AMMP

12th Annual Meeting • Hays, Kansas
Sternberg Museum of Natural History

Host Institution Committee
Laura Wilson, Chair
Christina Byrd
Hillary Cepress-McLean

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Association for
Materials&Methods
in Paleontology

This Book Belongs to:

About the Annual Meeting Logo: The logo was illustrated by Bobby Boessenecker (College of Charlston) and reflects the mission of AMMP, the Sternberg Museum logo, and the preferred fossil of the host committee chair. The yellow sun background is taken from the Sternberg Museum's logo, but the iconic *Pteranodon* was replaced by a *Hesperornis*, because tooted flightless birds are awesome.

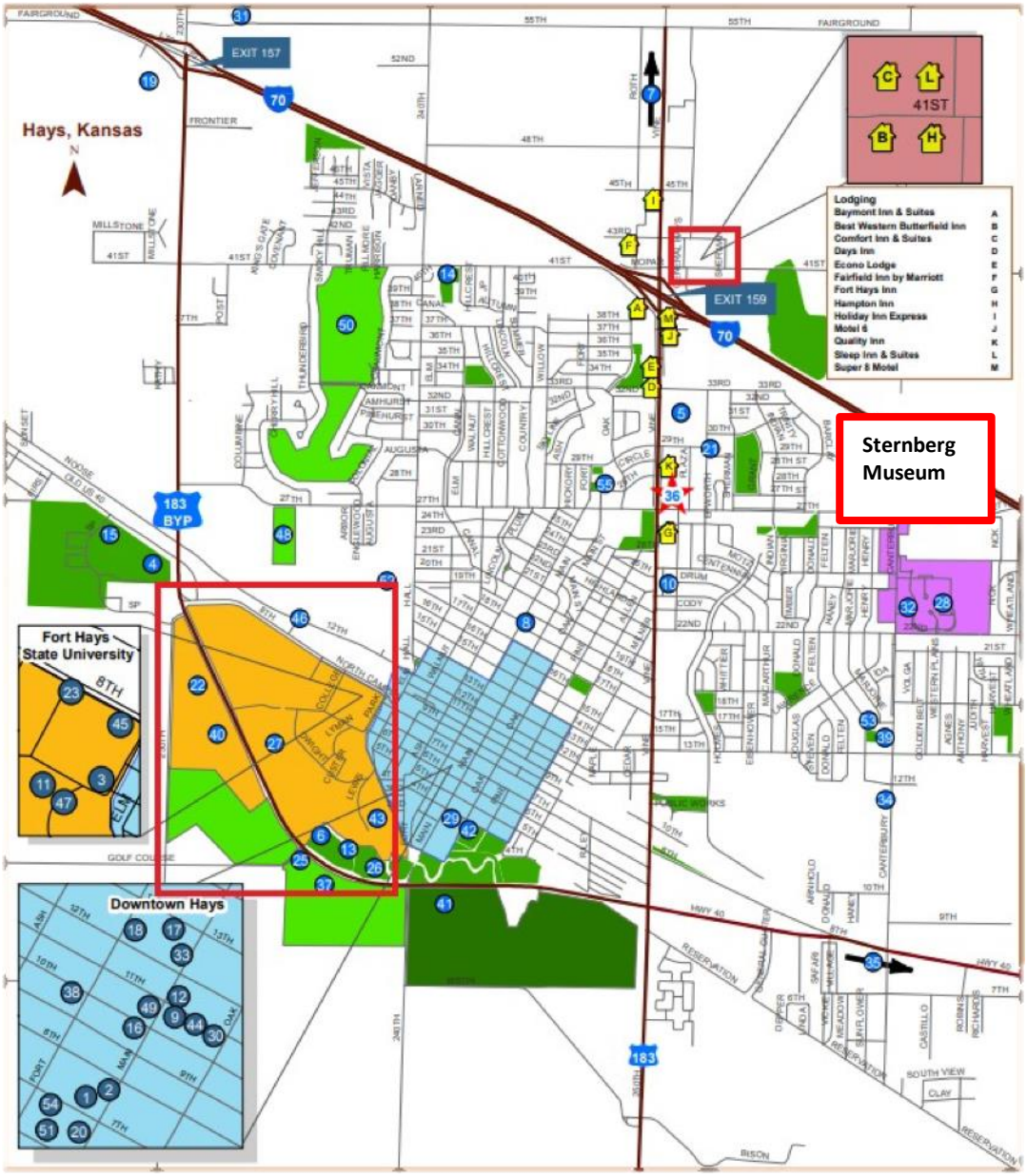
Follow us:

Association for Materials
and Methods in Paleontology

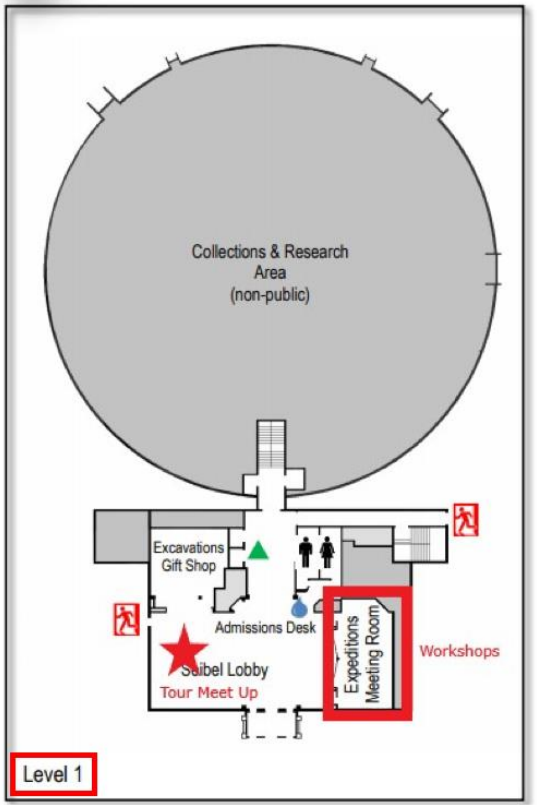
@AMMPaleo
This event is #AMMP12

www.paleomethods.org

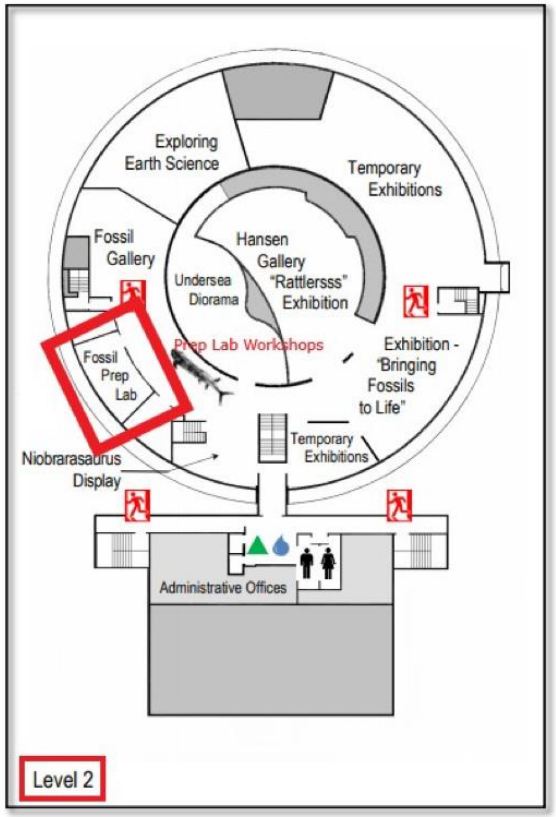
Hays Area Map

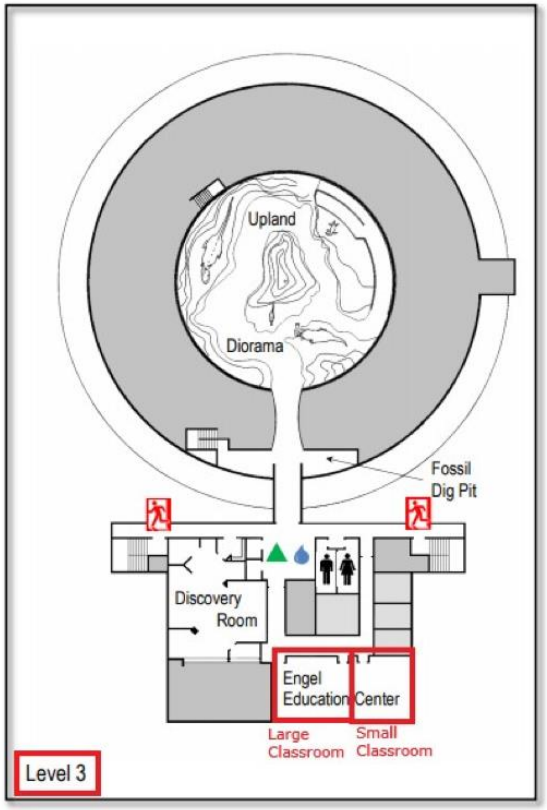


Sternberg Museum Floor Map



FORT HAYS STATE UNIVERSITY'S STERNBERG MUSEUM OF NATURAL HISTORY





Level 1:

- Expeditions Meeting Room
- Tour Meet Up

Level 2:

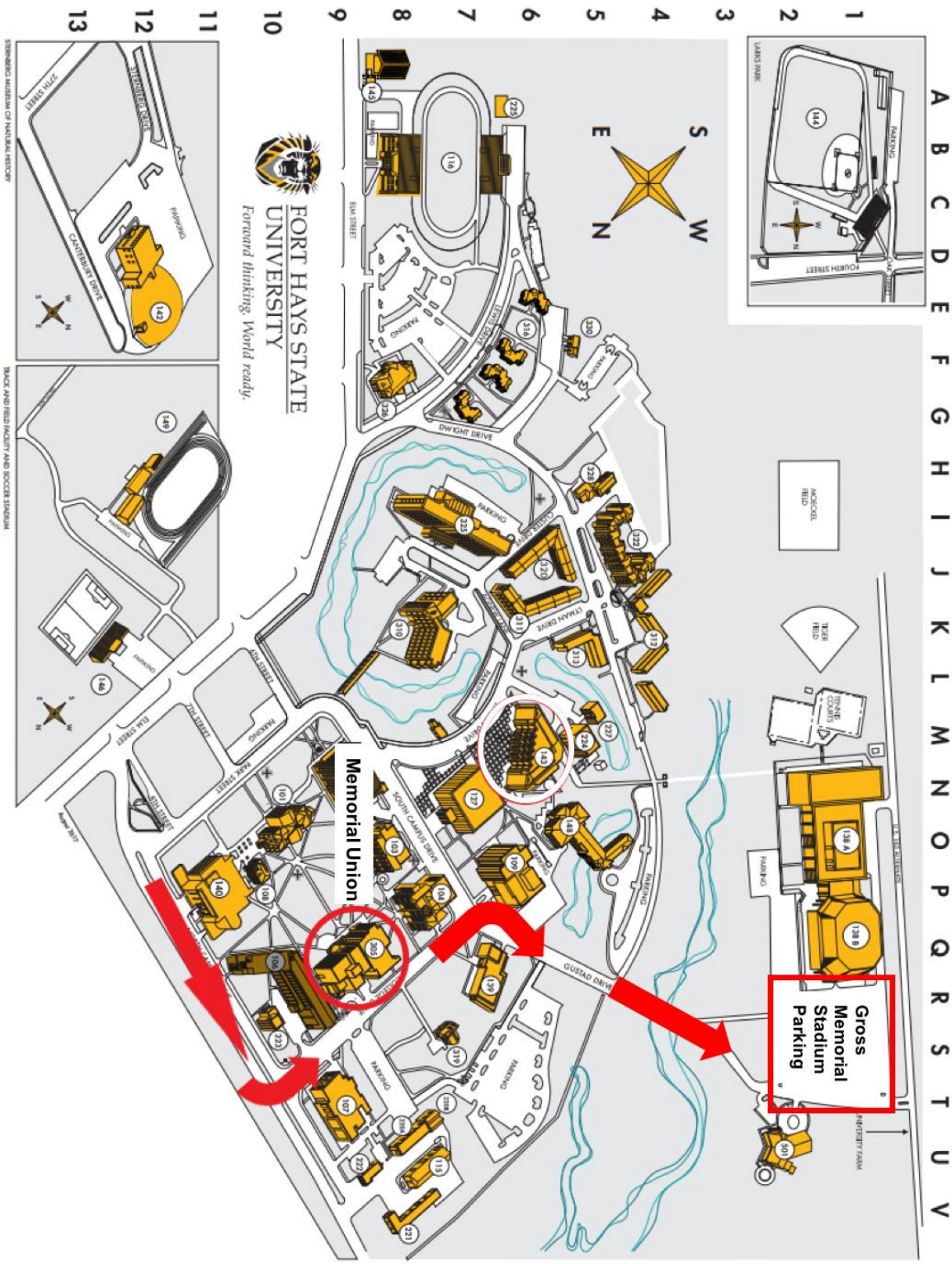
- Fossil Prep Lab

Level 3:

- Large Classroom
- Small Classroom

Key to Symbols:

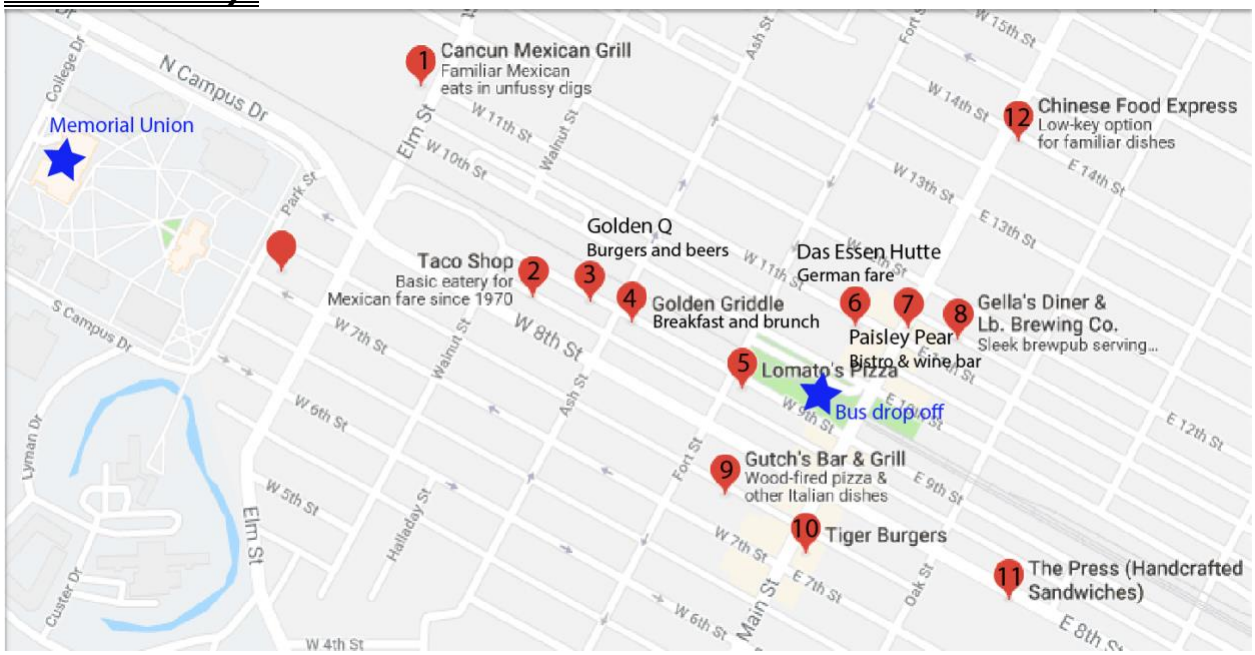
- Elevators
- Emergency Exits
- Restrooms
- Water Fountain


Gross Memorial Stadium Parking
Memorial Union
FORT HAYS STATE UNIVERSITY
Forward thinking. World ready.
DWIGHT DRIVE
GUSTAD DRIVE
SOUTH CAMPUS DRIVE
ELM STREET
PARKING

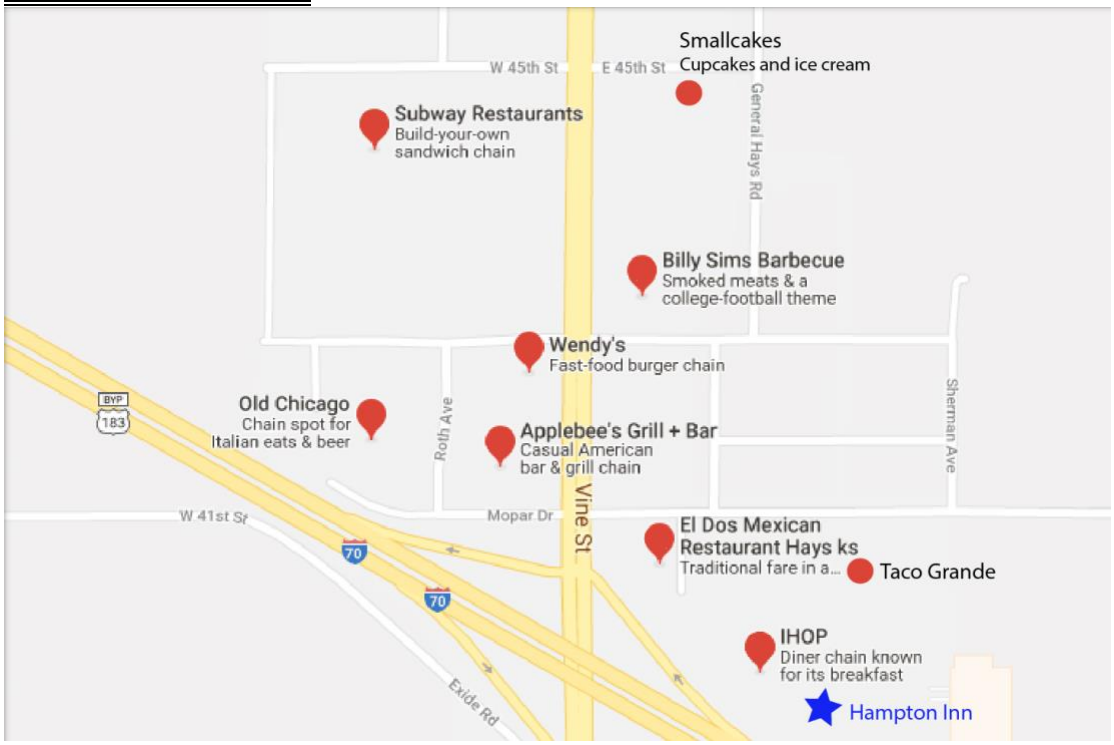
FHSU MEMORIAL UNION
SECOND FLOOR

Restaurants

Downtown Hays



Near the Host Hotel



FHSU MEMORIAL UNION
GROUND LEVEL

- Starbucks
- Grab ‘n Go snack shop (inside the Starbucks) with sandwiches, salads, fruit, drinks, chips, and other snacks
- Mondo Subs with made-to-order subs and bowls
- Cafeteria with salad bar, sandwich, burger, pizza, and ethnic food options

Schedule of Events ~ Overview

Monday – April 15		
Registration/Silent Auction Drop-off	Hampton Inn – Hotel Lobby	6:00 PM – 8:00 PM
Tuesday – April 16		
Registration/Silent Auction Drop-off	Hampton Inn – Hotel Lobby	7:00 AM – 8:00 PM
Prepping for Paleohistology Research	Sternberg Museum – Fossil Prep Lab	8:30 AM – 5:00 PM
Introduction to Line Drawing	Sternberg Museum – Expeditions Room	8:30 AM – 12:00 PM
Introduction to Digital Illustrations	Sternberg Museum – Expeditions Room	1:30 PM – 5:00 PM
Kansas Wetlands Education Center Field Trip	Meet in hotel lobby at 7:30am	8:00 AM – 5:00 PM
Registration/Silent Auction Drop-off	Hampton Inn – Hotel Lobby	6:00 PM – 9:00 PM
Wednesday – April 17		
Registration/Silent Auction Drop-off	FHSU – Memorial Union – Ballroom	7:30 AM – 8:25 AM
Welcome/Announcements	FHSU – Memorial Union – Ballroom	8:25 AM – 8:30 AM
Large to Small: Museum Solutions for All Symposium – Presentations	FHSU – Memorial Union – Ballroom	8:30 AM – 10:30 PM
Break		10:30 AM – 11:00 AM
Large to Small: Museum Solutions for All Symposium – Presentations	FHSU – Memorial Union – Ballroom	11:00 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Large to Small: Museum Solutions for All Symposium – Roundtable Discussion	FHSU – Memorial Union – Ballroom	1:30 PM – 3:00 PM
Break		3:00 PM – 3:30 PM
Poster Session	FHSU – Memorial Union – Ballroom	3:30 PM – 5:00 PM
Opening Reception	Sternberg Museum	6:30 PM – 9:00 PM
Thursday – April 18		
Registration/Silent Auction Drop-off	Hampton Inn – Hotel Lobby	7:30 AM – 8:25 AM
Workshops – Session 1	Sternberg Museum – Various (pg. 17)	8:30 AM – 10:00 AM
Break	Sternberg Museum – Lobby	10:00 AM – 10:30 AM
Workshops – Session 2	Sternberg Museum – Various (pgs. 17-18)	10:30 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Workshops – Session 3	Sternberg Museum – Various (See pg. 18)	1:30 PM – 3:00 PM
Break	Sternberg Museum – Lobby	3:00 PM – 3:30 PM
Workshops – Session 4	Sternberg Museum – Various (See pg. 19)	3:30 PM – 5:00 PM
Trivia/Game Night	Hampton Inn	8:00 PM – 10:00 PM
Friday – April 19		
Announcements	FHSU – Memorial Union – Ballroom	8:25 AM – 8:30 AM
Oral Presentations	FHSU – Memorial Union – Ballroom	8:30 AM – 10:00 AM
Break	Beverage Service	10:00 AM – 10:30 AM
Oral Presentations	FHSU – Memorial Union – Ballroom	10:30 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Oral Presentations	FHSU – Memorial Union – Ballroom	1:30 PM – 3:00 PM
Break	Beverage Service	3:00 PM – 3:30 PM
Oral Presentations	FHSU – Memorial Union – Ballroom	3:30 PM – 4:30 PM
Annual Business Meeting	FHSU – Memorial Union – Ballroom	4:30 PM – 5:00 PM
Closing Banquet/Silent Auction	FHSU – Memorial Union – Ballroom	6:00 PM – 10:00 PM
Saturday – April 20		
Western Interior Seaway of Kansas Field Trip – Lunch Provided	Meet in hotel lobby at 7:30 AM	8:00 AM – 5:00 PM

Prepping for Paleohistology Research

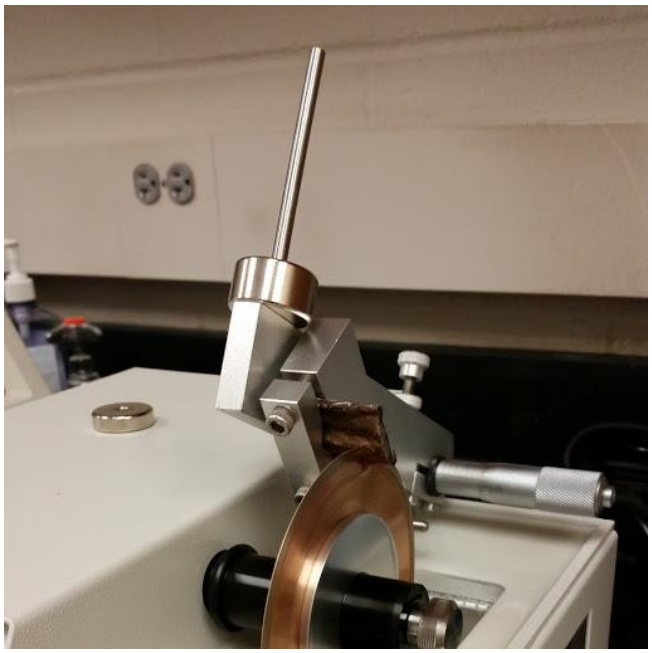
Histological analysis is an important analytical method for understanding the life history of an organism, and the number of labs involved in paleohistology has been growing over the past few decades. This workshop will take participants through the method of thin sectioning fossil bones and teeth: specimen selection, specimen preparation, embedding, sectioning, mounting, grinding, and polishing. We will discuss how methods change based on the size of the specimen being sectioned, as well as considerations for navigating space and other resources concerns at different-sized institutions. There will be an emphasis on documenting materials and methods used in every step in the process, including curating the resulting products.

Hands-on demonstrations and take-home examples will be part of this workshop.

Organizer(s):

Laura Wilson
Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas

Holly Woodward
Center for Health Sciences, Oklahoma State University, Tulsa, Oklahoma



Introduction to Line Drawing

This workshop will provide participants with an introduction to creating natural history illustrations by hand. This half-day morning session will be an introduction to line drawing for scientific illustration. Demonstrations, exercises, and critiques will help you draw what you see. Instructors will focus on the basics of shapes, shading, perspective, and other basic skills to provide participants with an introduction to basic drawing skills. There will be an emphasis on skeletal anatomy and techniques needed for scientific illustration.

Organizer:

Amy Schmierbach
Fort Hays State University, Hays, Kansas

Introduction to Digital Illustrations

The afternoon session will focus on creating digital images. The workshop will begin with an introduction to digital illustration platforms with a focus on Adobe Photoshop. Instructors will cover basic tools and functions. Participants will then progress to digitizing and modifying hand-drawn images using Adobe Photoshop, as well as generating original images. Participants are welcome to bring personal computers for the digital session if they have a license to Photoshop/Adobe. Laptops with Photoshop will be available for participants, but we are not able to give out Photoshop/Adobe licenses.

Organizer(s):

Hillary Cepress-McLean
Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas

Chase Shelburne
Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas

Kansas Wetlands Education Center

Kansas is on the main migratory bird corridor, with the Cheyenne Bottoms wetlands located in the heart of the state. Cheyenne Bottoms is a stopover for thousands of migratory shorebirds and waterfowl, as well as home to many other birds during nesting, staging, or wintering periods (including endangered and threatened species). The Kansas Wetlands Education Center (KWEC) at Cheyenne Bottoms is run by Fort Hays State University and is dedicated to educating the public about wetland communities. This fieldtrip starts with a welcome and introduction to KWEC, Cheyenne Bottoms, and the nearby inland salt marshes (Quivira National Wildlife Refuge) by the KWEC director, followed by a tour of the education center. KEWC includes interactive and interpretive exhibits and outdoor trails and viewing areas. After lunch (which is included with registration), we will go on a guided birdwatch trip at Cheyenne Bottoms.

Trip Leaders:

Curtis Wolf
Kansas Wetlands Educational Center, Fort Hays State University

Reese Barrick
Sternberg Museum of Natural History, Fort Hays State University

Large to Small: Museum Solutions for All

7:30-8:25	Registration open. Silent Auction drop off. Hang posters.
8:25	**Laura Wilson – Host Institution Committee, Chair** OPENING REMARKS
8:30	**Laura E. Wilson, Fort Hays State University** ALL IT TAKES IS MONEY…AND A FEW OTHER THINGS
9:00	**Denver Fowler, Dickinson Museum Center** LESSONS LEARNED IN UNUSUAL PALEONTOLOGICAL ORGANIZATIONS AND THEIR APPLICABILITY TO TYPICAL MUSEUM SETTINGS
9:30	**Darrah Steffen and Hillary Cepress-McLean, Sternberg Museum of Natural History** RUNNING A FOSSIL PREP LAB PART TIME: A CASE STUDY EXAMINING THE EFFICIENCY OF A PART-TIME VERSUS FULL TIME LAB
10:00 – 10:30	**BREAK (Hang posters)**
10:30	**Kelsie Abrams, Burke Museum** MANAGING VOLUNTEERS: TECHNIQUES FOR TRAINING, TRACKING, AND FOSTERING INDEPENDENCE IN THE FOSSIL LAB
11:00	**Vanessa Rhue, Natural History Museum of Los Angeles County** MAINTAINING DATA LABEL INTEGRITY: A REVIEW OF MATERIALS AND TECHNIQUES FOR AFFIXING LABELS TO VERTEBRATE FOSSILS, HOUSING, AND COLLECTION STORAGE AREAS
11:30	**Jessica Miller-Camp, Indiana University** SMALL TO MID-SIZED NATURAL HISTORY MUSEUMS AS PILLARS OF THEIR COMMUNITIES
12:00 – 1:30	**LUNCH (on your own) (Hang posters)**
1:30 – 3:00	ROUNDTABLE DISCUSSION
3:00 – 3:30	**BREAK**
3:30 – 5:00	**POSTER SESSION**
6:30 – 9:00	**OPENING RECEPTION, STERNBERG MUSEUM OF NATURAL HISTORY**

3:30 – 5:00

Matthew Bushell and Chris Widga,
REBURYING A MASTODON: A DIGITIZATION WORKFLOW FOR VERTEBRATE PALEONTOLOGICAL SPATIAL DATA

Lucas Michael Carroll-Garrett, Shawn Haugrud, and Bruce Fischer
THINKING OUTSIDE THE BOX: REDESIGNING SCREEN BOXES TO MAXIMIZE WET SCREENING EFFICIENCY

Linsly J. Church and Gretchen Anderson
DUST DEM BONES: DRY CLEANING METHODS FOR CARING FOR FOSSIL SPECIMENS

Jarod T. Duckworth and Shawn Haugrud
THE TRAINING AND RESEARCH BENEFITS OF MULTI-ORGANIZATION PARTNERSHIPS: REVISITING THE COAT HINES MASTODON

Shannon Harrel, Julie Driebergen, and Megan Norr
MOVING *PAHASAPASAURUS HAASI*: HELPING THE ADAMS MUSEUM (DEADWOOD, SD) BECOME A PALEONTOLOGICAL OASIS IN THE WILD WEST THROUGH REHOUSING A RARE FOSSIL AND CREATING FAMILY FRIENDLY EXHIBITS AND ACTIVITIES

Carrie Howard
TESTING DIGITAL REPLICATION OF MICROFOSSILS AT RANCHO LA BREA

Scott Johnston and Amy Davidson
PHOTOGRAPHS AND FOSSIL FILLINGS: A REVERSIBLE POLYESTER FILL AND UTILIZING NATIVE IPHONE APPS FOR COMPREHENSIVE PHOTO DOCUMENTATION

Brian Lauters
COMPARATIVE ANALYSIS OF PARALOID B-72 AND BUTVAR B-76 DISSOLVED IN ACETONE SOLUTIONS

Virginia Naples and Michael Haji-Sheikh
DEVELOPMENT OF A METHOD FOR THE DETECTION OF FOSSIL MATERIALS *IN SITU* TO IMPROVE PREPARATION

Morrison Nolan, Alexandria Hoeher, and Frederick Marc Michel
A 3D-PRINTED CELL PHONE CAMERA TO MICROSCOPE ADAPTOR: A NOVEL DEVICE FOR RESEARCH, REFERENCE, OUTREACH, AND STUDENT PROJECTS

Stephany Potze, Stevie Morley, and Chris Stavroudis
EFFICACY OF VARIOUS SOLVENTS IN ASPHALT-REMOVAL FROM PLEISTOCENE FOSSILS: A COMPARATIVE STUDY FROM RANCHO LA BREA, CALIFORNIA

James Preston, Alan Zdinak, and Corinna Bechko
REPURPOSING SOLDERING IRON STANDS FOR USE WITH AIR SCRIBES

Poster Session (cont'd)

3:30 – 5:00

Riley Sanford, Kaitlyn Scriven, Kaiden O'Dell, Jerrad Watts, and Laura E. Wilson
EFFECTIVENESS OF FOSSIL PREPARATION TRAINING FROM THE VOLUNTEER'S PERSPECTIVE

Darrah Steffen
DIFFERENTIATING MIOCENE HORSES: AN IDENTIFICATION STUDY USING DISCRIMINANT FUNCTION ANALYSIS

Mireia Ferrer Ventura, Xavier Mas-Barberà, Angelica Torices Hernández, Raúl San Juan Palacios, and Pablo Navarro-Lorbés
BACK TO THE PAST: TRADITIONAL MORTAR FOR THE RESTORATION OF DINOSAUR FOOTPRINT SITES

Wm. Justin Wilkins and Sharon E. Holte
NEW EDUCATION AND RESEARCH INITIATIVES AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.: THE TURNER GEOSPATIAL CENTER

Patrick J. Wilson and Brian Lauters
EMPIRICAL TESTING OF A MIXTURE OF BUTVAR B-76 AND PARALOID B-72 FOR USE AS A FOSSIL CONSOLIDANT

Alan Zdinak
BUILDING BETTER SANDBAGS

8:30 – 10:00	**Session 1 – Session assignment is indicated on the reverse of the name badge.**

2D Digitation
Organizer(s): Christina Byrd and Hannah Horinek
Location: Sternberg Museum – Large Classroom

Air Scribes 101
Organizer(s): Kelsie Abrams
Location: Sternberg Museum – Small Classroom

AMMP: Archiving Methods and Materials in Paleontology
Organizer(s): FHSU IT Staff
Location: Sternberg Museum – Expeditions Room

Molding and Casting: The Basics
Organizer(s): Hillary Cepress-McLean and Pike Holman
Location: Sternberg Museum – Prep Lab

Paleontology Collection Tour
Organizer(s): Laura Wilson and FHSU Paleontology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Zoology Collection Tour
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

10:00 – 10:30	**BREAK**

10:30 – 12:00	**Session 2 – Session assignment is indicated on the reverse of the name badge.**

Air Scribes 101 (cont'd)
Organizer: Kelsie Abrams
Location: Sternberg Museum – Small Classroom

AMMP: Archiving Methods and Materials in Paleontology (repeat)
Organizer(s): FHSU IT Staff
Location: Sternberg Museum – Expeditions Room

Guided Nature Trail Walk
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Molding and Casting: The Basics (cont'd)
Organizer(s): Hillary Cepress-McLean and Pike Holman
Location: Sternberg Museum – Prep Lab

Workshops and Tours (cont'd)

Time Lapse Photography Set-ups: A Simple and Spectacular Technique for Public Outreach and Specimen Documentation
Organizer: Mike Eklund
Location: Sternberg Museum – Large Classroom

Paleontology Collection Tour
Organizer(s): Laura Wilson and FHSU Paleontology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Zoology Collection Tour
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

12:00 – 1:30	**LUNCH (on your own)**

1:30 – 3:00	**Session 3 – Session assignment is indicated on the reverse of the name badge.**

3D Digitization
Organizer: Chase Shelburne
Location: Sternberg Museum – Expeditions Room

Acid Preparation
Organizer(s): Joshua Lively, Lee Hall, Anthony Maltese
Location: Sternberg Museum – Prep Lab

Developing and Adapting Workflows
Organizer: Christina Byrd
Location: Sternberg Museum – Large Classroom

Guided Nature Trail Walk
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Molding and Casting: Education, Outreach, and Consumption
Organizer(s): Hillary Cepress-McLean and Mitch Sommers
Location: Sternberg Museum – Small Classroom

Paleontology Collection Tour
Organizer(s): Laura Wilson and FHSU Paleontology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Zoology Collection Tour
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

3:00 – 3:30	**BREAK**

3:30 – 5:00 Session 4 – Session assignment is indicated on the reverse of the name badge.

3D Digitization (cont'd)
Organizer: Chase Shelburne
Location: Sternberg Museum – Expeditions Room

Acid Preparation (cont'd)
Organizer(s): Joshua Lively, Lee Hall, Anthony Maltese
Location: Sternberg Museum – Prep Lab

Molding and Casting: Education, Outreach, and Consumption (repeat)
Organizer(s): Hillary Cepress-McLean and Mitch Sommers
Location: Sternberg Museum –Small Classroom

Social Media and Paleontology
Organizer(s): Ashley Hall and Darrah Steffen
Location: Sternberg Museum – Large Classroom

Paleontology Collection Tour
Organizer(s): Laura Wilson and FHSU Paleontology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Zoology Collection Tour
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby

Schedule of Events ~ Friday Morning, April 19
FHSU – Memorial Union – Ballroom
Platform Presentations

8:20 **Welcome/Announcements**

8:30 **Thomas Gaetano*, Shawn Haugrud, and Chris Widga**
FUTURISM IN PALEONTOLOGY: APPLICATIONS OF 3D SPATIAL DATA FROM THE GRAY FOSSIL SITE TO A VISUAL FRAMEWORK FOR RESEARCH AND EXHIBITS

8:45 **Anthony Maltese*, Alaina Fike, and Alanna Self**
USE OF 3D PRINTED MAQUETTES AS AN AID IN THE RESTORATION OF A CERATOPSIAN SKULL

9:00 **Cyrus Green* and David Bustos**
USE OF 3D MODELS FOR LONG-TERM PRESERVATION OF EPHEMERAL FOSSIL TRACKWAY DATA AT WHITE SANDS NATIONAL MONUMENT

9:15 **Patrick O'Connor, Joseph Groenke*, and David W. Krause**
MAXIMIZING SPECIMEN DATA, MINIMIZING SPECIMEN RISK: MECHANICAL AND DIGITAL PREPARATION OF FOSSILS FROM A LATE CRETACEOUS BONEBED IN MADAGASCAR

9:30 **Joseph Groenke*, Waymon Holloway, Simone Hoffmann, David W. Krause, John Wible and Patrick O'Connor**
THE PREPARATION OF *VINTANA SERTICHI* (MAMMALIA, GONDWANATHERIA) FROM THE LATE CRETACEOUS OF MADAGASCAR)

9:45 **Carrie Herbel*, Rob Skolnick, Jeremy D. McMullin, and Diana Dohmen**
PROJECT OREODONT: TRAINING VOLUNTEERS TO PREPARE AN HISTORIC BACKLOG

10:00 – 10:30 BREAK

10:30 **Kayleigh A. Johnson**
SIGNIFICANT EFFECTS OF FOSSIL PREPARATION USING SODIUM BICARBONATE AIR ABRASION ON DENTAL MICROWEAR

10:45 **Eric Bezner*, Shawn Haugrud, and Steven Wallace**
PLASTIC VAPOR BARRIERS IN PLASTER JACKETS TO MINIMIZE FOSSIL DAMAGE AT THE GRAY FOSSIL SITE

11:00 **Matthew Eads* and Andrew Heckert**
ASSESSING THE USABLE LIFETIME OF TIN- AND PLATINUM-BASED SILICONE RUBBERS UNDER HIGH AND LOW STRESS ENVIRONMENTS: DOES MOLD FLEXIBILITY TRUMP MATERIAL?

11:15 **Michael Holland**
A NOVEL METHOD FOR SAFE MANIPULATION OF LARGE AND HEAVY SPECIMENS

11:30 **Misty Haji-Sheikh* and Virginia Naples**
THE MISTY METHOD: A NEW TECHNIQUE TO IMPROVE AND INCREASE THE EFFICIENCY OF AIRSCRIBE USE IN MATRIX REMOVAL

11:45 **Q&A**

12:00 – 1:30 LUNCH (on your own)

1:30 **Peter Anderson* and Shawn Haugrud**
BREAKING THE ICE: GETTING THE MOST OUT OF YOUR SCREENING PROGRAM IN VARYING WEATHER CONDITIONS

1:45 **Nickolas A. Brand* and Shawn Haugrud**
BREAKING CLAY: TESTING THE EFFICACY OF HYDROGEN PEROXIDE AIDED SCREENWASHING AT THE PLIOCENE GRAY FOSSIL SITE

2:00 **Shawn Haugrud**
MICRO FOSSILS AND BIG DATA: TOOLS FOR OPTIMIZING RESEARCH POTENTIAL AND WORKFLOW AT THE GRAY FOSSIL SITE

2:15 **Juliet Hook**
THE GYPSUM CAVE COLLECTION: A CASE STUDY ILLUSTRATING THE WORKFLOW TO CURATE AND DIGITIZE A HISTORICAL PALEONTOLOGY COLLECTION

2:30 **Robert L. Evander**
ADAM HERMANN AND HIS TOOLS

2:45 **Q&A**

3:00 – 4:00 **ANNUAL BUSINESS MEETING**

A business meeting will follow the general platform presentations.

Please join us to learn more about AMMP and how you can become involved in shaping the society. We exist because of you and we want your feedback! Feel free to raise any questions or suggestions during the open forum after the presentation.

***Asterisk denotes presenting author**

Schedule of Events ~ Friday Evening, April 19
FHSU – Memorial Union – Ballroom
Closing Banquet/Silent Auction

6:00 **SILENT AUCTION VIEWING AND BIDDING OPEN**
HOSTED AND CASH BAR OPEN

7:00 **SILENT AUCTION OFFICIALLY ENDS**
PENS DOWN!
WINNING BIDS TO CASHIER FOR PAYMENT

7:05 **DINING BEGINS**

8:00 **CLOSING REMARKS**
ELECTION RESULTS
AWARD PRESENTATIONS
SILENT AUCTION TOTAL
FUTURE PLANS
ENTERTAINMENT
René Hernandez-Rivera, Harmonica

WESTERN INTERIOR SEAWAY OF KANSAS

Field Trip Organizer(s): Mike Everhart, Laura Wilson, Sternberg Museum of Natural History

Join us for a trip to western Kansas to explore the Western Interior Seaway. The Smoky Hill Member of the Late Cretaceous Niobrara Formation outcrops in the spectacular badlands topography of Castle Rock. Castle Rock itself is a large chalk pillar, but the badlands to the south are quite fossiliferous with marine vertebrate and invertebrates. The Smoky Hill chalk is capped by the younger Ogallala Formation. Castle Rock was also a landmark of a freight and mail coach line in the 1860s. This trip includes great views, discussion of the geological, paleontological, and cultural history of the region, and an opportunity for prospecting. We will also be making a trip to the famous Fish-Within-A-Fish fossil locality. This is your chance to see proof that Kansas is not completely flat!

Please note: Participants will need to be able to walk up to a mile over uneven ground.

7:30 AM **Transportation will arrive outside the Host Hotel.**

8:00 AM **Depart from hotel at 8:00AM SHARP!**

5:00 PM **Approximate scheduled return to hotel. Actual time may vary slightly.**

Workshop and Tour Descriptions

2D DIGITIZATION
Organizer(s): Christina Byrd, Hannah Horinek
Location: Sternberg Museum – Large Classroom
Session: 1

This workshop will discuss a variety of photography equipment and software that can be utilized for collections digitization, with a focus on how to tailor the set-up to your collection needs and budget. Equipment and software specs will be made available.

3D DIGITIZATION
Organizer: Chase Shelburne
Location: Sternberg Museum – Expeditions Room
Sessions: 3 – 4

This workshop will teach participants how to digitize specimens in three dimensions using the Creaform handheld 3D scanner, with a focus on scalability with specimens and within collections of various size. Techniques taught will include operation of the scanner and associated VXelements software, efficient workflow techniques, and basics of specimen reconstruction in three dimensions.

ACID PREPARATION
Organizer(s): Joshua Lively, Lee Hall, Anthony Maltese
Location: Sternberg Museum – Prep Lab
Sessions: 3 – 4

This will be a short-course (including demonstrations) on acid preparation techniques. Facilitators will cover basic how-tos, safety, and challenges, as well as provide opportunities for participants to get hands-on experience with different acids. Sulfamic and acetic acids will be covered.

AIR SCRIBES 101
Organizer: Kelsie Abrams
Location: Sternberg Museum – Small Classroom
Sessions: 1 – 2

Air scribes are a preparator's main mechanical way to bulk remove matrix from a specimen. This course will discuss several topics on air scribes, focusing on variety and options, maintenance, techniques, and safety. Safe handling of air scribes is critical, and we will go over the different issues that arise from their use and how to mitigate those conditions. An assortment of brands and models of air scribes that are available on the market will be presented with a discussion of the pros and cons of each. Finally, we will demonstrate and practice different matrix removal techniques in a hands-on lesson.

AMMP: ARCHIVING METHODS AND MATERIALS IN PALEONTOLOGY
Organizer: FHSU IT Staff
Location: Sternberg Museum – Expeditions Room
Sessions: 1, 2

Preparators, collections managers, research lab managers, curators, educators, and others in the field of paleontology have been working to refine procedures, develop best-practices, and document protocols and workflows. However, these documents are very rarely shared among institutions, with information most commonly passed from teacher to student, by word-of-mouth between colleagues, or in brief conference abstracts. This workshop will offer people a chance to share documents with others in the field in a centralized database. Fort Hays State University IT staff members will be present to introduce people to the document database and instruct on document upload and organization. Data will be housed on a FHSU server for long-term storage and be publicly available.

DEVELOPING AND ADAPTING WORKFLOWS
Organizer: Christina Byrd
Location: Sternberg Museum – Large Classroom
Session: 3

This workshop will discuss the process of workflow development, the importance of documenting workflows, and the ways a workflow can evolve with the needs and resources of your institution. We will cover developing workflows from scratch as well as modify existing workflows (whether developed by a previous employee or a different institution). Particular attention will be given on how to scale workflows to the size of the institution so they are efficient regardless of whether workers are employees, students, or volunteers, and whether you have many workers or just one person.

GUIDED NATURE WALK
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby
Session: 2, 3

The Museum campus includes a 22-acre nature preserve with over 2 miles of maintained dirt paths. Sternberg staff, community volunteers, and FHSU students and faculty are working to restore this area with native plants. Along the trail, learn about native plants and animals, open prairie and riparian ecosystems, our apiary, plans for an arboretum, and ongoing research projects. Even if a guided tour does not work in your schedule, the trails are open to the public free of charge dawn to dusk.

MOLDING AND CASTING: EDUCATION, OUTREACH, AND CONSUMPTION
Organizer(s): Hillary Cepress-McLean and Mitch Sommers
Location: Sternberg Museum – Small Classroom
Session: 3, 4

This workshop will focus on producing molds and casts for use outside of research and display projects. This includes tips for mass-production of casts for education/outreach/sales, material durability for handling, and production of food-grade molds and casts (i.e., chocolate!). Comments and tips on painting casts will also be offered.

MOLDING AND CASTING: THE BASICS
Organizer(s): Hillary Cepress-McLean and Pike Holman
Location: Sternberg Museum – Prep Lab
Sessions: 1 – 2

This workshop will feature demonstrations and hands-on opportunities for attendees to work with different materials and techniques. Special attention will be given to how materials and methods change with the size and morphology of the specimen.

PALEONTOLOGY COLLECTION TOUR
Organizer(s): Laura Wilson and FHSU Paleontology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby
Sessions: 1, 2, 3, 4

This is your chance to tour the Sternberg Museum's vertebrate and invertebrate paleontology collections. The collections are representative of Kansas and western Great Plains faunas, with exceptional Late Cretaceous Western Interior Seaway, Late Miocene grassland, and Pleistocene megafauna assemblages. The geology collection will also be available to those interested.

SOCIAL MEDIA AND PALEONTOLOGY
Organizer(s): Ashley Hall and Darrah Steffen
Location: Sternberg Museum – Large Classroom
Session: 4

This short-course will explore how different social media platforms can be used in paleontology, with discussion on applications for education, PR, marketing, recruitment, and more. We will cover an introduction to different platforms, how to share and receive information affectively, and ethical concerns. Information and discussion will be relevant to prep labs, collections, education/outreach, and research.

TIME LAPSE PHOTOGRAPHY SET-UPS: A SIMPLE AND SPECTACULAR TECHNIQUE FOR PUBLIC OUTREACH AND SPECIMEN DOCUMENTATION
Organizer: Mike Eklund
Location: Sternberg Museum – Large Classroom
Session: 2

All museums and universities are looking for ways to generate new and interesting content for public outreach purposes. There is also a widely recognized need to do a more thorough job of documenting fossil preparation or other associated tasks like quarry work in the field, specimen mounting or molding/casting of specimens. Timelapse photography is a very inexpensive and simple way to address both of these needs. Photography in the digital era has made the task of capturing and compiling images a much easier and more practical task. Once captured, timelapse imaging can be used for web-based outreach or 'in house' exhibit content while also serving as an archival record of changes to a specimen through time. Size does not matter with these techniques because they can be applied to small specimens under the microscope all the way up in scale to large mounts or quarry compositions in the field. Through hands-on demonstration, this workshop will cover the simple equipment needs as well as address planning, workflow, lighting, and processing of images. Comprehensive hand-outs will be provided to the class.

ZOOLOGY COLLECTION TOUR
Organizer(s): Curtis Schmidt and FHSU Biology Graduate Students
Location: Sternberg Museum – Meet in Museum lobby
Sessions: 1, 2, 3, 4

Our extensive zoology collection is vital to understanding, measuring, and monitoring the biodiversity of past and present ecosystems of the region. This collection includes entomology, ichthyology, herpetology, ornithology, and mammalogy. Specimens include skins, taxidermy mounts, skeletons, fluid-preserved skeletons (in alcohol), and a tissue bank.

Abstracts, Alphabetical by Primary Author

BREAKING THE ICE: GETTING THE MOST OUT OF YOUR SCREENING PROGRAM IN VARYING WEATHER CONDITIONS

Peter Anderson* and Shawn Haugrud
East Tennessee State University, Johnson City, Tennessee, United States of America
*andersonpm@etsu.edu

The seasonal climate of East Tennessee presents unique challenges for wet screeners at the Gray Fossil Site during the 10-month field season. Screeners must carefully consider their strategy when dealing with temperature, humidity, precipitation, and wind strength which all fluctuate wildly depending on time of year. Screening effectiveness hinges on minimizing drying time, so screeners adapt their methods to mitigate impediments and exploit favorable conditions. During a drying cycle screens are angled toward the sun, being adjusted to follow it throughout the day and year. Mild wind conditions aid the process if screens are aligned with the airflow. Heavy wind necessitates precautionary measures to prevent the loss or disruption of fossils. In this scenario screens are angled against the wind to shield the drying sediment. Light screens are placed lower on the drying racks with heavier screens placed progressively higher on the racks. Humidity is commonly very high and slows screening cycles (and the productivity of screeners when paired with excessive heat). Screening is done under shelters, but in the case of heavy precipitation and wind, screens may be moved indoors. During the winter, care must be taken not to allow wet sediment to freeze, which could potentially damage fossils. Screens may be left in tanks overnight in anticipation of freezing conditions, with a protective layer of ice forming at the water surface while the fossils remain safe in liquid water below, a practice adapted from agriculture. When temperature rises above freezing the ice is broken and screening resumes. Screen sets can be taken inside and fitted with fans if temperatures remain below freezing. Allocation of personnel is adjusted according to conditions. More labor is diverted to screening in favorable conditions, and is diverted away from screening in unfavorable conditions. Duration of screening cycles varies depending on conditions; if worker count is low and conditions are conducive to drying, number of cycles is prioritized over screening duration. All sites should carefully consider local climate, matrix, and fossil condition when developing screening protocols.

PLASTIC VAPOR BARRIERS IN PLASTER JACKETS TO MINIMIZE FOSSIL DAMAGE AT THE GRAY FOSSIL SITE

Eric Bezner*, Shawn Haugrud, and Steven Wallace
East Tennessee State University, Johnson City, Tennessee, United States of America
*bezner@etsu.edu

Aluminum foil is commonly used in jackets as a separator between fossils and plaster. Workers at the Mio-Pliocene (~5 Ma) Gray Fossil Site (GFS) in East TN, U.S., use different methods because of the unique nature of the deposit. GFS formed as a sinkhole lake which consists of surficial colluvial gravels and paleosols, up to 8m thick, that are underlain by over 40m of well-laminated, extremely organic, dark-gray, lacustrine clays. The clay has remained hydrated since deposition and is not lithified. This presents 2 problems as it dries: 1) the clay minerals present result in shrinking, warping, cracking, and delamination, which pull fossils apart and disrupt original orientation, 2) hardened matrix also makes it difficult to recover delicate fossils. In 2004, workers began using black polyethylene sheeting to seal jackets based on observations of Tyvek use in construction. At GFS the vapor barrier is intended to keep moisture in. Moisture inside a jacket can introduce issues such as mold, so additional steps were needed to offset these consequences. Most toilet-paper is designed to break down in septic systems, in part through microbial action. Switching from toilet-paper to brown paper towels inside our jackets significantly suppressed microbial growth. Through trials, it became clear that keeping the matrix in "hydrated stasis" also suppresses mold (most growth occurs during drying while partially hydrated, rather than fully saturated). Workers wear respirators when dealing with mold as a precaution. To test our technique, we made a jacket of GFS matrix with traditional materials/methods and observed it for 2 months under stable temperature and humidity. In less than a month the matrix developed substantial cracks and delaminations. Because the matrix was able to slowly dry within the jacket, spending more time in a partially saturated state, more aggressive and substantial mold growth occurred than in numerous observed jackets with plastic barriers. By using plastic vapor barriers, excavated material from GFS is kept dimensionally stable, and mold growth is better controlled. Fossil localities with similar matrix may benefit from using this technique.

BREAKING CLAY: TESTING THE EFFICACY OF HYDROGEN PEROXIDE AIDED SCREENWASHING AT THE PLIOCENE GRAY FOSSIL SITE

Nickolas A. Brand* and Shawn Haugrud
East Tennessee State University, Johnson City, Tennessee, United States of America
*brandn@etsu.edu

The Gray Fossil Site (GFS) in eastern Tennessee utilizes a wet-screening operation that breaks down microfossil bearing clays in large quantities using water as the disaggregation agent. Surfactants are avoided because they leave a residue. We tested 3% concentration hydrogen peroxide as an alternative agent for the GFS clays. One cm cubes of clay, weighing an average of 4.4 g, were cut from the site and the breakdown time of one cube in hydrogen peroxide was compared against water in three trials where samples were soaked without agitation. All three water trial samples retained cubic shape after two weeks while the hydrogen peroxide samples were completely disaggregated in an average of 11 minutes. Three fossil vertebrae each of fish, salamander, and snake, as well as 3 acorn caps, and hickory nut fragments from the site were placed in hydrogen peroxide to assess damage to specimens. Each of the sample groups (divided by fossil type) were subjected to 5, 15, and 60 minute soaks in hydrogen peroxide. Before and after pictures were taken on a Dino-Lite microscope. Comparison of these revealed minor flaking damage to two hickory nuts and an acorn cap fossil, consistent with swelling/contracting damage seen during the normal water based screening process. Ten pounds of dried clay from GFS was then tested to determine the effectiveness of hydrogen peroxide breakdown at a large scale. This material was placed into a screen box, and then placed into a larger plastic container filled with 5 L of hydrogen peroxide. The reaction was timed to 15 minutes (the normal length of one part of the water screening cycle at GFS), and temperature was recorded at 30 second intervals with a meat thermometer. The crate was not agitated during testing. The temperature rose steadily from 69.7° F to a maximum of 81.5° F at the end of timing. The remaining clay was soaked in water for five minutes to ensure that no hydrogen peroxide remained, and resulted in microfossil concentrate, in an amount comparable to a 12 hour session of wet-screening at GFS. These preliminary results suggest that hydrogen peroxide dramatically decreases processing time without significantly increasing damage.

REBURYING A MASTODON: A DIGITIZATION WORKFLOW FOR VERTEBRATE PALEONTOLOGICAL SPATIAL DATA

Matthew Bushell* and Shawn Haugrud
East Tennessee State University, Johnson City, Tennessee, United States of America
*bushell@etsu.edu

Geographic Information Systems (GIS) can be a powerful paleontological tool. This project's goal was to digitally reconstruct a large, mostly-articulated mastodon (*Mammut* sp.) excavated from the Gray Fossil Site during the 2015 to 2018 field seasons. This was done by compiling total station survey data, field notes, sketch maps, and cataloged specimen data within ArcGIS Pro. Field drawn sketch maps were geo-referenced to relevant survey points. Then, a polygon layer was created by tracing the spatially referenced field drawings. Each polygon was given the specimen's designated field number and connected to a table containing all associated field data. The result was a polygon layer that displayed all major bones and bone fragments of the mastodon which was linked to museum catalog information. Researchers can use this digital product to interpret site taphonomy, examine the distribution of skeletal elements or fossil taxa, or potentially identify areas of interest for future excavations. This workflow will streamline future specimen digitization efforts at the Gray Fossil Site.

THINKING OUTSIDE THE BOX: REDESIGNING SCREEN BOXES TO MAXIMIZE WET SCREENING EFFICIENCY

Lucas Michael Carroll-Garrett*[1], Shawn Haugrud[1], and Bruce Fischer[2]
[1]East Tennessee State University, Johnson City, Tennessee, United States of America
[2]Milton, West Virginia, United States of America
*carrollgarrett.lucas@gmail.com

The Gray Fossil Site utilizes a massive wet screening operation to process over 20 tons of fossil bearing matrix annually. The sediment is collected as over 1,000 discreet samples, each weighing approximately 40 pounds. Each has a unique data set including precise location and elevation that greatly increases the research value of the micro-fossils. Originally the site used wooden screens based on Hibbard's designs. These had many drawbacks and the design was modified over the years with little success. The biggest flaw was the extensive maintenance required, resulting in every screen being out of circulation for a week each season and a significant monetary investment in worker hours to repair them. In 2015 the authors developed a prototype design for a plastic screen box that went into production the next season. This design evolved over further seasons and eliminated the problems associated with the wooden boxes. The current design uses a 16.75" wide by 13.5" long by 10.25" deep plastic crate with extra holes cut into the bottom and corners for water flow and drainage. Holes in the sides and bottom make clogging impossible and allow multi-directional flow. One layer of 0.5mm or 1.7mm aluminum screen is cut in a cross pattern to fold along the corners of the screen base, then bolted with a corner bracket for a mechanical seal. Silicone caulk is applied to the corners to seal screen edges. A weather strip inserted into the factory-incised line at the top of the box seals the screen ends. Foam pool noodles are cut to fit, internally reinforced with wooden dowel rods and attached to the holes in the crate sides via zip ties for buoyancy. These modular floats can be quickly replaced when degraded. The boxes degrade very slowly and have lasted 3 seasons without repair. These plastic screen boxes do not waterlog and are 50% more buoyant allowing for indefinite pre-soaking of sediment. The screens are much lighter and easier to use and can be nested. The color-coded floats have almost entirely eliminated data loss from human error. Coupled with improved crew management these more efficient screens have contributed to a 150% increase in finished sediment production.

DUST DEM BONES: DRY CLEANING METHODS FOR CARING FOR FOSSIL SPECIMENS

Linsly J. Church* and Gretchen Anderson
Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, United States of America
*churchl@carnegiemnh.org

Everything accumulates dust. Even in a museum setting, dust is unavoidable. Dust can obscure the surface of a fossil and begin to adhere if it remains for too long; therefore, it is important to develop nonharmful techniques for dusting specimens. Dry cleaning methods are preferred, because, as their name suggests, liquids are not involved, and thus no harmful chemicals are used.

At Carnegie Museum of Natural History, we use a variety of dry cleaning methods on fossils throughout our exhibits and collections. Exhibit specimens are cleaned once a year by the Vertebrate Paleontology staff. To begin cleaning, we use a reusable (i.e., can be vacuumed or hand washed) synthetic duster with an extendable handle. In addition to this large duster, smaller tools are used to remove particulates. A soft, natural fiber brush is ideal for accessing small spaces, and sometimes removes dust more efficiently than the duster. After use, brushes are cleaned with soap and water. A photo bulb uses air to remove dust from specimens. Tweezers can be used to collect larger 'dust bunnies' or to remove debris that the brush or photo bulb cannot. Vacuums are not often used to clean specimens due to their unwieldiness when used on a lift.

When cleaning in collection areas, one additional dry cleaning method is used. Due to Pittsburgh's history in the steel industry and the museum's open shelving and formerly poor air filtration systems, over time, soot and other particulates have entered the collections and settled onto specimens. Recent updates to the HVAC system have helped mitigate these problems. To clean fossils covered in particulates, we use soot sponges. Made of vulcanized rubber, these sponges have been engineered to absorb fine soot particles in tiny surficial pores without depositing chemicals on the fossil. Therefore, when using these sponges, there is no need for water or additional solvents, which can cause staining on the surface being cleaned. In some cases, soot on the specimens is so dense that it is obvious where cleaning has taken place.

THE TRAINING AND RESEARCH BENEFITS OF MULTI-ORGANIZATION PARTNERSHIPS: REVISITING THE COATS-HINES MASTODON

Jarod Duckworth*, Shawn Haugrud, and Chris Widga
East Tennessee State University, Johnson City, Tennessee, United States of America
*duckworthjt@etsu.edu

The Coats-Hines-Litchy (CHL) site is a Pleistocene vertebrate locality in Williamson County, Tennessee. Excavations by the Tennessee Division of Archaeology in 1972 produced the most complete published specimen of *Mammut americanum* from Tennessee. The added presence of stone tools and scratches on some bones were initially proposed as possible evidence for human butchering. CHL vertebrate material from these excavations remained unprepared for four decades, wrapped in old newspapers and stored in brown paper bags with non-archival adhesives and little documentation. Over the years, this resulted in extensive breakage and damage, particularly to the humerus, and contributed to the specimen's overall low research value. In 2018, it was proposed that the East Tennessee Museum of Natural History (ETMNH) become the repository for these specimens, ensuring that they would be prepared, catalogued, and housed in accordance with museum best practices. Bones were identified, inventoried and rehoused in appropriate materials. A student training program was set up to prepare the specimen. The original undocumented adhesives were removed when possible, and all bones cleaned. Bones were consolidated with Butvar B-98 and reassembled with Butvar B-76 at 50/50 in acetone v/v as the adhesive. This work dramatically increased the research value of the specimen. In addition to producing measurable elements, the discovery of several unreported elements makes the mastodon more complete than initially thought. Pathological damage to some elements indicates possible disease and will be the subject of further study. Re-examination of the scratch marks indicate they are likely the result of normal taphonomic processes and not modification by humans. This project was an invaluable training opportunity for students, increasing their experience and knowledge, and providing baseline experiences that can be applied to more complex projects.

ASSESSING THE USABLE LIFETIME OF TIN- AND PLATINUM-BASED SILICONE RUBBERS UNDER HIGH AND LOW STRESS ENVIRONMENTS: DOES MOLD FLEXIBILITY TRUMP MATERIAL?

Matthew Eads* and Andrew Heckert
Appalachian State University, Boone, North Carolina, United States of America
*eadsms@appstate.edu

The goal of this project was to assess differences in quality and production of casts from tin-based (TB) and platinum-based (PB) silicone rubber molds, while also considering the molds' rigidity under high and low stress environments. PB molds are advertised as ideal for shelf life, but are not intended for mass production, whereas TB are the opposite. We compared two PB rubbers (Mold Star® 16 FAST and Dragon Skin® 10 FAST) along with three TB rubbers (Mold Max® 10, Mold Max® 27T and Mold Max® 40). These are abbreviated MS, DS, MM10, MM27, and MM40 hereafter. The casting agent was Smooth-Cast® 320 urethane resin and a tooth of *Carcharocles megalodon* was used for our comparison. Each material was used to make a pair of one part molds, with the tooth positioned identically in each mold. Two tests were done on each of the five mold types a short-term, high-stress and a long-term, low-stress test. For the short-term, or 'torture-test,' we poured the mold every eight minutes for 8-10 hours a day until the mold was exhausted to simulate a "rush production" prior to a major event. In contrast, for the long-term test we poured the mold once or, at most, twice a day to emulate occasional use in a museum. During curing, the resin reaches 60°C, which slowly causes the inside of the mold to become dry, rigid, and more susceptible to tearing. This process is exacerbated during the short-term test due to the interior of the mold constantly experiencing high temperatures. Our results demonstrate that less rigid molds (lower shore values) outperform the higher shore values regardless of material type. DS and MM10 both have a shore value of 10A, the lowest used thus far, and outperformed all of the other molds with no discernible loss of cast fidelity. Because we have not observed any negatives to using flexible molds, we plan another series of identical tests with shore values of 00-10 to 00-50 using EcoFlex® 00-10, 00-20, 00-30, and 00-50. We predict that in this range of values there will be the best balance of long-term use and flexibility.

ADAM HERMANN AND HIS TOOLS

Robert L. Evander
Columbia University, New York, New York, United States of America
rle10@columbia.edu

Adam Hermann was born in west-central Germany in 1847. He was trained to boss lead in his homeland. Bossing lead involves the shaping of lead sheets into pipes, vessels, and flashings. Hermann immigrated to America in 1869, and settled in New Haven CT. Originally working as a roofer at Yale University, Hermann began supplementing his income as a taxidermist at the Yale Peabody Museum. In 1882, he switched vocations and learned to prepare fossils.

In November of 1892, Hermann became the fourth full-time staff member, and first preparator, in the Department of Vertebrate Paleontology at the American Museum of Natural History. During the formative years of the Department, Hermann prepared fossils, trained new workers, and managed the workflow thru the laboratory. The title 'head preparator' came into use about the turn of the century. Hermann's lasting legacy was his many free-standing skeletal mounts.

Hermann authored two publications describing his preparation techniques. In these publications, Hermann illustrated several of the hand tools that he used for fossil preparation. Most are no longer in common use. It is worth considering the hypothesis that Hermann adapted these unfamiliar tools from his former career as a roofer. The tools illustrated by Hermann included several stone carver's diamond-point chisels, a cobbler's hammer, a jeweler's chasing hammer, several awl blades fashioned from saddle-maker's harness needles, a plumber's shave hook, a cooper's inside shave, a sculptor's rubber cup, and a sculptor's spatula. The only one of these tools that Hermann might have used in bossing lead sheets on the roofs of Yale University would have been the plumber's shave hook. Clearly, Hermann's toolkit was not restricted to the instruments of his former profession.

Hermann introduced the use of electrical tools to fossil preparation. His dental lathe was a direct-current motor with a flexible shaft coming from one side and a grinding wheel attached to the other. Hermann frequently used drill bits placed in the chuck of the flexible shaft to drill holes in his mounts.

FUTURISM IN PALEONTOLOGY: APPLICATIONS OF 3D SPATIAL DATA FROM THE GRAY FOSSIL SITE TO A VISUAL FRAMEWORK FOR RESEARCH AND EXHIBITS

Thomas Gaetano*, Shawn Haugrud, and Chris Widga
East Tennessee State University, Kingsport, Tennessee, United States of America
*gaetano@etsu.edu

Over 20,000 fossil specimens have been excavated from the Gray Fossil Site (GFS) since 2000. GFS crews recover 100% of fossil materials >1mm and collect spatial data on all stratigraphic features and fossils. We precisely record 3D coordinates and assign descriptive categories to stratigraphic features and macrofossils using a Sokkia CX-105 total station connected to a Topcon FC 2600 data collector. These data are exported into AutoCAD and ArcGIS for visualization. Descriptive categories allow spatial analyses of taxa, skeletal elements, and geologic features. GFS data layers also include: 1) drone-based, close-range photogrammetry for a high-resolution orthophotomosaic layer, 2) micro-gravity data for remotely reconstructing paleotopography, 3) plane-based LIDAR, and 4) infrastructure data useful for site management decisions. The resulting digital product thoroughly documents site structure, taphonomic relationships, and stratigraphic trends through geologic time. This geospatial framework also provides a robust platform for the future incorporation of digital 3D models into virtual 3D space. Specimen-based 3D digitization occurs throughout preparation using photogrammetry (Agisoft Photoscan), structured light (Artec) and laser texture (Next Engine) scanners, and computed tomography. All digital data are curated on a 19 Tb network server. Cloud-based platforms (e.g., Sketchfab, Morphosource) are used for public distribution of 3D models. Recently, the 14-year archive of GFS geospatial data was used to develop a prototype Virtual Reality (VR) application where a user can navigate a point cloud representing fossils in original position. Alternatively, a user could experience a simulation of the museum lobby with a display of 3D specimens. Future work includes using field sketches in ArcGIS to streamline digitization of fossil locations and expanding the VR application to include 3D digitized specimens and geologic features into the point cloud. The ultimate goal is a user-friendly interface for research, science outreach, and online virtual tours that reconstruct the ancient environment and encourage real-time interaction with museum staff online and on-site.

USE OF 3D MODELS FOR LONG TERM PRESERVATION OF EPHEMERAL FOSSIL TRACKWAY DATA AT WHITE SANDS NATIONAL MONUMENT

Cyrus Green* and David Bustos
White Sands National Monument, Alamogordo, New Mexico, United State of America
*cyrus_green@partner.nps.gov

Within the soft gypsum sediment of an ancient lake bed an enormous number of Ice Age mammal tracks have been found at White Sands National Monument. Tracks include mammoth, giant ground sloth, camel, dire wolf, large feline, and human, with many over-stepping each other, providing evidence for animal and human interaction. Resource preservation is the mission of the National Park Service and preservation of track data is paramount as tracks only last a few years once they are exposed. The sheer amount of tracks and the soft gypsum sediment makes collection or molding of tracks difficult. The purpose of this study was to find a method of preserving data from important tracks before they were destroyed by erosion. Photogrammetry is typically used to build 3D models with an object on a turntable and a stationary camera, but methods have been devised for field photogrammetry as well. Taking photogrammetry in the field allows sub-centimeter scale data of immovable objects to be precisely collected for preservation and future research. This study focused on a pedestalled, eroding, large feline track of which data loss was imminent. The track could not be molded due to its fragility. This study used photogrammetry to build a model and print a 3D replica of the track that could then be molded and cast safely. Photos were taken of the track in the field using a Nikon D750 DSLR camera with a 20mm lens. These photos were then used to build a 3D model using Agisoft PhotoScan software. This model was then fed into Cura 3D software and an Ultimaker S5 3D printer was used to print a replica of the track. To avoid an obvious digital signature, the finest mesh possible was used during 3D printing; a thicker mesh left digital marks on the replica that were picked up by the molding agent. The replica was molded using Mold Max™ 14Nv Silicone Mold and cast using Smooth-Cast™ 325. This study found that using photogrammetry and 3D printing in this way provided a non-invasive method for replicating an accurate cast of a delicate track, preserving the data before it was lost.

THE PREPARATION OF *VINTANA SERTICHI* (MAMMALIA, GONDWANATHERIA) FROM THE LATE CRETACEOUS OF MADAGASCAR

Joseph Groenke*[1], Waymon Holloway[2], Simone Hoffmann[3], David W. Krause[4], John Wible[5], and Patrick O'Connor[6]
*[1,6]Ohio University College of Osteopathic Medicine, Athens, Ohio, United States of America
[2]Stony Brook University, Stony Brook, New York, United States of America
[3]New York Institute of Technology, New York, New York, United States of America
[4]Denver Museum of Nature & Science, Denver, Colorado, United States of America
[5]Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, United States of America
*groenke@ohio.edu

We relay the circumstances of discovery leading to, and the subsequent mechanical and digital preparation of, the holotype and only known specimen of *Vintana sertichi*, the cranium of a gondwanatherian mammal from the Kinkony Member of the Late Cretaceous Maeverano Formation. While the specimen was collected in 2010 within a large sample from an unusual lag deposit in the formation, it was not 'discovered' until June of 2011, when systematic hospital CT-scanning of unopened field jackets fortuitously showed it to be flush against the edge of a jacket containing hundreds of medium to small scale fossils of fish and other vertebrates. Before being opened, the jacket above the specimen was drilled through to dispense a ~1:20 Vinac B-15:acetone (by volume) solution into the loosely-consolidated sandstone. With the potential for damage by vibration mitigated, a portion of the jacket immediately above the specimen was removed with an oscillating saw. A volume of matrix surrounding the cranium, defined by using the CT data, was isolated into a support jacket and prepared under a microscope. Preparation employed carbide rods and steel insect pins held in pin vices. Two-hundred and fifty-six fragments within a ~2 cm of the specimen were photodocumented and removed from the matrix during preparation, though none proved to be part of the specimen. Paraloid B-72 in acetone (in various concentrations) was used to consolidate during prep, as well as to adhere a portion of a nasal bone knocked off during jacket block trenching in the field. The specimen was transferred several times to Specialist® support cradles as preparation continued, using cyclododecane to temporarily adhere the cranium into place. Once mechanically prepared, the specimen underwent CT scanning. The resultant dataset was digitally prepared using Avizo software at three different institutions. Digital prep results were standardized by using a uniform threshold volume prior to segmentation. This allowed for the virtual disarticulation of cranial elements for detailed study in three dimensions of sutural boundaries and internal morphology not available through non-destructive mechanical preparation.

THE MISTY METHOD: A NEW TECHNIQUE TO IMPROVE AND INCREASE THE EFFICIENCY OF AIRSCRIBE USE IN MATRIX REMOVAL

Misty Haji-Sheikh* and Virginia Naples
Northern Illinois University, DeKalb, Illinois, United States of America
*misty.haji@gmail.com

Fossils in matrix can require extensive preparation prior to exhibition or study; often remain stored for decades. Originally collectors used picks, hammers/chisels, shovels, brushes, and dental tools to remove matrix. Hand-held airscribes (mini jack hammers) that are slightly larger than an indelible marker are now used where air compressors are available. A person holds a single air scribe (SA) that vibrates the substrate, as air is forced around the stylus tip. In the 2018 field season, while using ME 9100 Airscribes that operate at 15,000 cpm and 100-120 psi at the Hanksville-Burpee Dinosaur Quarry, we pioneered a method that dramatically increases matrix removal efficacy, which speeds getting fossils from field to exhibit. The SA removes only a shallow furrow or spalls off fingernail-sized pieces which removes the matrix slowly. The user should wear eye/ear protection and gloves and take reasonable care using the tool with any air scribe method. In contrast, two airscribes generate a fracture threshold that surpasses the matrix strength to a greater degree, thus allowing faster removal. Our experiments in the field and in the lab varied the angles of the two tips as they are aimed at each other with angles ranging from 90 degrees to nearly parallel. One tip was also held steady while the other tip moved. This enabled us to determine of the range of maximum effectiveness of this removal technique. The Misty Method, named after the discoverer, does not alter a preparator's ability to control the positions of the stylus tips or to decide which method to use; therefore this method can be used safely near a delicate/fragile fossil as can the traditional SA method. A SA must be used for far longer than two; the overall vibrations to the user's hand and to the specimen would be subjected to vibrations over a longer span of time. The Misty Method uses one air scribe in each hand so it needs a shorter amount of time to reveal the specimen. No damage to any of the specimens recovered could be detected. The Misty Method is useful from about 30 centimeters (12 inches) of matrix down to near the fossil and is useful in both field and laboratory.

MOVING *PAHASAPASAURUS HAASI*: HELPING THE ADAMS MUSEUM (DEADWOOD, SD) BECOME A PALEONTOLOGICAL OASIS IN THE WILD WEST THROUGH REHOUSING A RARE FOSSIL AND CREATING FAMILY FRIENDLY EXHIBITS AND ACTIVITIES

Shannon Harrel*, Julie, Driebergen, and Megan Norr
South Dakota School of Mines and Technology, Rapid City, South Dakota, United States of America
*shannon.harrel@mines.sdsmt.edu

The Adams Museum in Deadwood, SD, opened its doors in 1930, and became the home to Deadwood's rich history. The museum is free to the public and acts as an educational site to smaller communities in the Black Hills and a tourist stop during the summers. By 1934, the Adams Museum had acquired a unique marine reptile: *Pahasapasaurus haasi*, a 60% complete 'missing link' Cretaceous plesiosaur collected locally from Fruitdale, SD. *P. haasi* was donated by the Haas family along with many other specimens and artifacts, and the museum dedicated its entire basement level exhibit floor to the Haas' donations. Previously, *P. haasi* had been housed in a small, custom-built case along a wall near a children's activity area, and was often overlooked.

In the Fall of 2017, the Deadwood History Exhibits Director, Darrel Nelson, contacted the South Dakota School of Mines and Technology (SDSMT) to ask for assistance in rehousing the fossil into a much bigger case, in a room dedicated to paleontology and geology, since the museum has mostly historians. In the Spring of 2018, as a part of a volunteer project, *P. haasi* was moved and placed in an anatomically correct position into its new case. New exhibit signs were created, children's activities were conceptualized, and an entire 'surf and turf' display case (to exhibit the rich fossil record of the Cretaceous Western Interior Seaway and the terrestrial Paleogene fauna of the Badlands) were also created by SDSMT Master's in Paleontology students with the guidance of the Adams Museum staff.

The new exhibit will engage museum visitors in the fossil collection in a way previously unknown to the Adams Museum, bringing the fossils more appreciation, the guests more learning opportunities, and the Haas family the esteem they deserve for their contributions to the Adams Museum. The rehousing project also helped the graduate students begin their museum careers, apply skills gained from museology classes, and learn invaluable skills in trying to create an exhibit with high educational value. The final exhibit is easy for young minds to comprehend and is aesthetically pleasing.

MICRO FOSSILS AND BIG DATA: TOOLS FOR OPTIMIZING RESEARCH POTENTIAL AND WORKFLOW AT THE GRAY FOSSIL SITE

Shawn Haugrud
East Tennessee State University, Johnson City, Tennessee, United State of America
haugrud@etsu.edu

The Gray Fossil Site utilizes extensive data collection in a fully integrated approach throughout the field, lab, and collections. All macro fossils are surveyed, and all sediment is collected in bags with unique data. This includes pit, square (Northing and Easting), excavation date, and bag sequence number for that square/date. Along with horizontal location by square, excavation date gives a relative vertical location within the strat column, and can be refined by cross-referencing with fossil survey data for the same date. Bag sequence number for that square and date can provide further relative elevation. Processing 100 percent of all sediment ensures that any fragments of surveyed macro fossils will be recovered, and the unique data of the sediment makes reunification possible, even years later. Though preservational bias is still an issue, screening all excavated sediment removes collecting bias. More than 75 percent of over 200 identified taxa come predominately from the screening. Besides giving us the best ecological view of the site possible, this has also yielded several index species and greatly constrained the age of the site. Because each bag of micro fossils has unique data, the collective meta-data can be used to look for patterns in concentration and distribution. Varied representation of taxa across the site can indicate different habitats. Using this data, crews have targeted specific areas with a statistical advantage for finding specific desired specimens. Concentration data allows crews to focus efforts on areas that statistically have a higher yield. Because all production numbers and finds are logged daily in the lab and field, workers in the various divisions can be redistributed in real-time if priorities change. If a micro picker finds part of a significant specimen, all pickers can be reassigned to every relevant bag in their inventory, portions of the dig crew can be sent to assist the screeners in processing all relevant sediment bags in their inventory, and remaining dig crew can be moved to the location of interest, all within 15 minutes. Production meta-data allows for highly effective predictive models and scalable production.

PROJECT OREODONT: TRAINING VOLUNTEERS TO PREPARE AN HISTORIC BACKLOG

Carrie Herbel*, Rob Skolnick, Jeremy D. McMullin, and Diana Dohmen
University of Nebraska State Museum, Lincoln, Nebraska, United States of America
*carrie.herbel@unl.edu

Nebraska is famously known, or more accurately, infamously known, for the Schultz and Falkenbach Oreodont Volumes. Before data analysis of this study took place, many oreodont specimens were collected by the Works Project Administration (WPA) in the 1930s and early 1940s. Later, primarily in the 1950s, University of Nebraska State Museum (UNSM) Director C.B. Schultz tasked field crews to 'head hunt' oreodonts. A small portion of these collections led to the Oreodont Volumes, while the majority languished for decades in the fossil collections (375+) and in field jackets (647) unprepared. In 2017, a project began where these specimens were prepared and stabilized using the growing UNSM volunteer preparator program. In July 2018, a dozen boxes labeled 'Skinner Oreodonts,' collected in the 1960s, were found to hold unprepared skulls and jaws with location and stratigraphic data. These 200+ specimens are also being integrated into this project.

The project's primary goal is to expose oreodont dentition and other diagnostic features typically used by researchers during analysis. Volunteers start by learning oreodont anatomy via labeled skull and jaw images along with previously prepared specimens. Initially, simple, often poor quality, skulls or jaws are given to the volunteer and prepared using only hand tools such as carbide needles. Close supervision along with reminders on methods and comparison to images or prepared specimens help develop volunteer confidence with the oreodonts. Consolidant application methods are introduced throughout the process. Once finished, specimens are reviewed then rehoused in archival boxes with simple support. As volunteer experience grows, they begin using airscribes to remove mudstones and siltstones surrounding the majority of unprepared oreodonts. Some volunteers are fearless and often over-prepare specimens, while others are nervous and hesitant throughout the preparation effort. Trying to find a balance between these two extremes can be challenging.

Since the start of Project Oreodont, 166 specimens have been prepared and rehoused. The 1000+ remaining specimens will keep the volunteer preparators busy for many years to come!

A NOVEL METHOD FOR SAFE MANIPULATION OF LARGE AND HEAVY SPECIMENS

Michael Holland
Burke Museum of Natural & Cultural History, Seattle, Washington, United States of America
michaelholland@mail.com

The recovery of an uncommon complete skull of *Tyrannosaurus rex* from Montana presented a common challenge to preparators – how to minimize the risks of lifting, repositioning, and setting down large, heavy, fragile specimens. To address this challenge, some innovative methods were developed.

The optimal solution involved meeting four goals: To minimize the number of lifts the specimen must endure, provide stable immobilization and support for the specimen, allow easy repositioning, and especially ensure safety of the preparators. It was determined that rotation of the specimen along a single horizontal axis would provide excellent access and allow for only a single lifting event, so design efforts were focused on creating a device robust enough to suspend and turn a 3,500 pound block of rock. Upon reaching a feasible design, a device employing a modular steel cage suspended on high-capacity bearings was constructed. To ensure a single gantry lift operation, 3D scanning and printing of the field jacket enabled predictive modeling for choosing the starting orientation of the specimen and preparing the rigging for lifting. Specimen immobilization and support was achieved by sequential applications of 3 lb. density expandable rigid urethane foam.

After about 18 months, preparation of the skull is nearly complete. The lift went exactly as predicted by the 3D model study, and all components of the suspension system continue to function as intended. Preparators have been able to work safely with confidence and flexibility throughout the project. This project has demonstrated that: 3D scanning and printing are viable as a planning aid prior to lifting/suspending large heavy specimens, that having the means to easily reposition large specimens whenever needed enables greater flexibility during preparation with far less risk than conventional lifting/turning methods, and that expandable urethane foam is a viable support material for very large heavy specimens.

THE GYPSUM CAVE COLLECTION: A CASE STUDY ILLUSTRATING THE WORKFLOW TO CURATE AND DIGITIZE A HISTORICAL PALEONTOLOGY COLLECTION

Juliet Hook
Natural History Museum of Los Angeles County, Los Angeles, California, United States of America
juliet.hook@gmail.com

The relationship between early humans in North America with Ice Age megafauna has been an ongoing debate. Excavations at Gypsum Cave, Nevada in the early 1930's sparked the interest of archaeologists and paleontologists alike, as both artifacts and vertebrate fossils were found immaculately preserved *in situ*. The dry conditions within the cave yielded exceptional preservation of soft tissue remains, such as ground sloth hair, skin, and claw sheaths, as well as plant material from ground sloth dung. Despite the intriguing aspects of the fauna, not much research has been done on this collection in the last 80 years.

In order to increase accessibility and use of this collection for research, a grant from the Bureau of Land Management was obtained to complete the curation, conservation, and digitization of this vertebrate fossil collection housed at the Natural History Museum of Los Angeles County. Using the Gypsum Cave Collection as a case study, the following workflow establishes the materials and methods employed to update a historical vertebrate paleontology collection to modern museological standards.

The project began with the creation and implementation of a quantifiable condition assessment form to inventory 150+ catalogued and 1000+ uncatalogued materials. Following the condition assessment, modern mammalogy collections and other Pleistocene cave deposit collections were utilized to identify and label specimens by element and taxon. Then, all material was pulled for archival rehousing and placed in trays lined with inert, non-abrasive materials, such as closed-cell polyethylene foam and polyester spun olefin. During the rehousing, deteriorated accessory labels were digitally photographed and encapsulated in polyester mylar to preserve data related to the specimen. Lastly, the collection was organized according to the evolutionary timeline set forth in McKenna and Bell's *Classification of Mammals Above the Species Level* for cataloging. As a result of this workflow, potential data loss was reduced due to improved specimen housings, an enhanced understanding of the specimens and locality were gained, and researchers and the public could access the collection.

TESTING DIGITAL REPLICATION OF MICROFOSSILS AT RANCHO LA BREA

Carrie Howard
La Brea Tar Pits and Museum, Los Angeles, California, United States of America
scuriouslepus@gmail.com

Cutting-edge studies in Quaternary paleontology often require the complete destruction of microfossil specimens for molecular analysis. Physical or digital replication of these specimens prior to destructive analysis is essential for their continued study by future paleontologists. Photographs and molding and casting have traditionally been used to preserve the qualities of a fossil at Rancho La Brea, but recent technology in digital imaging and 3D printing has introduced the potential to create a digital model that can also be used to print a model replica on a 3D printer. Here I present a case study of a *Sylvilagus bachmani* dentary from the Rancho La Brea locality, Los Angeles, USA, to compare different options for specimen replication: molding and casting, 3D scanning, photogrammetry, and 3D printing. I investigate whether a digital model and print can provide the resolution needed for digital and physical preservation of such small sized specimens. Replication of *S. bachmani* requires high resolution technology to capture the diagnostic enamel pattern on the lower p3 that is less than 0.25 mm in width.

The original specimen was 3D scanned with the Artec Space Spider surface scanner and modeled in Artec Studio 12. Four hundred eighty-eight images were captured for photogrammetry and focus-stacking with a Canon 6D DSLR camera and Canon MP-E 65 mm macro lens. Seventy focus-stacked images in Helicon Focus were processed in the photogrammetry software Agisoft Metascan Standard Edition. The specimen was sent to an off-site service for molding and casting. The model from the scanner was quick to make, but did not capture the detail on the teeth. The photogrammetry model involved more time and labor than the scan, and a complete model did not process, but the enamel pattern did show potential to be captured. The incomplete model was printed on a FlashForge Hunter DLP resin 3D printer, and although the resin print was high resolution with 0.025 mm sized layers, it showed less clear detail than the plastic cast. Further research and experimentation with photogrammetry and printing is needed.

SIGNIFICANT EFFECTS OF FOSSIL PREPARATION USING SODIUM BICARBONATE AIR ABRASION ON DENTAL MICROWEAR

Kayleigh A. Johnson
South Dakota School of Mines and Technology, Rapid City, South Dakota, United States of America
kayleigh.muilenburg23@gmail.com

Dental microwear refers to microscopic pits and scratches found on wear surfaces of teeth and is used to interpret the diet of an animal, typically herbivorous mammals. Microwear has a high turnover rate and therefore can be sensitive to changes in diet and taphonomic processes. Techniques commonly used in preparing fossil vertebrate material can also be destructive and can potentially alter microwear patterns. Here, I test for significant changes in microwear counts before and after treatment with sodium bicarbonate air abrasion, a common preparation technique, on fossil *Nannippus* sp. and modern *Bos taurus* teeth. Using a low magnification method to photograph clear casts of teeth for microwear counts before and after treatment, I found a significant change in the number of scratches and no significant change in pit counts. On average, the number of scratches decreased after treatment and although pits did not change statistically, I observed that original pits were erased and new ones appeared with treatment. A microwear analysis also shows that both *Nannippus* sp. and *Bos taurus* are inferred to be grazers before treatment but browsers afterwards. These results reveal that air abrasion treatment using sodium bicarbonate can alter microwear patterns and affect dietary analysis, calling into question previous work that did not account for preparation methods used on the fossil teeth examined. In addition, more care should be taken in the future to document preparation methods used on fossils to allow researchers to control for the potential effects on dietary analyses.

PHOTOGRAPHS AND FOSSIL FILLINGS: A REVERSIBLE POLYESTER FILL AND UTILIZING NATIVE IPHONE APPS FOR COMPREHENSIVE PHOTO DOCUMENTATION

Scott Johnston* and Amy Davidson
American Museum of Natural History, New York City, New York, United States of America
*sjohnston@amnh.org

When working with fragile fossils, it's normal to encounter missing pieces that endanger the stability of the section or fossil as a whole. To combat this, it's common to fill these sections to provide support, stabilize and to allow for further preparation of the specimen. In working on a small notoungulate jaw, I needed to fill a missing chip of tooth on the inner edge of a crown. Bulked adhesives commonly used offer reversibility but overall were much too soft for my purpose. Epoxy putty would also be too soft on such a small scale. Polyester bulked with talc had the desired rigidity but isn't easily reversible. The solution to this dilemma was the utilization a Paraloid B-72 coating as a separator for the polyester, enabling removal if desired.

In addition, the iPhone's native Camera and Photos apps has proven very useful in reassembling fragmentary teeth. In the iOS 10 update, the 'Markup' feature was added to allow the user to draw on images with their finger or a stylus. When reassembling complex projects with multiple fragments, it can be difficult to remember where each individual piece exactly fits over the course of multiple prep sessions. With this tool, it's easy to trace, write notes, number, label and otherwise organize reference images. I utilized this method to photograph *in situ* pieces of a shattered brontothere tooth through a microscope and number the fragments for easier reattachment after prep. The Markup feature could be helpful with other types of extended projects. For example, it would allow for multiple people working on the same project to easily pick up where another person left off without having to relocate the fits.

COMPARATIVE ANALYSIS OF PARALOID B-72 AND BUTVAR B-76 DISSOLVED IN ACETONE SOLUTIONS

Brian Lauters
South Dakota School of Mines and Technology, Rapid City, South Dakota, United States of America
brian.lauters@gmail.com

Despite the incredible importance of solution adhesives and consolidants in the preparation and conservation of fossil material, very little empirical work has been done to compare the effectiveness of one brand of polymer over the other. It is currently unknown if there is an advantage to using Paraloid B-72 or Butvar B-76 polymers dissolved in acetone in any given situation. Current anecdotal knowledge holds that low viscosity, low concentration consolidants will have better penetrative and consolidative capabilities than a high concentration, high viscosity consolidant, and Paraloid B-72 has superseded the use of Butvar B-76 in many institutions. The results of this experiment should help preparators and fossil conservators choose which polymer-based solution adhesive/consolidant to use in a given situation.

In order to compare the penetrative and consolidative capabilities of these two solution adhesives/consolidants, 20ml treatments of each adhesive/consolidant prepared in varying concentrations using the weight by volume method and were applied to 200ml well sorted sand samples in varying concentrations, and the effectiveness of each consolidant was determined by directly comparing the results of volumetric, resistivity, and diffusion measurements. After the experimental data was collected, it was analyzed using the statistical program PAST.

Qualitative analysis of the data confirmed the expected results that of Paraloid B-72 in low concentrations (5, 10, and 15%) showed greater penetration and mass consolidated than Paraloid B-72 in high concentrations (40, 45, and 50%) and Butvar B-76 (in 5%, 10%, and 15% solutions). Statistical analysis using Kruskal-Wallis and Dunn's Post Hoc tests confirmed the initial analysis, but also showed that high concentration Paraloid B-72 showed no significant difference from the Butvar B-76 test group.

USE OF 3D PRINTED MAQUETTES AS AN AID IN THE RESTORATION OF A CERATOPSIAN SKULL

Anthony Maltese*, Alaina Fike, and Alanna Self
Rocky Mountain Dinosaur Resource Center, Woodland Park, Colorado, United States of America
*anthony@rmdrc.com

After excavation and preparation in 2018, the restoration of a disarticulated, concreted and trampled chasmosaurid skull from the Coal Ridge Member of the Judith River Formation, Fergus County, Montana posed several problems. Not only were several skull elements missing, but many that were found were incomplete. The original fossils were prepared using air scribes and air abrasion techniques. They were then molded with RTV silicones and cast parts were poured with binary urethane plastics. A copy of the set of elements is reposited at the Denver Museum of Nature and Science. Traditionally a large amount of manual sculpting work would be done with the casts to assemble a restored skull for display or molding. More recently, 3D scanning and printing technology using an Artec Spider scanner and Formlabs Form 2 printer has advanced to the point to allow us to print high-fidelity sub-scale models at a reasonable cost. A 30% scale model of all preserved elements (and where needed mirrored prints) as well as scaled and retrodeformed elements from other ceratopsians was printed. These scaled printed parts were then used as an artist's maquette in order to mock up bone placement and restoration areas before committing to position of the full-scale cast elements. The benefits of this method were twofold: It helped recognize which missing elements could be replaced by 3D printed parts sourced from scans, and it provided a 3-dimensional roadmap to greatly aid the accuracy and speed of the restoration process. Some minor disadvantages and surprises were discovered when moving between sub-scale and full-scale projects including potential issues with printed parts warping, scanner error and the inherent asymmetry of ceratopsian skulls. Once these limitations were addressed, this method proved useful in the scope of this project.

DEVELOPMENT OF A METHOD FOR THE DETECTION OF FOSSIL MATERIALS *IN SITU* TO IMPROVE PREPARATION

Virginia Naples* and Michael Haji-Sheikh
Northern Illinois University, DeKalb, Illinois, United States of America
*vlnaples@niu.edu

Fossil preparation requires intensity, precision and detailed focus. It is time consuming and misses chemical signatures that could reveal more information about the specimen (that is invisible to the preparator). This backlog generated the axiom that one of the best places to find new fossils is in the basements of natural history museums where they may have been stored for decades. An automated method for sensing the presence of specimens still in matrix will improve preparator time use, reducing the human scrutiny presently required. An advantage would be it would help the preparator limit the damage caused to the fossil, while maximizing preparators' talents and researchers' opportunities. These methodologies are like those used in the medical field using a concept called data fusion, where data from multiple sources are fused into a single data matrix.

We are developing a new method to help reduce the volume of unprepared or incompletely prepared fossils. Our system uses advanced techniques, including sensor fusion and data fusion to distinguish specimens from the nonfossiliferous matrix. As a concept, we are fusing imaging, x-ray tomography scanning (Cat Scan), and other types of scanning, with precision machining. The Advanced Paleontological Extraction System (APES), will automate the removal process. Fossil preparation presently uses airscribes to remove matrix. Micro sandblaster tools can also be used, and both tools can be adapted for mounting on a desktop robot. Data fusion can create a complete picture of the overburden and embedded fossils which can be fed to the control system. These data determine the working distance of the airscribe and calibrates the removal rate of the rocky material.

One important aspect is that this system looks for the organic envelope by chemical analysis, around a fossilized bone. Then it will remove the overburden until it reaches a preset distance (set by the user) from the fossil and stop. The long-term goal is to create a system that researchers, both engineering and paleontology, can modify by creating an open source system and by storing the data generated in the cloud.

A 3D-PRINTED CELL PHONE CAMERA TO MICROSCOPE ADAPTOR: A NOVEL DEVICE FOR RESEARCH, REFERENCE, OUTREACH, AND STUDENT PROJECTS

Morrison Nolan*, Alexandria Hoeher, and Frederick Marc Michel
Virginia Polytechnic Institute and State University, Blacksburg, Virginia, United States of America
*mnolan1@vt.edu

Acquiring images of petrographic slides is important; whether for preparing figures, creating reference pictures for lectures, or taking observational notes, it is useful to capture digital images of petrographic slides. There are many ways to take these images, from USB microscopes, petrographic microscopes with built in data outlets, or third-party adaptors for cameras. These techniques are limited by low resolution for cheaper options, or large expense and specific equipment requirements for options using microscopes' higher resolutions. Desktop additive manufacturing, or "3D printing" offers the ability to make low cost adaptors compatible with a variety of equipment to take high quality digital petrographic images. As part of a graduate/undergraduate seminar, we designed microscope adaptors to photograph slides using cell phone cameras. We designed the adaptors using formZ Pro (AutoDesSys) and Preform (Formlabs) software (which have free student licenses) and printed them using a Formlabs Form 2 UV stereolithography desktop 3D printer and Durable resin. The adaptor was designed to work with a Leica ICC50 HD style microscope, though it is compatible with other microscopes and accepts a variety of phone styles. This adaptor provides a novel way for researchers to take petrographic images cheaply and quickly if they have access to 3D printers. While this device was printed using inverse UV stereolithography, it could also be 3D printed using more prevalent and cheaper fusion deposition modeling printers.

MAXIMIZING SPECIMEN DATA, MINIMIZING SPECIMEN RISK: MECHANICAL AND DIGITAL PREPARATION OF FOSSILS FROM A LATE CRETACEOUS BONEBED IN MADAGASCAR

Patrick O'Connor[1], Joseph Groenke*[1], and David W. Krause[2]
[1]Ohio University College of Osteopathic Medicine, Athens, Ohio, United States of America
[2]Denver Museum of Nature & Science, Denver, Colorado, United States of America
*groenke@ohio.edu

We illustrate an integrated mechanical and digital preparation methodology for specimens from the Upper Cretaceous MAD05-42 locality in the Mahajanga Basin of Madagascar. Between 2005 and 2015, over 400 collected, yet-unprepared specimens were scanned in a medical CT unit to preliminarily identify the contents and spatial distribution of fossils within blocks of matrix. These results stand as an archival record of the field-collected material, and are used for morphological and taphonomic studies, digital preparation projects, and site-mapping. The datasets often allowed for preparation planning and prioritization before jackets were opened. Concentrations of evaporitic minerals in some blocks (e.g., diagenetic crystals, matrix cement) inhibited clear scan outcomes but still provided a means for assessing content, spatial organization, and workflow priority. Using carbide rods and steel insect pins in pin vices, some materials were fully prepared out of jackets, whereas others received partial or surface preparations based on specimen fragility and/or association of elements. Associated, bone-dense jackets with specimens of larger size were first surface prepared and sometimes surface molded, after which elements were photographed with disarticulation codes; elements were afterward removed for further prep, molding, casting, and re-scanning in some cases. Secondary jackets and cyclododecane were employed to extract small, delicate materials from field jackets. Important materials are CT scanned and digitally prepared. Rapid prototypes of polygon models are used for study of delicate in-situ material. Models from CT datasets have been mapped volumetrically back into the original hospital scans. In one case we will highlight, an associated partial skeleton of a small theropod dinosaur, collected as two field numbers in three jackets and then further divided to fit into a CT scanner gantry, was re-associated to in-situ position within jacket matrix. Further digital modeling using these data provide a robust foundation for assessing associations, whole-animal reconstructions, character assignments, and other research and exhibition efforts into the future.

EFFICACY OF VARIOUS SOLVENTS IN ASPHALT-REMOVAL FROM LATE PLEISTOCENE FOSSILS: A COMPARATIVE STUDY FROM RANCHO LA BREA, CALIFORNIA

Stephany Potze*[1], Stevie L. Morley[1], and Chris Stavroudis[2]
[1]La Brea Tar Pits Museum, Los Angeles, California, United States of America
[2]Paintings Conservator, West Hollywood, California, United State of America
*spotze@tarpits.org

The Rancho La Brea (RLB) collection from California has yielded millions of Late Pleistocene fossils since the Natural History Museum of Los Angeles County excavations began in 1913. Cleaning techniques for asphalt-preserved fossils require degreasing solvents. Endeavoring to improve preparation techniques used at RLB, efficacy of six solvents was tested using specimens from Deposit 14 of a nearby Late Pleistocene asphalt deposit known as 'Project 23'. The selected solvents were Aerotron ($C_2H_2Cl_2$), Butyl cellosolve ($C_6H_{14}O_2$), D-limonene ($C_{10}H_{16}$), Ecolink 1171 ($ClC_6H_4CF_3$; $C_3H_6O_2$; $C_{10}H_{16}$), Novec 73DE ($C_2H_2Cl_2$; $C_7H_3F_{13}O$), and n-Propyl Bromide (C_3H_7Br; C_4H_8O). Experimental methods included ambient temperature soaking and manual cleaning of bird femora and canid metapodials and vertebrae (n=48). Assessments were based on the degree of surface removal of asphaltic matrix, post-preparation fossil integrity, resources required, cost, ecological impact, and human health effects. Preliminary results indicated that n-Propyl Bromide was the best in soaking trials, whereas Novec 73DE provided more desirable results with manual cleaning. Aerotron has an extremely high evaporation rate resulting in inferior asphalt removal through manual cleaning with a greater degree of mechanical effort required. Butyl Cellosolve, D-limonene and Ecolink 1171 performed poorly in asphalt removal with the soaking method and manual cleaning techniques, as well as producing lingering odors which raises concerns about fossil conservation and integrity over time. These preliminary results indicate that n-Propyl Bromide and Novec 73DE are best for effective solvent removal of asphalt from Rancho La Brea fossils.

REPURPOSING SOLDERING IRON STANDS FOR USE WITH AIR SCRIBES

James Preston*, Alan Zdinak, and Corinna Bechko
Natural History Museum of Los Angeles, Los Angeles, California, United States of America
*jpreston3247@yahoo.com

Airscribes are a common tool used extensively in fossil preparation labs to remove matrix. Maintaining these devices often requires replacement of parts such as springs and styluses, the latter being quite expensive. After a string of accidents resulting in broken styluses affected volunteers and veterans alike, a new way of securing the airscribes at rest was required. Methods that were currently in use included weighing the scribe down with a sandbag or clipping the cord to the work table with a clamp. Even with these measures in place, many styluses, primarily from Microjacks #1 and #6, were broken by either dropping or slipping out of the user's hands when retrieving them from under sandbags, or getting the cords snagged by armrests on lab chairs. After discussion with my colleagues Alan Zdinak and Corinna Bechko, I suggested using a soldering iron stand as a table top dock for the air scribes. I had used soldering iron stands in the past and believed the angle and weight of the metal stands would prevent the scribe from slipping off the table. The Aven Soldering Iron Stand with Soft Coiled Brass Tip Cleaner was chosen as the test run product due to cost and style. Minor modifications were as follows: The cooling barrel was removed and a block of Ethafoam was carved to shape and wedged into the stand body cavity. Using a dremel the Ethafoam block was cored down from the barrel collar in a shrinking step pattern so as to enable different sized scribes to seat snugly. The coiled brass was removed and metal hardware washers bolted in place for added weight. The end result was cost effective, stylish and stable. With its 24 mm (ID) collar, the stand fits everything from a Microjack #1 to a PaleoAro. Four more stands were ordered and modified to fit airscribes. In addition, a larger, multiple port stand was created using a big electrical bracket and inserting a triangular wedge of Ethafoam. Three shafts of varying sizes were cored into the foam to seat scribes. Since implementing these stands accidental drops of air scribes have ceased and fewer styluses have had to be replaced.

EFFECTIVENESS OF FOSSIL PREPARATION TRAINING FROM THE VOLUNTEER'S PERSPECTIVE

Riley Sanford*, Kaitlyn Scriven, Kaiden O'Dell, Jerrad Watts, and Laura E. Wilson
Fort Hays State University, Hays, Kansas, United States of America
*rgsanford@mail.fhsu.edu

Training new fossil preparator volunteers can be challenging for both the lab manager and volunteer. New volunteers and lab managers alike bring their own unique background, skill set, and point of reference. Here, we outline the experiences of four new volunteers in a recently renovated prep lab and review the methods of our training. The goal is to help institutions who are interested in creating, renewing, or revising their own preparation volunteer programs.

Reflecting upon our training experiences, there were methods that positively contributed to our training, as well as some that could have been better implemented. Our training began with basic hand preparation using dental picks and wet toothbrushes on vertebrate fossils encased in different matrices (shale and chalk). We also learned methods to puzzle broken fossils by practicing gluing broken ceramic pots back together. The ceramic pot exercise used to simulate fossil puzzling was a beneficial training technique. It helped us gain an understanding of how to find tight locking fits, balance points, and to use thin and thick B-72 and a sandbox. Another thing that helped was working with real fossils early on; this was important for keeping up interest and morale. Beyond that, we learned how to interact with the public by explaining our projects and role at the museum. This not only helped us learn museum etiquette, but ensured that we knew enough about the fossils and our methods to explain them.

There were also methods that could have been improved upon in our volunteer training. We found that a consistent lab routine helps the volunteer know what short and long term goals are for each project. This, as well as organized sign-in sheets, clean up checklists, and assigned projects aid in volunteer skill-building and lab consistency. Systematic training introducing all volunteers to the same techniques keeps everyone on equal ground. By talking with lab volunteers, institutions may be able to improve their volunteer programs and experiences or create new programs with the volunteer in mind. In turn, this will help inspire new generations of volunteers to keep visiting and working with their home museums.

DIFFERENTIATING MIOCENE HORSES: AN IDENTIFICATION STUDY USING DISCRIMINANT FUNCTION ANALYSIS

Darrah Steffen
Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas, United States of America
darrah.jorgensen@gmail.com

Paleontological specimens are often difficult to identify. This can be due to lack of expertise, taphonomic bias, or time constraints. Unidentified specimens are not as valuable to the collection and research. The Sternberg Museum of Natural History vertebrate paleontology collection has several horse (Equidae) teeth collected at the Minium Quarry in Graham County, Kansas in the 1980s that were only identified to the family level. Basic geometric morphometric techniques were used to measure the length and width of teeth from three Miocene horses (*Neohipparion*, *Protohippus*, and *Calippus*) were measured along the occlusal surface. Thirty-two samples were used to train a discriminant function analysis (DFA) to identify specimens. The DFA identified tooth width as important factors in identification (LD1 =0.097, df=1,3, $p<0.02$). The model was then used to identify unknown horse teeth. With the DFA, teeth were correctly identified 50% of the time (LD2 =0.021, df=1,3, $p<0.01$). However, the model was able to accurately identify *Calippus* teeth but was unable to identify *Protohippus* and *Neohipparion* teeth. The model was unable to identify between the genera because the horses were too similar in aspect ratio of the occlusal surface. This study could possibly be used to identify specimens that have similar features, but a distinct aspect ratio, such as *Calippus* and *Protohippus* or *Neohipparion*. This could help with the identification of unknown specimens and decrease the time it takes to identify specimens.

BACK TO THE PAST: TRADITIONAL MORTAR FOR THE RESTORATION OF DINOSAUR FOOTPRINT SITES

Mireia Ferrer Ventura*[1], Xavier Mas-Barberà[2], Angelica Torices Hernández[1], Raúl San Juan Palacios[1], and Pablo Navarro-Lorbés[1]
[1]Universidad de La Rioja, Logroño, La Rioja, Spain
[2]Universitat Politècnica de València, València, Spain
*mireia.ferrer@unirioja.es

La Rioja (Spain) has one of the best paleoichnological fossil records in the world, with almost 10,000 dinosaur footprints and around 1000 trackways. One of the best-known sites is La Virgen del Campo, found in the Enciso locality. In this presentation we will discuss the preservation and restoration work done in the summer of 2018.

We analyzed the site to discover the elements that could be causing harm. The site is exposed to temperature and humidity variations, rainfall erosion and other factors that could be damaging for the preservation of the footprints. During the field season, we tried materials that are usually used in conservation and restoration of stone monument heritage and are not traditionally used in fossil footprint restoration. Before the restoration work on the site, we performed laboratory tests on samples from the same geological layers as the site to verify the functioning of the material.

Knowing the properties of traditional lime mortars, their durability and reversibility, we studied different kind of mortars made of hydraulic lime and different types of aggregates, such as sand, silica and calcium carbonate. Depending on the desired result, we could choose one kind or another. There is a problem of accumulation of water in the footprints; sometimes water leaks under the geological layer that contains the footprints.. This leaking is problematic because it can erode the layer under the tracks causing fractures and cracks. For this reason, we decided to test and use a hydrofugant product.

After all the laboratory tests, we performed the same analysis near the site but in the same stone. We applied the different mortars depending on the need. For example, some cracks were so deep that we had to inject it. Wider cracks needed another kind of mortar. In the end, we developed different injecting and sealing mortars. For the correct application of the mortars by the work team, we designed a diagram with instructions for every possibility. Now we are monitoring the results of our work, so we can determine the efficiency and durability of this restoration in the future.

NEW EDUCATION AND RESEARCH INITIATIVES AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.: THE TURNER GEOSPATIAL CENTER

Wm. Justin Wilkins* and Sharon E. Holte
The Mammoth Site of Hot Springs, SD, Inc., Hot Springs, South Dakota, United States
*wmjwilkins@gmail.com

The Mammoth Site has long been a place of exciting discoveries in the field of Pleistocene paleontology. Since 1974, when the site was first uncovered with construction equipment, the primary goals have been the excavation of our fossils and sinkhole, and to share this collection locally and globally. These goals have been continued over the 44 years, shifting from salvage paleontology to in-situ stabilization and exhibition. In doing so, The Mammoth Site is now a fossil locality accessible to all visitors with developed meaningful educational programs while continuing to conduct research on local and global scales.

New technology brings new opportunities, and The Mammoth Site is expanding more actively into the digital realm. The new Turner Geospatial Center will continue supporting research on Pleistocene fossils and producing from this research educational programs and products to be shared with local, regional, and global communities. This will be done initially by continuing to document Mammoth Site fossils in-situ using ArcGIS. However, where previously this was done with overhead and aerial imagery in two dimensions, a three dimensional component is now being added, allowing The Mammoth Site to digitize fossils and reconstruct virtual in-situ environments. Previously removed specimens are being scanned and paired with legacy data to reconstruct prior excavation states within the bonebed. The resulting virtual excavations will be rendered into digital models and be the basis for new classes being developed to be shared with schools and colleges for both onsite and offsite outreach activities. Scanning of fossils at The Mammoth Site allows for us to share these collections with the scientific community through digital repository initiatives, like the IDigBio, MyFossil, and MorphoSource projects. An Ultimaker S5 3D printer allows for greater flexibility in the design of educational programs due to the wide range of accessible virtual objects that can now be included. In the future, programs will include expanded comparative collections and lessons, classes teaching 3D scanning and printing skills to K-12 teachers, and other additional STEAM initiatives.

EMPIRICAL TESTING OF A MIXTURE OF BUTVAR B-76 AND PARALOID B-72 FOR USE AS A FOSSIL CONSOLIDANT

Patrick J. Wilson* and Brian Lauters
South Dakota School of Mines and Technology, Rapid City, South Dakota, United States of America
*pjwilson3@mail.fhsu.edu

Butvar B-76 polyvinyl butyral (B-76) and Paraloid B-72 ethylmethacrylate and methyl acrylate co-polymer (B-72) are used as archival consolidants for the stabilization of delicate material. Over the years, B-76 and B-72 have been applied in various concentrations and in different solvents to compensate for each polymer's penetrative and consolidative properties. To date, there is no published information on these polymers being mixed in the same solution. This study aims to determine if mixing B-76 and B-72 ("Paravar") will result in a mixture that has suitable properties for use as a consolidant. To analyze these mixtures, solutions of 5% B-72, 10% B-72, 5% B-76, 5% Butvar B-76/5% Paraloid B-72 (5-5 "Paravar"), and 5% Butvar B-76/10% Paraloid B-72 (5-10 "Paravar") were dissolved in acetone and applied in 10 mL portions to 200 mL of fine-grained sand contained within straight walled mason jars. Once applied and dried for a week, the samples were weighed to determine the mass of consolidated sand, measured for the depth penetrated, and stroked with a toothbrush 20 times on the top and bottom of the consolidated mass to determine the ability to remain consolidated. The best consolidating solutions were the 5% B-76, 5% B-72, and 10% B-72. The 5-10 "Paravar" consolidated about as much sand as the Paraloid B-72 solutions. The best penetrating solution was the 5-5 "Paravar" mixture. The 5-10 "Paravar" showed about the same penetration as the Paraloid B-72 solutions. For the resistivity, the 5-5 "Paravar" mixture did poorly with an average mass loss from the bottom of about 17 grams. The 5-10 "Paravar" mixture showed about the same mass loss as the 5% B-76 and 10% B-72. This study shows potential benefits to using a consolidant mixture in fossil preparation, such as increased penetration of stronger polymers. However, chemical testing of dissolved polymers to determine cross-linking potential and tests of archival stability are essential parameters that must be assessed before using a consolidant mixture on fossil material.

BUILDING BETTER SANDBAGS

Alan Zdinak
Natural History Museum of Los Angeles County, Los Angeles, California, United States of America
azdinak@nhm.org

Sandbags are one of the most basic, yet essential, tools of fossil preparation. They are used as pillows, props and weights for specimens, jackets, and forearms. But making sandbags that will not leak, will not puncture readily, and can be easily mass-produced entails a balancing act between economics and craft.

In many labs sandbags are made by filling and cinching readymade Crown Royal or geological sample bags. But dangling cords can catch on tools. Knots can loosen, allowing sand to leak out. Knots also limit the shape and usable surface area of the bag.

It's also possible to sew sandbags from scratch using material purchased from a fabric store, or even repurposing old jeans. The results can have high utility but the process is labor intensive and requires a level of sewing skill not everyone possesses.

A happy medium — advocated by Amy Davidson as gleaned from Bill Amaral — converts geological sample bags into sturdy, pliant, leak-free sandbags with relative ease:

First, remove any draw-strings and trim labels from a pair of same sized, geological sample bags of lightweight cloth. Turn the bags inside out so the seam fringes are exposed and insert one bag in the other. Align the mouths of the bags. Using a sewing machine, or by hand, stitch the open ends of the bags together about ¼" in from the edge. Do not sew the bags together completely, leave a 2" gap unstitched at either one end or the center of that side. Invert the bags, pulling them through the 2" gap so they are right side out again, one inside the other. Fill the bag through the gap no more than ¾ full of sand. Hand stitch the gap seam together the neatest way you know how.

The resulting bags are highly resistant to leaking. The double bagging retains pliability while preventing leaks from either breaches of the outer layer, or fine particles seeping through the inner layer. They are relatively easy to mass produce since most of the sewing is already done. The sleek profile of the bag is comfortable under the wrist and readily conforms to the contours of a specimen, making them ideal for producing Smithsonian-style storage jackets. Since this style bag was introduced at the LACM, users clearly preferred them, leaving older, cinched sandbags on the shelf.

Symposium Descriptions, Alphabetical by Primary Author

MANAGING VOLUNTEERS: TECHNIQUES FOR TRAINING, TRACKING, AND FOSTERING INDEPENDENCE IN THE FOSSIL LAB

Kelsie Abrams
Burke Museum, Seattle, Washington, United States of America
kdabrams@uw.edu

Trained and capable fossil preparation volunteers are an absolutely critical component of any museum. Many institutions, big or small, suffer from decades of fossil collection and lack of subsequent preparation, resulting in overloaded storage spaces with little to no organization of those specimens. Volunteers serve to significantly decrease backlogs of fossil jackets, increase the productivity of fossil labs, and assist with ongoing research by providing free, enthusiastic, and competent labor. However, managing volunteers is a time-consuming challenge for professional staff. Creating and disseminating training materials, facilitating access to the lab, and tracking hours and multiple projects can significantly decrease professional staff's ability to do other activities, such as maintaining lab spaces or conducting fossil preparation themselves. As the previous manager of a fossil lab at a small institution, and as the current manager of a lab at a large institution, I will compare and contrast my experiences and present the different tools, techniques, and resources I have found most useful and time-effective for managing volunteers. Providing formal, classroom-style training is time-consuming initially but most effective for long-term volunteer training programs. Standardized training sessions in the lab on non-fossil materials, such as pottery set into plaster, increases volunteer confidence with different tools without risking damage to fossil specimens. Selecting and dictating specific days for workshops and work hours in the lab eases the amount of time spent on scheduling and can be utilized to increase work flow. There is an abundance of software programs available to fit any budget, such as Volgistics Volunteer Logistics, that aid with tracking volunteer schedules, hours, and skills. Training independent, skilled volunteers does not require large budgets, numerous professional staff, huge facilities, or copious amounts of time. There are solutions for managing volunteers efficiently for institutions of all sizes.

LESSONS LEARNED IN UNUSUAL PALEONTOLOGICAL ORANIZATIONS AND THEIR APPLICABILITY TO TYPICAL MUSEUM SETTINGS

Denver Fowler
Dickinson Museum Center, Dickinson, North Dakota, United States of America
denver.fowler@dickinsongov.com

There are many paleontology organizations that exist at the fringes of academia. Such organizations can be quite varied in their mission and approach (especially compared to traditional academic institutions), but similarly provide important contributions to science and education, and are excellent sources of experience, often in unique or unusual circumstances. This presentation outlines personal experiences and lessons learned in such organizations that may be applicable and useful to a more typical paleontological museum setting.

"Dinosaur Farm" is a small private museum in a rural setting on the Isle of Wight in Southern England. Its original purpose was to show preparation of bones of a sauropod dinosaur that had been discovered in 1993 on nearby farmland, and was housed in a 17th century barn. This unique attraction, essentially a walk-through preparation laboratory, expanded over a number of years to incorporate fossils from local collectors, paleo artwork, and modest but popular exhibits. In the same area was "Dinosaur Island" a fossil shop specializing school fossil-hunting field trips to the nearby cliffs, catering for up to 500 students per day. Both of these organizations provided affordable up-close paleontological experiences in an informal setting.

Many aspects of television production are directly relevant to museum work. Knowing what television researchers look for can help in securing a role as a "talking head" expert, promoting use of your research, or when scouting your museum as a filming location. Television documentaries are often exercises in structured storytelling, and similar to museum exhibits. Modern CGI-rich documentaries make use of physical and digital reconstructions of extinct animals, which are created using the same consultation and design process as with museum reconstructions.

These experiences have been invaluable in the creation of a new paleontology program at Badlands Dinosaur Museum (formerly Dakota Dinosaur Museum) in Dickinson ND. This is itself an unusual museum in that it is owned by the City of Dickinson, and faces new challenges in establishing a science community hub in a traditionally conservative community.

SMALL TO MID-SIZED NATURAL HISTORY MUSEUMS AS PILLARS OF THEIR COMMUNITIES

Jessica A. Miller-Camp*[1] and Cynthia Crane[2]
[1]Indiana University, Bloomington, Indiana, United States of America
[2]Aurora Fossil Museum, Aurora, North Carolina, United States of America
*jessmc@iu.edu

In their heyday, natural history museums were seen as status symbols, and thus given ample resources. Things changed, and they became remote, dusty storehouses in the eye of many. Drained of funding as priorities shifted elsewhere, smaller museums suffered worse due to their lower momentum.

Recently, there has been a patchy renaissance. Some museums have been revitalized, but many—particularly smaller ones—remain grossly understaffed and underfunded. Those who've experienced a resurgence have tended to employ at least one of two strategies: emphasizing their role as repositories of research data to participate in the digitization revolution, or rebranding themselves as active, contributing members of their communities.

Digitization is widely-funded, but many smaller museums struggle to receive these grants as big ones are also competing. Physically removed big museums cannot, however, produce the localized effect small and mid-sized museums have on their communities through initiatives such as in-person non-traditional learning opportunities, and activities that directly benefit the local economy.

Considering sources outside the field- or museum-specific grants we're accustomed to opens up new prospects. Educational grants from national, state, and local sources, and forging symbiotic relationships with local officials, politicians, and businesses are some options. Successfully tapping them (particularly the latter grouping) requires a shift in mindset and delivery from "we should be given resources because it's good to fund science" to "here's how our actions directly benefit you; if you give us resources, we can continue doing so or do it better".

Examples of small to mid-sized museums who've succeeded at this include: the Aurora Fossil Museum, which emphasized its stimulation of the local economy and status as a community focal point; the Burpee Museum with its widely-praised annual event, Paleofest; the multiple, targeted outreach initiatives of museums represented by Cosplay for Science; and museums that have invested in mutually beneficial student involvement, such as universities with local chapters of the Natural History Collections Club Network.

MAINTAINING DATA LABEL INTEGRITY: A REVIEW OF MATERIALS AND TECHNIQUES FOR AFFIXING LABELS TO VERTEBRATE FOSSILS, HOUSINGS, AND COLLECTION STORAGE AREAS

Vanessa Rhue
Natural History Museum of Los Angeles County, Los Angeles, California, United States of America
vanessa.rhue@gmail.com

In order to track the identification and disposition of vertebrate fossils, specimens are often assigned catalog or locality numbers before being organized into a systematic or geochronostratigraphic arrangement. Assigning numbers and placing objects within a standard system is a common practice in paleontology. Yet many of us have experienced the frustration of data loss due to poor labeling materials or techniques. Paper deterioration can occur due to absorption of pollutants, insect damage, fluctuations in relative humidity and temperature, as well as UV and fluorescent light. Custodial neglect can result in equivocal association of data labels with the specimen. While digital methods for tracking specimen data may continue to advance, the need to manually label specimens and their storage containers will remain. Each specimen has a labeling history involving a suite of labeling materials and techniques from the time it is discovered in the field to its preparation in the lab to its curation for research or public display. During these stages, people of various expertise may handle or move the specimen to different physical locations. Every person entrusted with handling a specimen should take care to maintain the physical association of any data labels with the specimen. Developing a consistent method of labeling and a tool kit of materials and techniques is important. Selecting durable, long-lasting materials will help maintain the longevity of the information, but consideration should also be given to how labels are attached to the object, as well as the storage environment in which the specimen and label will reside. Examples of durable materials include the use of archival pens with light fast India ink, acid free Bristol cardstock, Tyvek, titanium white acrylic paint, and metal tags affixed with engraved or stamped numbers. Examples of methods for associating labels with specimens include, inserting labels directing into cavity mounts, using solution adhesives to affix labels to various surfaces, placing extra labels inside field jackets, using wire rivets, writing numbers on nested containers, encapsulating paper labels in mylar or polyethylene zip bags, and the use of plastic label sleeves with magnetic or adhesive backing for metal cabinets and oversize storage racks. Awareness of the physical properties of materials and how they behave in different storage environments over time is essential to maintaining data label integrity.

RUNNING A FOSSIL LAB PART TIME: A CASE STUDY EXAMINING THE EFFICIENCY OF A PART-TIME VERSUS FULL TIME LAB

Darrah Steffen*[1] and Hillary Cepress-McLean[1,2]
[1]Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas, United States of America
[2]Perot Museum of Nature and Science, Dallas, Texas, United States of America
*darrah.jorgensen@gmail.com

The purpose of a fossil preparation lab is to prepare, stabilize, and repair a museum's vast collection of fossils. It serves a second purpose to educate the public about that preparation process, even functioning as an interactive exhibit. One of the challenges to running a successful preparation lab is finding funding and volunteers who are willing and able to fulfill the duties that preparation involves. There are a variety of solutions to this problem which can be scaled to different sized institutions. Recent expansions to the Sternberg Museum of Natural History fossil preparation lab and volunteer corps can serve as one case study on how to utilize limited resources to maintain a successful prep lab. The Lab Manager is a part-time position that staffs the lab. He/she manages the prep lab, recruits and trains volunteers, and works with collections staff. The majority of the volunteers starting preparation at the Sternberg are younger undergraduate students from the nearby university. In exchange for labor, these volunteers gain experience in fossil preparation, molding and casting, educating the general public, and enjoy a unique learning opportunity. The recently renovated preparation lab at the Perot Museum of Nature and Science can serve as another case study for a new lab being used in a larger, well-funded institution. When comparing the two fossil prep labs, further differences are identified. The public lab is larger at the Sternberg lab, but the Perot Museum's lab is staffed full time. Other differences are the management of a younger volunteer group in the Sternberg lab, which prefers more structure and assigned work compared to an older group managed at the Perot lab that is more willing to adapt as needed. A stark difference in the intention of each use of the preparation labs can be seen by the ability of both to engage with the public. The Perot lab is inaccessible to the public except through a window while the Sternberg lab is used as part of the main public engagement. All together, we highlight that there are varied solutions to running preparation labs of all sizes.

ALL IT TAKES IS MONEY…AND A FEW OTHER THINGS

Laura E. Wilson
Fort Hays State University, Hays, Kansas, United States of America
lewilson@fhsu.edu

One of the prevalent issues facing paleontology departments is inconsistencies in the availability of resources, including personnel, money, time, supplies, and equipment. Even departments with an annual budget generally do not have the resources to make long-term hires, renovate, or purchase big-ticket items. This can impede the ability to modernize collections, keep up-to-date on current methods and techniques, or make larger-scale improvements. The recent changes in the paleontology department at the Sternberg Museum of Natural History can serve as a case study of how to utilize a variety of funding sources and methods for long-term collection and fossil preparation improvements.

There are several solutions to resource problems that can be scaled to projects and institutions of different sizes. Financially, federal grants are the obvious source of big project funding. However, these are not practical for all institutions, as they have a low funding rate, are time-intensive to write, often require a Ph.D., and do not cover building infrastructure renovations. If federal grants are not in your purview, working with your institution's foundation or board can help open avenues to individual donors and partnerships within the community. Private foundations that support education and community initiatives in the region are also an option.

Along with directly soliciting funding, networking is key. Attending conferences and workshops, encouraging publications on specimens from the institution, and building the reputation of your institution can ensure you are on the radar when opportunities arise and/or other institutions are looking for partnerships. For example, NSF Thematic Collections Network (TCN) grants can be a great way to partner with larger institutions and share workload and resources. Additionally, agreeing to reposit specimens can lead to collection and prep funding from research grants. Having staff, faculty, and volunteers speak to groups like Lions and Kiwanis clubs or the local chamber of commerce can increase community awareness for your institution's current projects and needs. The latter is also a great way for junior staff and volunteers contribute to department goals.

Lastly, use your resources wisely, especially time. It is important to understand that you may have to sacrifice short-term progress to allocate time to write grants, fundraise, and/or complete projects. If resources are limited for the foreseeable future, consider making workflows for collection management, digitization, and fossil prep tasks. This takes time, but helps your department efficiency and adaptability when there are changes in resources. Prioritizing projects can help tackle big problems in more manageable chunks. Long term increases in budget or staff are unrealistic for many institutions, but short-term bursts can help tackle big projects. Modernizing, implementing new technology, developing new workflows, and reducing backlog can help make the workload manageable within the given resources of the institution.

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We look forward to hearing from you!

1. Critical Thinking

The judgments and actions of the qualified preparator are guided by a methodology that places a priority on enhancing, not diminishing the scientific value of the specimen. Critical thinking allows the application of the knowledge, skill, and experience of the preparator to assess the specimen, the task at hand and the desired end product before commencing preparation and during every stage of preparation. The preparator must be able to continually monitor the immediate physical impacts upon the specimen by treatments, handling, examination, and consider the long-term effects of the materials and techniques applied to the specimen. The qualified preparator has the ability to conceptualize, think creatively and evaluate information in a systematic, purposeful, efficient manner. The preparator also has an appreciation for their own limits and knows when and where to seek guidance.

2. Aptitude for Fossils as Materials

Competent preparation requires an intrinsic sensitivity and feel for fossils as physical, often fragile material. The preparator combines this innate aptitude with an understanding of the scientific value of fossils, and a lack of competency in this area cannot be offset by knowledge of preparation and conservation theory.

3. Understanding of Fossils as Biological Materials and Data

The qualified preparator has the ability to exercise good judgment when interpreting the distinction between biological remains and matrix, and is guided by a fundamental knowledge of vertebrate anatomy, physiology and evolution. The preparator can recognize that fossil specimens are the physical representations of primary paleontological data. A preparator has a basic understanding of fossils as an individual's remains and the biological data contained therein. A qualified preparator uses correct anatomical terminology to document preparation and communicate with researchers.

4. Understanding of Fossils as Geological Materials and Data

A qualified preparator should have an understanding of fossils and matrices as the products of geological processes and as geological data. This should include knowledge of taphonomy, basic geological principles, and different modes of preservation. Preparation usually requires removal of matrix from bone, and some fossil evidence such as trace fossils, root-casts, phytoliths and soil structure are contained within the matrix. Therefore, the preparator should have an awareness of data contained within the matrix and understands that any modification of matrix

is a potential loss of data.

5. Participation in the Science of Paleontology

A qualified preparator is conversant in the specialized vocabulary, terminology, and research goals of paleontology, and can alert researchers to evidence and assist in its interpretation. The preparator understands the pertinent scientific references, and is able to share and receive relevant information with other subject matter experts.

6. Understanding of Conservation Principles and Ethics

The preparator is also a conservator and makes every effort to ensure that the prepared specimen will resist deterioration for as long as possible. The qualified preparator recognizes the agents of deterioration and understands the principles of preventive and remedial conservation. The preparator is familiar with the current literature, principles, ethics, and specialized vocabulary of conservation.

7. Documentation and Record Keeping

The qualified preparator understands that preparation is part of the scientific process and ensures that all data generated within the laboratory, including identifications, photographs, preparation records, and housing materials are documented and archived. The preparator keeps identifying numbers in association with specimens throughout the preparation process. The preparator keeps records of all tools, techniques, and materials used to prepare or house the specimen that might impact physical or chemical interpretation, or that might have to be removed in the future. The qualified preparator is able to create publishable documentation of materials and methods for inclusion in scientific descriptions of the specimen.

8. Understanding and Aptitude in the Use of Preparation Tools and Techniques

The qualified preparator can select the most appropriate tools and techniques to skillfully reveal scientific information, and safeguard the long-term well being of the specimen. The preparator should be proficient in the preparation of common modes of vertebrate fossil preservation and in challenging situations should be able to seek further guidance in the preparation and conservation literature. The preparator augments this knowledge through professional conferences and communication with colleagues.

9. Understanding and Use of Adhesives

The qualified preparator is familiar with the range of adhesives available and is able to select the most appropriate adhesive for a given task. The preparator has knowledge of the physical and chemical properties, uses of various adhesives, the setting mechanism and reversibility of

adhesives, their solvents, and the advantages and disadvantages conveyed by each kind of adhesive. The preparator should also be familiar with the ethical implications of using adhesives on museum objects and the kinds of scientific data that may be obscured, lost or destroyed by the use of adhesives. A qualified preparator is conversant in adhesives terminology and nomenclature and is able to justify decisions and correctly document adhesives used on specimens in preparation records and reports for publication. The preparator is able to mitigate and manage the potential health risks associated with the use of adhesives and solvents.

10. Understanding and Use of Molding and Casting Materials and Techniques

The qualified preparator is familiar with the ethical implications of using molding compounds on museum specimens and the kinds of scientific data that may be obscured, lost or destroyed during the molding process. The preparator is able to determine the suitability of the fossil for molding and type of mold produced based on its fragility, morphology, and other physical properties. The preparator is familiar with the physical properties and uses of various gap fillers, separators, molding and casting compounds commonly used in paleontology, is adept in their use and also trained in the management of potential health risks associated with molding and casting.

11. Use of Archival Labeling, Housings and Storage Environment

The preparator is aware that an essential step in the long-term conservation of fossil material is the use of archival labeling, housing, and proper storage environment. The qualified preparator incorporates specially designed archival housings into their preparation strategy, in collaboration with collection management staff. The preparator is knowledgeable about archival materials and proper storage environments and can recognize deterioration due to improper materials or storage conditions. As the understanding of storage materials evolves, the preparator is able to evaluate and modify storage materials and methods to ensure the long-term stability of the specimen.

12. Ethics of the Use of Specimens

The preparator is able to mitigate the risk of damage from research and education as much as possible without compromising the scientific value of a fossil specimen. The preparator is able to evaluate whether the specimen would be subject to undue or unnecessary risk by sampling, handling, loan, or display. A qualified preparator understands exhibition as a form of specialized specimen storage, and can evaluate exhibitions and their accompanying furniture, lighting, and other materials to ensure their compatibility with sound conservation practices.

13. Understanding Fieldwork

The preparator is aware that specimens should be collected with the goal of obtaining a stable specimen while ensuring that the greatest amount of geological and biological information is preserved, and understands that no fossil should be collected without comprehensive documentation. The preparator ensures that specimens are collected in a manner that facilitates preparation in the laboratory. The preparator knows and practices proper health and safety procedures while working out of doors in varying climatic conditions.

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14. Health and Safety

The qualified preparator has the training to ensure their own safety and the safety of their coworkers and visitors by determining and mitigating physical and chemical hazards in the paleontology laboratory. The preparator should be able to comprehend Material Safety Data Sheets and select appropriate personal protective equipment and environmental controls, and have basic knowledge of emergency response and first aid.

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