various developers support the community's diverse database needs.

Digital Workflows Using Specify at the University of Michigan

Singer R¹, **Rabeler R**², Tucker E¹, Holman G²

¹University of Michigan EEB-UMMZ, Ann Arbor, Michigan, United States, ²University of Michigan EEB-Herbarium, Michigan, Ann Arbor, Michigan, United States

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

Prior to 2015, Specify had been used by individual collections at the University of Michigan (UM), in one case as early as 1999. In 2015, the decision was made to adopt Specify across the University Herbarium, Museum of Zoology, and the Museum of Paleontology, in part to focus support on a single product. Michigan was one of the charter Founding Members in the Specify Consortium.

Beginning in 2012, the UM Museums became involved in Thematic Collection Networks (TCNs), collaborative digitization efforts sponsored by the Advances in Digitization of Biodiversity Collections (ADBC) program of the National Science Foundation. During the course of the last eight years, UM has participated in twelve TCN projects; four are currently in progress.

In this talk, we will present workflows that have been designed to integrate Specify into the project workflows for three TCN projects: Digitizing Collections to Trace Parasite-host Associations and Predict the Spread of Vector-borne Disease, The Pteridological Collections Consortium: An Integrative Approach to Pteridophyte Diversity Over the Last 420 Million Years, and Digitizing "Endless Forms": Facilitating Research on Imperiled Plants with Extreme Morphologies. While each workflow has its own goals for efficient data capture, the use of Specify 6 and 7 for dealing with both enhancing existing records and creating new records will be examined.

Publishing Fuzzy Data to the Web Portal: Why We Truncate

Skibinski L¹

¹Paleontological Research Institution, Ithaca, New York, United States

Thursday, 11 June - Symposium: Managing and Mobilizing Collection Data with Specify Software

Several years ago, there were no community standards about the precision of locality coordinate data being published. In the rush to digitize and publish data, many institutions dumped full locality data, including exact coordinates, into online databases and by default, data aggregators. These full data dumps often had detrimental, unintended consequences. Today, the community is still struggling to find an acceptable middle ground between all or nothing attitudes.

The Paleontological Research Institution (PRI) became aware of the lack of standards soon after we migrated our records to Specify. We eagerly georeferenced our localities but published our first data sets with no coordinate data. Because of this, our specimens would not show up on web based distribution maps.

We and eight other institutions were awarded a National Science Foundation (NSF) Thematic Collection Network (TCN) grant to digitize, photograph and publish the data for our Eastern Pacific Cenozoic invertebrate material. As the Eastern Pacific Invertebrate Communities of the Cenozoic (EPICC) members were planning on using collaborative georeferencing during the grant, a consensus about data standards

was reached. We agreed to "fuzz" our data and provide documentation in our published records about our imposed restraints.

Using the Specify database, the Schema Mapper and the Data Exporter, with a little behind the scenes tinkering from scripts, allows us to publish this "fuzzed" data without having to store two sets of coordinates for each record or have to laboriously reconstruct fresh data sets for every upload. The ability to customize fields and easily edit our data helps in keeping our published data up to date and relevant. If the natural history collection community ever comes to a consensus on standards we would be able to respond.

If the community standards come to pass, perhaps future versions of Specify will allow you to customize your level of published data by picking components from a drop down menu or easily choose different levels of openness for subsets of records within a single publish event.

Imaging Systems and Workflows for Digitizing Pinned, Wet and Slide Mounted Specimens

Smith M¹

¹*Macroscopic Solutions, LLC, Tolland, Connecticut, United States*

Friday, 12 June - General (Miscellany) Session 4

Conventional microscope systems have severe color, resolution, and depth-of-field limitations that interfere with the operators' ability to make clear observations. Recent technical innovations in photography are generating contextually strong results that are more consistent with human perception than was previously experienced.

Focus stacking is the image generation technique used to generate 2D imagery and 3D models that are completely in focus, color accurate and high resolution. The mechanical process uses a motorized stage that moves the object relative to the camera. Images are automatically captured to record thin, overlapping focal sections used to create and show total depth of field for the targeted specimen. The computer process distinguishes sharp from blurry as represented by the image. The blurry areas of each image are discarded and the sharp areas are blended together until the entire image is displayed completely in focus; hence the term, focus stacking.

These technologies allow operators to non-destructively recreate visually striking images that combine the structural detail of an SEM, with the color detail of a microscope, without having to prepare or alter the specimen for analysis. Focus stacking is shown to generate more robust observations, which can be shared professionally and interpreted by larger groups of students and lay audiences.

Adaptation and Evolution: Reassessment of Collection Use and Interpretation

Snider J¹

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

Thursday, 11 June - General (Polyphyly) Session 2

The Earth and Mineral Sciences Museum & Art Gallery (EMS Museum) is part of an earth material sciences, engineering energy-focused college within a large university located in a rural region. Over the past 125 years, the Museum's collections have grown from and reflected the research conducted within the college and its five departments. However, as the college's research focus has 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 and surrounding communities. The EMS Museum now serves not only the college but the entire university as well as the region's largely low socioeconomic rural population.

Refocusing the Museums' mission and rethinking how the geologically-based collections can be categorized and utilized has allowed us to be more strategic in setting priorities that have the potential to ensure the collections retain their relevance through being recognized as objects that embody knowledge, foster learning, and promote new pathways of engagement with science, technology, engineering, and art. Working within a limited budget and with two full-time staff, 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. This balancing act has resulted in a series of thematic collections-based exhibits that reflect the history of research and education in the college. These exhibits have been 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, geoscience, and material science.

The outcomes and success of these programs are dependent upon not only the content provided 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. Steps that the EMS Museum have taken to remain relevant are transferable to other museums wanting to promote their collections, broaden science communications, and provide opportunities for informal learning and new modes of research.

Cost efficient and minimally destructive methodologies for sequencing DNA from museum specimens

Streicher J¹

¹*Natural History Museum, London, United Kingdom*

Thursday, 11 June - General (Polyphyly) Session 2

Obtaining DNA from archival specimens is becoming increasingly feasible. Because of this, requests for the destructive sampling of museum specimens are increasing. This creates a scenario where curators must balance the need to conserve irreplaceable specimen tissues with enabling scientific progress in a variety of disciplines. Methods for extracting DNA from specimens often require large amounts of tissue, a requirement that places destructive sampling requests at odds with good curatorial practice. Thus, many destructive sampling applications are not approved and/or the low success rate discourages qualified researchers from utilising natural history collections. I believe that the extraction of genetic information from natural history specimens is a vital activity for demonstrating the modern relevance of collections. However, I also recognise that for this type of research to be routine, the amount of tissue taken from specimens must be small enough to permit future anatomical and histological research. I present results of proof-of-concept experiments applied to our herpetology and ornithology collections that demonstrate small pieces of specimen tissue are often adequate for sequencing partial mitochondrial genomes and the targeted sequence capture of nuclear DNA. These results, coupled with examples from the literature, suggest that we are nearing a time when DNA sequence output is high despite minimally destructive specimen sampling. These examples demonstrate that curators may be more permissive of tissue sampling while also protecting the physical integrity of their collections for future generations of museum specialists, researchers, and society at large.

Curating Sporific Basidiomycetes

Tocci G¹

¹Harvard University Herbaria, Cambridge, Massachusetts, United States

Friday, 12 June - Symposium: Storage Techniques for Art, Science, and History Collections (STASH)

Storing basidiomycete fungi collections is especially challenging when they produce a voluminous number of spores. Preserving these collections while preventing the spores from covering, and genetically contaminating, everything around them is crucial and difficult. At the Farlow Herbarium we have started using an alternative to boxes and polypropylene bags to contain these specimens and their spores.

If You Give a Student a Job: Student Paleontology Digitization as a Museum Strategy

Uehling A¹

¹University of Utah, Salt Lake City, Utah, United States

Friday, 12 June - Symposium: MIDS and MICS: Minimum Information Out of Digitisation

Accessible museum collections include high-quality digitized information, and Minimum Information of Digital Specimen (MIDS) can be standardized across a single collection. Minimum Information about a Digital Collection (MICS) will vary between collections and even between museums; for example, large fossil bones and trackways will include a different set of necessary information and technology than microfossils such as palynomorphs. The basic information should be consistent in both MIDS and MICS, any additional information should be included at the discretion of the collecting museum. Museums should also be wary of leaving information out and creating an access barrier. Between the beginning file quality and eventual digitization of information, the digitization work process can be standardized; once accomplished, those trained to digitize will be able to overcome more challenging digitization processes in multiple areas as techniques become refined. Extraction of minimum information from physical copies to create a repository can streamline workflow for research and visiting professionals; a subset of data can be digitized with generalized tools, such as a rapid-feed or flatbed scanner, which may be included with museums' efforts to digitize records and personnel files. Trained students who digitize this information from the beginning of the process can see workflow from the inception of high-quality content to its use for the entire museum; this longevity in projects can help the MIDS and MICS as a whole. Standards are easier to meet as students become more experienced working through collections, and when difficulties are met in digitization efforts, students with prior knowledge of standards for information can creatively overcome challenges as they arise with increasing ease.

Dwarf Sperm Whale Skeleton Articulation at the Charles Darwin Foundation in the Galápagos Islands

Velez M¹

¹California Academy of Sciences, San Francisco, California, United States

Friday, 12 June - Symposium: Specimen Spotlight

In January 2019, as a Curatorial Assistant in the Ornithology and Mammalogy Department at the California Academy of Sciences (CAS), I helped with the assembly and reconstruction of a Dwarf Sperm Whale (*Kogia sima*) skeleton that washed up on shore in August 2015 on Isabela Island in the Galápagos. Even though the distribution of this species is worldwide, this was the first specimen that was collected in the Galápagos. Godfrey Merlen, a resident from Santa Cruz Island, had previously completed the entire cleaning process of

the bones and stored it for possible future assembly. I was part of a CAS team that traveled to the Galápagos to assemble the skeleton in collaboration with the Charles Darwin Foundation (CDF). Our team along with staff from CDF spent two weeks meticulously assembling the skeleton of the specimen, consisting of 231 pieces plus teeth. We set up an articulation lab on the main floor of the CDF Visitors Center. We used specialized epoxies and connective materials to reconstruct a rare whale specimen for public display. My days consisted of carefully drilling vertebrae, gluing bones, and casting small missing bones from epoxy clay to create the complete skeleton. Our project was conducted in full public display, and as the only Spanish speaking scientist on the team, I often conducted informative talks for the visitors of CDF. In addition to explaining the reconstruction process, I also performed demonstrations of echolocation using a tuning fork to show how whales and dolphins listen throughout vibration in the lower jaws. This project was a meaningful experience that provided an opportunity to educate not only the tourists that visit the island but inform the local community in Santa Cruz about this unique species that is threatened by overfishing, entanglements, and ingestion of plastic pollutants. The specimen is now on permanent exhibit in the CDF Exhibition Hall.

Interpreting Data Quality, or How Collections Can Approach Providing Useful and Useable Data

Wallis E¹, Nicholls M²

¹CSIRO, Melbourne, Australia, ²CSIRO, Canberra, Australia

Wednesday, 10 June - Symposium: Envisioning Collections Management for the Evolving Biodiversity Data Lifecycle

Biodiversity data aggregators, such as the Atlas of Living Australia (<https://www.ala.org.au/>), operate with an assumption that the data contributed is 'good'. This assumption of good data can be incorrect at the level of individual records and the same aggregators receive considerable negative feedback from users when the data is perceived to be (or actually is) 'bad'. What makes a high-quality record is subjective and there are many dimensions of how a 'good' record can be defined. The aggregators attempt to provide indicators of record quality by flagging by a set of validations on each record but this measure alone does not capture the essence of good quality. In this presentation, some nuances of what makes quality data are described, and some practical actions that can be taken in collections to improve the real or perceived quality of data are explored.

A few examples include that users require different types of data depending on their intended downstream use. The data needed by a collection manager to carry out the transactions of loans, display and digitisation is very different to what a government policy maker requires to assess a species as threatened. Data that is fit for one purpose, may be inadequate for another. Old collections contain old specimens, and old specimens often come with data that is deficient for research purposes today. This does not make the record value-less, but simply that it must be interpreted within limits.

As a third example, the data required by certain users may not be passed to the aggregator, even though it's held in the collection management system. A user who wants to contextualise the provenance of the data and of the collecting event to a detailed level will not be satisfied with a bland Darwin Core record. Servicing diverse stakeholders by providing each with 'good' data is a constant challenge – one that we're beginning now to understand and act on.

Building Transdisciplinary Infrastructure for Natural History Material Samples with the Internet of Samples (iSamples)

Walls R¹, Davies N², Kansa S³, Kunze J⁴, Lenhert K⁵, Vieglais D⁶

¹University of Arizona, Tucson, Arizona, United States, ²University of California Berkeley, Berkeley, California, United States, ³Open Context, Berkeley, California, United States, ⁴California Digital Library, Berkeley, California, United States, ⁵Lamont Doherty Earth Observatory, Columbia University, Palisades, New York, United States, ⁶University of Kansas, Lawrence, Kansas, United States

Wednesday, 10 June - General (Potpourri) Session 1

Many types of research, including studies of nutrient flux, environmental health, or crop diseases, require collection and analysis of both biotic (microbial, plant, animal) and soil, water, or rock samples, yet there is no single resource that can give identifiers to samples and track data about all their materials. The current ecosystem of sample and collection management in the U.S. and globally is highly fragmented across stakeholders including museums, federal agencies, academic institutions, and individual researchers, with a multitude of institutional catalogs, diverse practices for sample identification, and discipline-specific data and metadata standards. The Internet of Samples (iSamples) is an emerging, transdisciplinary infrastructure providing services to uniquely, consistently, and conveniently identify material samples, record metadata about them, and link them to other samples, derived data, and research results published in the scientific literature. iSamples Central will provide a low-overhead central discovery and resolution service for any community that wishes to participate, while iSamples-in-a-Box will deliver distributed infrastructure tailored to the needs of specific research domains. iSamples will initially focus on natural history samples - any sample where geolocation is of primary importance - but can scale to any domain. iSamples will extend existing domain- and sample-specific cyberinfrastructure, such as the IGSN Global Sample Number, DataONE, CyVerse, Genomic Observatories Metadata Database (GEOME), System for Earth Sample Registration (SESAR), and Open Context, rendering a cross-domain infrastructure that can serve all samples from the natural and built environment. iSamples will allow scientists to track natural history samples, their derivatives, associated metadata, and data products. iSamples is a single, distributed, transdisciplinary infrastructure based on domain-neutral technologies, standards, and consistent sample identification that is extensible to accommodate domain-specific needs. The project will thus enhance existing research within disciplines while enabling new research across them. A consistent approach to linking material samples with data, literature, and with other identifiable entities in the scholarly research ecosystem is fundamental for broad adoption and implementation by all stakeholders, including federal agencies, museums, publishers, funders, research data infrastructure providers, and individual researchers.

Digital Initiative and Innovation: Coordinating Digital Asset Creation and Management for Medium to Small-Sized Museums

Wilkins A¹, Call R¹

¹Natural History Museum of Utah, Salt Lake City, Utah, United States

Thursday, 11 June - General (Polyphyly) Session 2

The Natural History Museum of Utah (UMNH) recently embarked on a new initiative to comprehensively digitize large portions of the Museum's collections and associated records. This initiative has a two-fold purpose to assist the museum in achieving its strategic goals in innovating around digital engagement, making collections more accessible, promoting student success through transformative education, and connecting students to wider research communities. Managing, creating, storing, and utilizing digital assets can be overwhelming without thoughtful planning. A museum-wide strategy for creating and managing digital museum content can be a solution that facilitates improvements and efficiencies.

Working with collections managers, curators, researchers, and IT staff, UMNH is creating new digital asset management strategies. The first step is to assess the current status of all digital collections material and associated documents. Next, ongoing digitization projects and current project goals are evaluated for value to the mission, size of the collection, the volume of assets, value to researchers, and interest level for public audiences. Through this process, collections are prioritized for ingestion into a digital asset management system (DAMS), are categorized according to guidelines around data sharing and usage, and linked to the collections database. This guidance allows UMNH to share information appropriately with scientific communities, university and K-12 students, and museum visitors.

Avoiding a MICS-up: Using the TDWG Collection Description Data Standard to Help to Define the Minimum Information About a Digital Collection

Woodburn M¹, Paul D², Addink W³, Groom Q⁴, Hardisty A⁵

¹Natural History Museum, London, United Kingdom, ²Florida State University, Tallahassee, USA, ³Naturalis Biodiversity Center, Leiden, Netherlands, ⁴Meise Botanic Garden, Meise, Belgium, ⁵Cardiff University, Cardiff, United Kingdom

Friday, 12 June - Symposium: MIDS and MICS: Minimum Information Out of Digitisation

Although rates of specimen digitisation within natural science collections continue to increase, around 90% of the world's estimated 3 billion natural science specimens are still yet to be made digitally discoverable. While a number of online registries of high-level collections do exist, these are often sparse and text-based data, without the standardised definitions, the Global Unique Identifiers (GUIDs) or the controlled vocabularies that would support quantitative collection metrics and aid discovery of related expertise and publications. To best understand and plan for our world's bio- and geodiversity represented in collections, we need standardised, quantitative collections-level metadata.

The Biodiversity Information Standards (TDWG) Collections Descriptions (CD) Data Standard Task Group aims to provide a data standard for describing natural scientific collections that enables the ability to provide automated metrics using standardised collection descriptions and/or data derived from specimen datasets (e.g., counts of specimens). This aligns well with the intentions of the Distributed System of Scientific Collections (DiSSCo) to implement a Minimum Information about a Digital Collection (MICS) specification that will drive quality of published collections data within the DiSSCo platform. The TDWG standard has the potential to provide a framework for establishing common MICS definitions, and consequently for the automation of calculating MICS levels from institutional data within the DiSSCo platform.

In this presentation, we will introduce the draft TDWG CD data standard, and discuss how it might underpin the MICS concept to provide an ongoing assessment of collections data quality within the DiSSCo platform.

Destructive Sampling of Fossils: Striking a Balance Between Scientific Research and Preservation

Zipfel B¹

¹Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, GP, South Africa

Thursday, 11 June - General (Mixed Collection) Session 3

In recent years, there have been remarkable technical advances in palaeontology and palaeoanthropology. Sophisticated, accurate imaging techniques have limited the need to access original specimens and require no destructive procedures. However, direct dating, isotopic studies, and the study of ancient DNA, proteins,

and microstructures have advanced with great technical improvements but still require a degree of invasive sampling. The power of these invasive approaches for answering important questions in palaeontology and evolutionary anthropology poses the question of how to balance preservation of fossil remains for the future against the advances in scientific analyses and their ability to answer scientific questions.

The Evolutionary Studies Institute, Johannesburg, houses one of the largest fossil collections in the world, representing an almost continuous record of life on earth, from Devonian fish and Permian mammal-like reptiles to Plio-Pleistocene hominins. Requests to carry out destructive sampling are common. Many of these requests have been granted in the past, however, with a substantial number of fossils having been sampled, the wisdom of when to allow such sampling has been questioned. South African Heritage legislation requires a destructive-sampling permit to carry out any destructive work on heritage objects, and would only consider granting a permit with the permission of the Curator of the collection after consulting an Advisory Panel.

With reference to the literature and institutional guidelines, the following summarized principles are recommended in making decisions:

1. A ranking system of the uniqueness of specimens: holotypes and fossil hominins are considered more critically. Specimens are required to have been published, imaged, and open access for study.
2. A standardized formal application procedure: formal application form and research protocol are submitted. The scientific question addressed should be important enough to justify invasive sampling of fossil remains.
3. An impartial Access Advisory panel and list of referees make an informed decision and take collective responsibility.

It is hoped that by employing sound procedures in vetting destructive sampling requests, it makes it easier to strike the delicate balance between preservation of precious fossil remains for future generations and the use of such remains for gaining further insights into evolution of life.

POSTERS

Posters are hosted on the SPNHC Wiki: <https://spnhc.biowikifarm.net/wiki/Posters>

Here Today, Gone... [Date Unknown]: Databasing a Historic Accession and Deaccession Record

[Biedron E](#)¹

¹*Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, United States*

Understanding the unique history of a fossil specimen can be difficult with historic collections. This is especially true if staff cannot determine when a specimen was received and/or transferred or with whom a specimen is associated. Well-groomed accession and deaccession records can aid in understanding the full holdings of a collection in its historic and current usage; however, tackling decades-to-centuries worth of paper records is a daunting task. In the Vertebrate Paleontology collection at the Museum of Comparative Zoology (MCZ, Harvard University), we have captured this data in a four-stage process, consisting of: 1) identifying transactions from historic documents; 2) inventorying related specimens; 3) databasing accession and deaccession transactions; and 4) digitizing their associated media for ready access. While the primary documents were often repurposed loan forms, other material included correspondence and informal documents from previous staff, donors, and recipients. This meant each document and transaction had to be individually evaluated, increasing the complexity of the project. Other challenges included identifying uncatalogued material and relating incomplete specimen descriptions to cataloged material. Other collection documents (e.g., field journals, yearly reports, and staff notes) and communication with other institutions' collection staff proved key to our success in clarifying specimen record data. Previously, accession records were entered into our database but required cleaning, while deaccession records had not yet been captured. As a result of this project, we verified and digitized 126 accession and 111 deaccession records, updating over 1,500 specimen records in the process. We were also able to identify information and documents relating to historic loans and other MCZ collections (e.g., Invertebrate Paleontology), as well as illuminate the connections between the MCZ, other institutions, and the researchers we support.

A Rocking Revamp: How an IMLS Grant Brought a Fresh Look to the Sternberg Museum Geology Collection

[Byrd C](#)^{1,2}, [Fanks A](#)², [Wilson L](#)²

¹*Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, United States*, ²*Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas, United States*

Fort Hays State University's Sternberg Museum of Natural History in Kansas has always had a geology collection, but it was often overshadowed by the larger paleontology and zoology collections. However, a significant donation of mineral specimens in 2017 necessitated that the Museum address the geology collection storage and housing needs to properly curate these specimens. Curation needs included updating the specimen cabinets, rehousing specimens into modern archival materials, digitizing the paper ledger book, and processing the backlog of specimens still wrapped up from a 1999 move. In order to achieve these goals, we applied for and were awarded an Institute of Museum and Library Studies (IMLS) Museums for America grant to improve the collection conditions of the geology area. An essential key to success for this project was specialized staff. Along with the Collections Manager, we hired a part-time student with a strong background in geology. This student was responsible for the day-to-day progress, including packing/unpacking of the geology collection, cataloging, housing specimens, digitizing accession cards and

the paper catalog ledger, and beginning the integration of the geology data to our relational database, CollectiveAccess. Curation and archiving revealed specimens that require specialized care, such as the meteorites and radioactive specimens. After consulting colleagues at other natural history museums, we were able to adapt established methods for specimen care to fit with the needs and resources of the Sternberg Museum. Fitting geologic data into a database with a paleontological framework required consideration of how much data overlapped between the collections and how data storage might need to change to accommodate all recorded data. Though small, this collection is needed for various education and outreach programs, including interpretive exhibits and geology-focused summer camps. Revamping the storage conditions, cataloging all the geologic specimens, and having a searchable catalog will increase the utility of the collection and enable best-practice storage methods for conserving this collection into perpetuity.

Identifying, Documenting and Digitizing Types: A Priority Program in Collections Management at MUSE - Science Museum of Trento (Italy)

[Deflorian M](#)¹, Bernardi M¹

¹*Muse - Museo delle Scienze di Trento, Trento, Italy*

It is known that Type specimens are the most important specimens for taxonomy because the description of new species for science is based on them. Nevertheless, their management in natural history museums is not always adequate to their relevance. Curators and collections managers are often unable to determine with good precision how many and which type specimens are held in their collections. This is for several reasons: the fixation of name-bearing types and the statement of their holding collection became mandatory only with the last edition of the Zoological Code (International Code of Zoological Nomenclature (ICZN)) and remains only strictly recommended in the Botanical Code (International Code of Botanical Nomenclature (ICBN)); the study of historical material presents difficulties and uncertainties; taxonomists and collection professionals are often not sufficient to the amount of work required by such great task.

Among the 2 million specimens held in the MUSE - Science Museum of Trento natural history collections, spanning more than two centuries and mostly of local origin, we estimate that there are about 1,000 types. Many of them are connected to the collections of important botanists and micologists held in the Herbarium Tridentinum (TR) (Ambrosi, Gelmi, Porta, Bresadola); numerous others are amphibians and reptiles coming from the Eastern Arc Mountains (Tanzania) and other tropical African countries collected in the last 25 years; the number of insect and spider type specimens are also relevant. During a first survey held in 2019, 60% of the types results clearly identified; 10% are thoroughly catalogued, whilst only a few dozen of type specimens are digitized.

To fill this substantial gap in knowledge and follow the recommendations of the Botanical and Zoological Codes, MUSE undertook in 2019 a program for the identification, documentation and digitization of type specimens, that aims to allow full access to their data and to make them “open digital specimens”. The identified workflow steps are: 1) Identification: gathering of information from catalogues and publications written by scientists that collected and/or studied our collections; 2) Detailed cataloguing of specimens; 3) Digitization with pictures and/or 3D scanning models; 4) Care: checking environmental and safety conditions of storage location; 4) Publication: realization of types inventories and web open access to all associated documentation.

Split decisions: A Herbarium Specimen Conservation Project

[Gardner E](#)¹

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

Many herbaria have some experience curating mixed sheet specimens. These specimens are comprised of two or more specimens mounted on the same sheet, that are either the same species or not, but often have different collection numbers and can also be from different collecting locations. It was often practiced in the past to save resources, especially when supplies were expensive and limited. Mixed sheets pose interesting challenges for curatorial staff, data entry technicians and researchers. Filing these specimens in the main collection can be difficult, especially if the specimens have different determinations or are from different locations. One must choose a specimen on the sheet to file the entire sheet under and then create a cross reference for the other specimens on the sheet. As we are rounding our 3.5 millionth digitized specimen, when entering data for mixed sheets, our data management team must create individual records in the database for each specimen on the sheet and then cross-reference the records. The challenge for researchers, those annotating and/or borrowing specimens, is that they must indicate which species goes to which annotation. Often by including an A and B, or a 1 and 2, on the sheet next to the specimen and on the annotation label. Usually when these specimens are found in the main collection or returned from being on loan, we place them in a designated specimen repair cabinet; eventually to be dismantled, split, and remounted onto separate herbarium sheets. This summer we conducted a pilot project and processed 180 mixed sheets. We created a nine-step workflow to help us organize and maximize efficiency. As with most projects in an herbarium, the amount of time needed is always more than initially expected. This poster will provide details about the preparation, organization, and our approach to remount mixed sheets.

Is Flowering in South West Greenland Advancing? Using Historical Records to Investigate Phenology in a Warming Arctic

[Grenier M](#)¹, [Phillimore A](#)¹, [Myers-Smith I](#)¹, [Haston E](#)², [Daskalova G](#)¹

¹*University of Edinburgh, Edinburgh, United Kingdom*, ²*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

Temperature is important for flowering and fruiting timing, and scientists have recorded earlier flowering with rising temperatures in several countries where abundant records stretching back for decades have allowed analysis. But what about the Arctic flora, where temperatures are rising at twice the global rate? The Arctic is vast, and compared to other countries such as the UK, relatively under sampled. A 2016 study by Panchen and Gorelick used herbarium and historical records to investigate the advancement of flowering and seed dispersal time in Arctic Canada and the sensitivity of certain species to warming. However, this is the only study to date from the Arctic region exploring the use of historical records to investigate phenology. Here, we used previously undigitised herbarium specimens from South West Greenland to investigate the flowering trend of 19 species over 122 years. We digitised over 5,600 herbarium plant specimens from the Royal Botanical Gardens in Edinburgh and the Museum of Natural History of the University of Copenhagen and scored the phenology of over 2,100 specimens using an adaptation of the protocol by Yost et al. (2018). We conducted a linear Bayesian hierarchical analysis to determine if flowering advanced in those 19 species over 122 years. Records indicated that flowering did not advance over that period (effect size coefficient 0.03, 95% credibility interval -0.2 to 0.3). Instead, we found that early flowering species were flowering later and late flowering species flowering earlier leading to a contraction of the flowering season. Shorter flowering seasons with warming have also been reported by Prevey et al. (2019) in a data synthesis of phenology data from Arctic and alpine ecosystems and has potential effects for both pollinators and plant populations. Vast numbers of herbarium samples with phenological information remain locked in undigitised specimens that could provide insight into phenological trends for remote

ecosystems such as the Arctic. Using a standardised phenology scoring protocol in herbaria would further enable urgently needed large synthesis of biological records to investigate the disruption of biotic interactions of shifting phenological trends with warming and any resulting disruption to biotic interactions.

Connecting Collections and Communities with ArcGIS Story Maps

[Markbreiter D](#)¹, Hendy A¹, Hamdan K²

¹Natural History Museum of Los Angeles County, Los Angeles, California, United States, ² California STEM Institute for Innovation and Improvement, Carson, California, United States

While museums function as repositories of scientific knowledge and discovery, they struggle to share exciting stories to the public in an inclusive way. The problem is often compounded by perceived limitations of their ability to broadcast information beyond the physical walls of the museum. This is especially the case for students in under-served, typically socioeconomically disadvantaged, communities. This poster will demonstrate how the Natural History Museum of Los Angeles County (NHMLA) has partnered with Los Angeles Unified School District (LAUSD) teachers and California State Dominguez Hills' California STEM Institute for Innovation and Improvement (CSI³) to create lesson plans about the natural history of Los Angeles. Because the CSI³ program trains and deploys teachers to schools of greatest need within LAUSD, this partnership has allowed the NHMLA to more inclusively expose students to the museum's collections and "behind-the-scenes" activities.

Utilizing Esri's Story Map platform, the NHMLA is able to develop easily accessible web resources that are cost-effective for both the museum to create and for teachers and students to use. This ensures that the product will be tailor-made for the classroom and will immediately find a real-world application for students of greatest need. A key motivation for these Story Maps is to connect the museum collections with the communities from which those collections originated. This is achieved through compelling story-telling, diverse and captivating media, and Esri mapping products that allow for exploration of pertinent data and local neighborhoods within the greater Los Angeles area. Here we discuss the process of forming partnerships with local educators and explore how other museums can take advantage of Esri's web platform to develop educational material, increase digital engagement, and reconnect communities with their natural heritage.

The MICRO Project at La Brea Tar Pits, Los Angeles, California: Gaining Mega Information From Micro Collections

[Mazzello C](#)¹, Clarke C¹, Dunn R¹, Ellwood E¹, Farrell A¹, Lindsey E¹, Morley S¹, Potze S¹, Rice K¹, Takeuchi G¹
¹La Brea Tar Pits, California, United States

Microfossils at the La Brea Tar Pits (LBTP) in Los Angeles, California, United States, are small fossil remains of hundreds of species of Late Pleistocene and modern-day plants and animals that tell the story of their journey through time and location. These specimens are found within the hundreds of tons of matrix surrounding the charismatic, and better-studied, megafauna of our asphaltic fossil deposits that have been excavated for over a century. Even after decades of sorting microfossils from the matrix, we have only a cursory understanding of the relative quantity and quality of these smaller fossils. Plans for extensive redesign of LBTP have provided research, collections, and lab staff the opportunity to consider our long-term requirements for collections space, research needs, lab workflows and opportunities for educational outreach. Further, recent research focused on food webs in the Los Angeles Basin over the last 50,000 years made extensive use of microfossils and provides us with a case study by which to consider specific institutional needs and wants. With renovations in mind, we developed MICRO — Microfossils In

Collections for Research and Outreach— to take a deeper look at our fossil-rich matrix and potentially inform on-site infrastructure planning. Here, we focus on the collections management aspects of MICRO.

Specimen safety during storage is highly important. Single-height drawers can be used to house hundreds of microfossils, while maintaining even weight distribution, and storing up to sixteen drawers in a single steel cabinet. Depending on the length, width, and fragility of the microfossils, they can either be housed individually or in bulk, in a plastic or glass vial or dram utilizing acid-free, archival materials to ensure long-term preservation. It is likely that research use of microfossils will continue to increase. It is therefore necessary to have a solid understanding of our microfossil resources, the time and materials it takes to prepare them for curation and research, the physical space they require, and the financial investment necessary to make it all possible. Through MICRO, we are gaining insights into the requirements of microfossils that are broadly applicable to other types of natural history collections.

The Evolution of Databasing at the INHS Insect Collection: Lessons Learned From Migrating Three Decades of Digital Data Into TaxonWorks

[McElrath E](#)¹, Dmitriev D¹, Yoder M¹

¹*Illinois Natural History Survey, Illinois, United States*

The Illinois Natural History Survey (INHS) Insect Collection recently migrated from several legacy collection management systems and into TaxonWorks, a biodiversity data management system developed by the SpeciesFile group and its collaborators at INHS. The migration process had several immediate outcomes. First, it unified semantics over five separate databases that were throttling collection management. Second, new interfaces illuminated past issues arising from inconsistent use, conflicting goals, and poorly constrained standards. Third, the migration itself introduced issues originating from the complex mapping of old to new data models. Once the migration was in place, we had the opportunity to quickly iterate on improvements in collections management workflows in conjunction with developers of TaxonWorks. Adoption of the new system allowed us to fully absorb digital assets, including several hundred thousand images and collection objects in collection management “limbo”. We discuss how to manage such a move, what we could have done better, and how valuable the relationship between museum professionals and behind-the-scenes coders can be. As we move closer to recording our millionth digital accession, we are excited to imagine the possibilities that a flexible and evolving biodiversity workbench means for innovation within collections digitization and downstream uses of digital data.

PLAY – Playing for Learning in the Museum: A Case for Understanding Human-Nature relationship through Game-Based Learning

[Oliveira G](#)^{1,2}, Kramar N¹

¹*Musée De La Nature Du Valais, Sion, Switzerland*, ²*University of Fribourg, Fribourg, Switzerland*

Here we present “PLAY – Playing for Learning in the Museum”, a project conducted in Switzerland by the CERF's Laboratory for Pedagogical Innovation (LIP) at the University of Fribourg, jointly with the Valais Nature Museum, in partnership with the Teacher Training College of Valais (HEP Valais). The project involves a digital game given to school children during a visit to the museum, designed to help them to inform their relationships with nature with the concept of the Anthropocene.

The Valais Nature Museum has devoted its permanent exhibition to the evolution of the relationship between humans and the environment with a narrative thread essentially based on an anthropological perspective. Its last room, opened in 2014, concludes the exhibition by presenting the Anthropocene, conceptualized as a new proposed epoch of Earth history signaling the profound and pervasive impacts of

human activities on the Earth System. By highlighting humans' role in modifying planetary processes and conditions, the Anthropocene disrupts the binary between 'Nature' and 'Society'. The Valais Nature Museum is seeking innovative and experimental approaches to educate visitors about this topic and to reflect on the modern conception of nature as an external world separate from human life. In this context, the PLAY project is dedicated to offer students from 12 to 15 years old an engaging experience to address the consequences of their relationships with the environment. It is a digital game-based learning activity fully integrated with the museum's exhibition and collections. By converting the museum's visit into a gameful experience, it aims to understand how the playfulness of a museum's visit allows students to engage with ill-structured problems, and in so doing to develop their relationship to knowledge. Learners' engagement is seen as one of the key elements of learning. Educators and researchers are studying how new media practices relate with visitors' learning in a museum, by changing visitors' experience in order to foster interactions with the museography, their peers and the mediators. This active collaboration with university-based learning science researchers highlights the importance of authentic natural history collections for engaging the public and teaching about complex environmental issues.

Sowing SEEDS: A Model for Museum-Based Teacher Certification and Environmental Outreach Programs

[Robinson J](#)¹

¹*Hefner Museum of Natural History, Miami University, Oxford, Ohio, United States*

Environmental concerns are one of the most pressing issues of our time. Yet, people are increasingly disconnected from nature and many educators feel ill-equipped to teach about the environment and show its connection to all students and subject areas. Miami University's Hefner Museum of Natural History and the Cecilia Berg Center for Environmental Education have created a program to address this dilemma.

Sowing SEEDS is a certification program available to educators at any career stage that provides the Science content and Environmental Education methodologies, Discovery-based learning techniques, and Synthesis of information across diverse fields-the "SEEDS"-needed to grow environmental literacy in a positive, nurturing, and inspiring way. Certification requirements align to the criterion set forth by the North American Association for Environmental Education and the Nature-Based Preschool Professional Practice Guidebook. Classes are available for both primary and secondary educators, tailored to provide age-appropriate, standards-based pedagogical methods that empower instructors to use natural history objects and content when teaching a wide range of subjects. Coursework includes creating and piloting new educational activities, honing inquiry skills, and learning methods to use and prepare scientific specimens that spark curiosity in students. These activities make natural history personally relevant-lessening the disconnect to the natural world. Educational kits created as part of coursework are retained by students for immediate use in their classrooms, and can be reproduced by the Museum as part of our outreach and loan materials, available to both formal and informal instructors.

Reorganizing the Systematics of 6 Million Herbarium Specimens

[Scherrenberg M](#)¹, Bijmoer R¹

¹*Naturalis Biodiversity Center, Leiden, Netherlands*

After a fusion of four herbaria (Leiden, Utrecht, Wageningen and Amsterdam) at the Naturalis Biodiversity Center, a move to a permanent and satisfactory building was urgent. This involved the move and decontamination of almost 6 million specimens. A unique opportunity presented itself: update the order of the Leiden boxes from the Dalla Torre & Harms (1907) taxonomic system to the APGIV (2016) system. In

addition, the Utrecht collections could be changed from an alphabetical APGII (2003) to reflect the new Leiden systematics.

Preparations started a year before the move which was planned for January 2019. Peter van Welzen, a taxonomic researcher at Naturalis, passed each of the 55,000 Leiden and 17,500 Utrecht boxes and assigned every genus to its current family. Using Peter's list and his notes on the boxes, we could begin a picklist of our own to prepare for the move. Coloured cards indicated where families broke into multiples, or where they were integrated into one. Our list was the backbone for the next step: placing stickers on the boxes denoting the new order. Finally, post-it notes with an easy to follow start/stop system were used to communicate the mammoth task of getting the roughly 600 individual sections of between 2 and 2,000 boxes onto the pallets into the taxonomically correct order. To round off the project, the BRAHMS database has been changed to reflect the APGIV system, adding the new family codes. At the time of writing, the move has been completed and the Leiden and Utrecht herbaria are in working order.

Collections at the Swedish Museum of Natural History: Case Studies for Innovative Palaeoecological Outcomes

[Vajda V](#)¹, Skovsted C¹, Larsson C¹

¹*Swedish Museum Natural History, Stockholm, Sweden*

The Swedish Museum of Natural History (NRM) is a major research institute with invaluable collections of >10 million specimens constituting an archive of the natural world. The collections have a broad taxonomic, temporal and spatial coverage and include several unique collections, such as the Linnaean Herbarium, Sino-Swedish fossil plant collection, and the Environmental Specimen Bank. State-of-the-art laboratories enable high-resolution microscopy, elaborate geochemical and isotope analyses, mineral spectroscopy, and DNA sequencing that facilitate high-quality research on the collections and in related fields. The research departments at NRM employ c. 150 researchers and curators.

Digitization is a time-consuming process but becomes considerably more motivating if concrete examples of practical scientific results can be illustrated and presented. In this case-study, a specific fossil assemblage from the Swedish Museum of Natural History, was selected based on its potential for providing interesting and illustrative palaeoecological patterns. As an example, a fossil Ordovician reef complex from central Sweden was selected. When registration of the several thousand specimens was completed, the statistical analyses showed interesting faunal differences between the various parts of the reef complex. In another example, fossil plant assemblages from several localities from the southernmost province of Sweden, and hosted in the NRM collections were selected. These fossils derived from successions spanning the Triassic-Jurassic boundary and also revealed interesting diversity patterns and extinction levels once digitized. We argue that the palaeoecological differences highlighted in these two case studies when visualized through photographs and colorful charts and graphics, significantly increase the incentive for digitization.

Capturing the Flowers of the Sierra Nevada Mountains: The Contribution of the Fresno State Herbarium (FSC) to the California Phenology Network

[Waselkov K](#)¹, Riley R¹, Peña M¹, Pearson K², Yost J²

¹California State University, Fresno, Fresno, California, United States, ²California Polytechnic State University, San Luis Obispo, California, United States

The California Phenology Thematic Collections Network (CAP TCN) is a collaborative project involving 22 herbaria, with the goal of capturing images, transcribing label data, and georeferencing locality descriptions for nearly a million plant specimens. A major additional component of the project is developing new Symbiota-based tools and workflows to enable precise scoring of the phenological status of herbarium specimens, and applying these methods to the imaged specimens from the California Floristic Province biodiversity hotspot. The FSC Herbarium at California State University, Fresno is contributing approximately 40,000 specimens to the CAP TCN. The collection dates from the 1890s to today, with a special concentration on coniferous forests and meadows at elevations above 2500 meters in the Sierra Nevada mountains, surveyed from the 1920s-1960s by the Fresno State Biology professor Dr. Charles H. Quibell. In addition to the high elevation ecosystems represented in this herbarium, the FSC has substantial collections from other severely threatened Central California habitats, including vernal pools and alkali sinks, riparian corridors along the Kings and San Joaquin Rivers, and foothill chaparral and native grasslands. Fresno County is the most agriculturally productive county in the United States, and the location of the 5th largest city in California (Fresno), with a total county population of almost a million people and a growth rate of approximately 0.8% per year. As the human population increases in the Fresno area, and climate change elevates temperatures while decreasing water availability, native habitats all over the county are facing ever-intensifying pressure from urbanization, agriculture, fire, drought, and invasive species. The digitization of the FSC specimens will enhance understanding of historical Central California ecosystems, especially those high elevation habitats particularly threatened by climate change, to establish baseline 20th century data at each elevation for species presence and phenology. Researchers in a variety of different disciplines will be able to use this data to study the ecology and evolution of different taxonomic and functional groups of Central California plant species, and help to develop better plans for conservation and habitat restoration.

Living fossils, as an Icon for Understanding the Past and Current Climate Changes

[Yabe A](#)¹

¹National Museum of Nature And Science, Tsukuba, Japan

The climate has not been stable throughout the Earth's history. In discussing anthropogenic problems, it is important to show how current climate changes differ from historical changes. Living fossils have the potential to make people understand how environmental issues change over time. A new temporary exhibition in the National Museum of Nature and Science, Japan, focuses on a living fossil, *Metasequoia*, a cupressaceous conifer genus "discovered" eighty years ago by a Japanese scientist. The genus is well known because an extant species is commonly planted in school grounds and along pavements in Japan. While this species is no longer found in natural habitats in Japan, we are able to find and collect numerous fossil remains throughout the islands. *Metasequoia* has been extinct from the Japanese islands until the middle Pleistocene, well before the Anthropocene. Soon after the recognition of this genus from fossil remains in Japan, natural habitats of *Metasequoia* were discovered in Central China in 1948. The stands of *Metasequoia* seen outside of China today are planted and conserved through people's efforts. In our exhibition, we will show the history of the discovery of this species, its fossil records from around the world, and a possible scenario describing its extinction in Japan and rest of the world due to climate and

topographical changes during the Quaternary Period. Next, we will show the conservation of natural stands in China after its discovery and current conservation efforts undertaken in China. We believe this prehistoric icon will provide a clear message to the general public about the relationship between the environment and biota, as well as about the difference between historic climate changes and the changes we are facing today.

What's Hidden in Your Herbarium? The Undiscovered Names of Lacistemataceae

[Young F¹](#)

¹*Bioscience Holistics, Bognor Regis, United Kingdom*

My monographic work on Lacistemataceae (www.lacistemataceae.org) was initially written for my Masters dissertation submitted in 2009. I chose this family because the previous monographer, Dr Herman Otto Sleumer, died in 1993. I am thereby continuing his research into the 21st Century. Lacistemataceae is a small Neotropical family consisting of two genera *Lacistema* (11 species) and *Lozania* (five species) distributed from the Mexican Gulf & Southwest regions across the Isthmus of Panama, as far south as Misiones Province, Argentina. Taxa are also located on the islands of Jamaica and Trinidad. Back in 2007, when version 1 of my electronic monograph was released, there were few virtual libraries or herbaria, so my website was just a list of type specimens, protologues, books and journal articles. But today what were just references are now hyperlinks to display type specimens directly on my website and external links to protologues and articles.

I have downloaded more than 5,000 specimen images from 88 virtual herbaria and perusing these images I have located 111 species names, 69 common names, and 9 family/tribe names. By comparison, for Sleumer's 1980 Monograph of Tribe Lacistemeae, 51 herbaria were visited to access 3,133 specimens, and 65 species names, 0 common names, and 9 family/tribe names were published. I am sure that there are far more names (and maybe type specimens) out there to discover and I cannot wait for the time when more virtual herbaria and articles become available, especially those held by herbaria and libraries based in the Americas.

VENDOR Q&A

Delta Designs

Peter Doucette, Brett Danielson

Tuesday, 9 June - 14:00 – 14:30 UTC

Delta Designs Ltd. specializes in the custom design, professional manufacture, and personal installation of quality museum storage equipment. Our products meet the highest standards of conservation practice for historical artifacts, art objects, textiles, scientific specimens and archival materials. For over 30 years we have been the standard for museum storage equipment, contact us to see how we can provide solutions for your current or future storage projects.

EarthCape Research and Collection Data Management System

Evgeniy Meyke

Tuesday, 9 June - 23:00 – 23:30

Enterprise grade highly customizable solution for natural history collections and lab data management. Available hosted or on-premises, both as desktop and web clients. Choose any relational database backend, integrate with institutional security and customize extensively without changing the source code. We convert, customize and deploy within days – give it all a try at no cost.

Specify Collections Consortium

Jim Beach, Norine Spears, Theresa Miller

Thursday, 11 June - 14:00 – 14:30 UTC

The Specify Collections Consortium's symposium at Virtual SPNHC 2020 will conclude with a short general Q & A session. Please join us to ask your questions about software capabilities, workflows, features, and membership in the Consortium.

Tru Vue, Inc.

Yadin Larochette

Thursday, 11 June - 23:00 – 23:30 UTC

What's New at Tru Vue? Learn more about our latest product solutions and programs aimed to help protect your collections, including Optium Museum Acrylic and UltraVue Laminated Glass. We will also discuss TruLife Anti-Reflective Acrylic, offering fun design options via face mounting, direct print, or eraser board applications.

Picturae

Victor Shields

Friday, 12 June - 14:00 – 14:30 UTC

Picturae specializes in the mass digitization of cultural heritage and natural history collections ranging from herbarium specimens and paleobotany acetate peels, to glass slides, ledgers, bound collections,

photographs, archives, maps, and more. We work closely with collections staff to implement custom imaging and metadata workflows. Ask us about digitization and share your favorite story about making collections digitally accessible!

SPONSORS

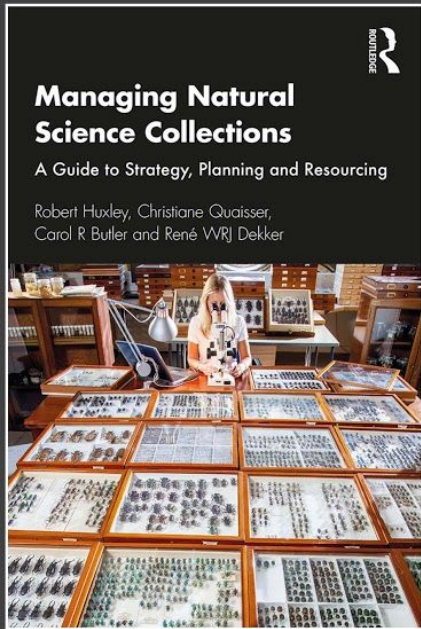


**SPNHC &
ICOM NATHIST
VIRTUAL 2020**
8-12 June



MACROSCOPIC
SOLUTIONS
Inspiring Discovery
WWW.MACROSCOPICSOLUTIONS.COM





Managing Natural Science Collections

A Guide to Strategy, Planning and Resourcing

Robert Huxley, Christiane Quaiser,
Carol R. Butler and René W.R.J Dekker

July 2020: 234x156: 226pp
12 illustrations

Hb: 978-1-138-38681-5 | £120.00
Pb: 978-1-138-38683-9 | £29.99
eBook: 978-0-429-42659-9

TABLE OF CONTENTS:

List of Figures; ABOUT THE AUTHORS; FOREWORD; ACKNOWLEDGEMENTS; Chapter 1: Introduction; Chapter 2: Natural Science Collections – Their Place in Society; Chapter 3: Strategy and Management; Chapter 4: Governance, Legal Aspects and Policy Relating to Strategic Management of Natural Science Collections; Chapter 5: Staff Resources; Chapter 6: Acquisition and Deaccession; Chapter 7: Virtual Collections; Chapter 8: Access to Collections; Chapter 9: Asking the Right Questions – Putting it All into Practice; Appendices; Glossary; Index;

20% Discount with this Flyer!

Managing Natural Science Collections

A Guide to Strategy, Planning and Resourcing

Robert Huxley, Natural History Museum, London, UK, **Christiane Quaiser**, Museum für Naturkunde, Berlin, Germany, **Carol R. Butler**, Smithsonian National Museum of Natural History, Washington D.C. USA and **René W.R.J Dekker**, Naturalis Biodiversity Center, Leiden, The Netherlands

Managing Natural Science Collections demonstrates the need for consistency and evidence-based decision-making in the management of natural science collections, which are becoming increasingly valuable when it comes to addressing societal challenges. It encourages each reader to consider the different options available to them. As such, it should be essential reading for museum practitioners and other professionals around the world who are involved with any strategic aspect of managing natural science collections. Students of museum studies will also find much to interest them within the pages of this book.

20% Discount Available - enter the code FLR40 at checkout*

Hb: 978-1-138-38681-5 | £96.00
Pb: 978-1-138-38683-9 | £23.99

**Offer cannot be used in conjunction with any other offer or discount and only applies to books purchased directly via our website.*

For more details, or to request a copy for review, please contact: Katie Wakelin, Editorial Assistant, katie.wakelin@tandf.co.uk