2023 Preparators' Poster Session Abstracts

QUANTIFYING THE IMPACT OF FOSSIL PREPARATORS THROUGH TIME

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Nearly every fossil described in a scientific publication undergoes preparation prior to research. At times, exposure of fossil data from a rock matrix merely requires a few minutes with a toothbrush and water. In other cases, preparation can entail thousands of hours of intricate and invasive treatment methods applied to fossils to make them ready for study. Fossil preparators are highly skilled paleontologists who draw on their knowledge of geology, anatomy, chemistry, and specialized equipment and techniques to accurately reveal and preserve scientific data. Preparators typically contribute this labor behind the scenes in an institution and are customarily (but not always) credited through acknowledgment in any resulting publications. Rarely are preparators' contributions to the collection, preparation, and identification of data recognized with authorship. Additionally, the lack of professional accreditation or certification available to preparators can make it difficult for a preparator to establish their own relative contribution to the scientific enterprise. It is similarly difficult for hiring officials to evaluate the experience of job applicants, or for non-specialist managers to conduct performance appraisals.

A popular metric for quantifying contributions of individual scientists is the *h-index*, a simple formula for comparing the productivity and research impact of scientists based on the number of citations to their published research, where *h* represents the number of *h* articles having a minimum of *h* citations each. In recent years, several museums began calculating the *h-index* of entire collections to demonstrate the scope and impact of their use. This modification aggregates all the publications and number of citations by researchers during specimen-based research in each collection. In this project, I further adapted the application of an *h-index* concept as an exercise in estimating the contributions of the non-publishing scientists who facilitate paleontological research. This process aggregated papers based on specimens an individual had prepared and calculated an *h-index* using a purpose-built Google Scholar profile. Although this metric is subject to the same criticisms as the conventional *h-index* as an imperfect tool for evaluating the totality of an individual's contributions, this study demonstrates that an uncredited member of a research team can still have an equivalent quantifiable impact on the science as other project personnel.

DETECTING EROSION AT THE ENGARE SERO HOMINID FOOTPRINT SITE, TANZANIA, AND IMPLICATIONS FOR *IN SITU* TRACKWAY CONSERVATION

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Regardless of who or what made them, trackways and other trace fossils provide important paleobiological information that is not easily acquired from bones. However, trackways are difficult, sometimes impossible, to collect and often must be left *in situ*, where they are subject to degradation due to erosion. To compound the issue, the conditions that favor the preservation of tracks, such as fine grain size often correspond with those that make the tracks highly susceptible to erosion once uncovered. The more eroded a print becomes, the less reliable information extrapolated from it is. In this study we looked at the late Pleistocene Engare Sero footprint site in Tanzania, which is home to over 400 early hominin footprints. These prints provide insights into the physical stature and social groupings of the printmakers. Located in an ephemeral stream channel, the site floods on a regular basis. The frequent flooding of the site makes water-induced erosion a major concern for those researching and working to preserve the prints found here. A previous study (2010-2017) quantified the rate of erosion at three particularly well preserved prints and noted significant degradation during the study interval. Sometime between 2013 and 2015, an unknown party erected a stone and concrete wall and fencing system around the footprint site. Since the date of installation is unknown, the original study was unable to account for any influence of the wall on the erosion of the prints. The purpose of this study is to assess the efficacy of the wall and fence system in reducing erosion rates by keeping both people and moving water off the footprinted strata. For this study, we used images collected from the same three prints in 2017 and 2022 to photogrammetrically generate 3D models, which we then compared using point cloud comparison algorithms to identify areas of change. We selected this technique because it is a low-cost and non-invasive method to quantify erosion at any site, including those without permanent ground control points. The technique also maintains methodological consistency with the previous study. By comparing our results to the results of the previous study we aim to 1) determine if additional mitigation techniques are necessary for the long-term sustainability of the Engare Sero footprint site and 2) help conservationists decide whether strategically placed walls are actually an effective and costefficient way to reduce erosion at other vulnerable sites.

AN IMPROVED SYSTEM FOR STORAGE OF MICROFOSSILS AT CARNEGIE MUSEUM OF NATURAL HISTORY

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The vertebrate fossil collection at Carnegie Museum of Natural History (CM) contains numerous microfossils, which can be challenging to store. A variety of storage methods have been used in the past, but most have proved inadequate. The most commonly used method, which has evolved over time, is to place vials housing microfossils into wooden vial holders. Individual fossils are typically housed in gel caps placed into 2-dram glass vials, which have a thin piece of ethafoam padding on the bottom. The museum acronym and catalog number are written on the gel cap. A specimen label is wrapped around the inside of the vial. Corks bearing the museum acronym and catalog number are used to close the vials. This provides a relatively light-free environment, which helps to prevent breakdown of the gel caps. The vials are placed in wooden vial holders designed to fit into the specimen drawers. These holders can accommodate several vial sizes, as long as they do not exceed the height of the drawer. Taxon labels are placed in the vial holders. In the past, archival materials and pens were not used, which led to fading of labels. Presently, specimen labels are printed on acid-free paper and taxon labels are made from acid-free file folders. All hand labeling is done with pigma ink pens.

The wooden vial holders are the most significant problem with this system. They were originally made by drilling a grid of holes in a "two-by-four" piece of wood. Later they were custom built by museum carpenters who put a grid made of particle board into a rectangular, plywood box. The result is a heavy vial holder with openings that do not securely hold the vials, use space efficiently, and are expensive. A solution was to modify a technique used by the University of California Museum of Paleontology, Berkeley, that uses light fixture grids to hold vials. At CM we had the museum carpenters cut the light fixture grids to fit into specimen trays. The result is a light-weight, space efficient, and inexpensive vial holder. Half-dram sized vials fit snugly into the grid, and this vial size is large enough to hold the specimen label, foam padding on the vial bottom, and a specimen in a gel cap. The standard-sized taxon tags used in the wooden vial holders had to be reduced in size to better fit the new system. Now 1200 vials fit into one drawer, as compared to 378 that fit when using the old system, and the weight of a drawer with empty vial holders is now 10 pounds compared to 15 pounds.

AUGMENTING ANATOMICAL RECONSTRUCTION OF VERTEBRATE FOSSIL CRANIA - A CASE STUDY OF 3D

PRINTING FOR RESEARCH, OUTREACH, AND EXHIBITS

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In-situ fossils are rarely preserved in optimal conditions. They are usually broken, disarticulated, and distorted. However, understanding anatomy and establishing systematic relationships is best done on undistorted remains. This requires that fossils are restored to their life-like condition, or reconstructed. Traditionally, we have relied on line drawings to present an undistorted interpretation of fossil remains in 2D and we have used plaster, epoxy, and other materials to create 3D interpretations of missing anatomical detail. Structured-light/Laser surface or CT scanning permit creation of a three-dimensional (3D) model of a fossil which then can be sculpted and reassembled into an approximation of the in-life condition using animation software such as Blender or Maya. We used another steadily improving technology, 3D printing or additive manufacturing, to 3D print individual elements, as well as entire crania. The prints, in addition to the digital models, were then used to reconstruct the skulls of two extinct reptiles that showed some degree of taphonomic and diagenetic distortion. We found that 3D printing these models aids in the reconstruction process as a method for testing topological hypotheses through manipulating individual elements scaled up or down for ease of use. The finalized models can be added to existing and in-development exhibits and allow museums to quickly create stand-ins for specimens that have been removed for study or sent out on loan. These models also improve outreach efforts by adding tactile elements to show-and-tell and educational programs and aid in visibly demonstrating 3D damage to fossils. While the additional step of 3D printing does create storage and monetary concerns, we have found that the benefits far outweigh the drawbacks.

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MOLDMAKING AROUND ARMATURES ON A TILTED PEDESTAL: A CASE STUDY OF LARGE-SCALE FOSSIL WHALE MANDIBLES AND BALEEN IMPRESSIONS

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Moldmaking processes vary for each specimen due to differences in morphology, preservation, and size. Gamagori Natural History Museum, located on the coastal region of Japan, is home to the holotype of *Incakujira anillodefuego*, a Miocene baleen whale, despite the risk of natural hazards such as earthquakes and tsunamis. To mitigate potential damage or loss of the specimen, a high-quality cast was produced and relocated to an earthquake-proof building at the National Museum of Nature and Science in Tsukuba, Japan. This project encountered several key challenges including the molding of 2.4- meter-long mandibles and baleen impressions embedded in a pedestal with metal armatures; ensuring that the mold and mother mold were lightweight enough to be handled on the pedestal tilted at an angle of 24 degrees; and producing highfidelity casts that accurately represent the original type specimen. To address these challenges, a solution was devised that involved creating a seamless one-part thin-walled silicone mold

and a complex eight-part polyester mother mold. This approach facilitated demolding, reduced the weight of the mold, and enhanced the quality of the casts.

A five-layer method was employed using RTV silicone rubber *Shin-Etsu KE-12* (Shore A 40) with fumed silica *Aerosil* as a bulking agent and medical gauzes as reinforcement. The silicone was applied to cover the entire mandible and baleen impressions, except for the inside of the armatures. The mother mold consisted of the polyester resin *Polyhope AP150* with a catalyst *Permek N*, talc, fumed silica, fiberglass cloth, and chopped strand mat. Each of the eight pieces was held together with bolts, washers, and wing nuts, eliminating the need for metal or wooden frame supports. As a result, a 20-kg silicone mold and a 20-kg mother mold were created and successfully removed from the specimen without causing damage. Two casts were produced from this mold, although the silicone rubber experienced minor tearing during demolding and casting. To prevent such tears, it may be necessary to select silicone rubber with a lower hardness scale or apply the phantom shim technique.

'NATURE-FAKED' LAY-UP URETHANE PLASTIC METHODOLOGY FOR SAFER HOLLOW-CAST MAKING

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Fossil casts are a valuable resource for study, display, and outreach. Polyester resin is often the preferred casting material due to its cost, ease of acquisition, high fidelity of detail, ability to make strong hollow casts with fiberglass, and relative ease of use. However, polyester resin has a relatively short shelf life, a dangerous catalyst (MEKP = Methyl Ethyl Ketone Peroxide), is difficult and expensive to dispose of safely, and off-gasses fumes well after cure.

The Perot Museum of Nature and Science until recently used polyester resin to create hollow casts offossils for study and display. Recently, for a number of reasons, a large quantity of polyester resin expired before it could be used. The expensive waste of material combined with the costly process of safe disposal and considerations of future health and safety, cumulated in the decision that a different casting medium would be preferred. The main considerations in choosing a replacement material were: 1) the ability to create strong and accurate hollow casts; 2) ease of storage; and 3) be less hazardous chemically in both its unmixed form and once cured. Two-part urethane casting plastic resin was chosen as the preferred alternative. Urethane is safer, has variable cure times, high fidelity of detail, and can be pigmented during the casting process. However, urethane is usually used to create solid pour casts, is strongly sensitive to humidity, and often lightens the hue of added colorants.

Initial tests to modify the lay-up casting method used Smooth-Cast 321 (pot life of 7-9 minutes) low viscosity urethane plastic, talc as a thickener, So- Strong urethane pigment, and fiberglass cloth. Results from this test indicated the technique was viable but needed refining. It had too short a pot life to apply layers into larger molds before the material began to cure, the colorant was not a good base for dark colored fossils that needed "nature faked" replicas, and talc trapped moisture causing foaming. Greater success is had with: Smooth-Cast 322 (pot life 10-20 minutes), cement pigment dusted onto the silicon molds with makeup brushes, and polyurethane thickener URE-FIL 11. The resulting hollow casts are light, strong, odorless, detailed, and visually appealing even before artistic painting.

PROBLEM-SOLVING FOR PREPARING VERY THIN BONE - A SMALL THEROPOD ILIUM CASE STUDY

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Preparing fragile bones can be challenging. Bones such as the ilia of small theropods have a flat blade section that thins to 1 mm on both sides of the median vertical ridge. If preserved, this section is often fragmented and unstable. Preparation methods must be adjusted so that such a thin and delicate bone can be worked on safely.

The specimen used in this study is an ilium of a small theropod from Late Jurassic Morrison Formation of Central Wyoming. The matrix is a flaky, grey, finegrained mudstone. After opening the field jacket, the specimen was heavily consolidated with Butvar B-76 in acetone. Preparation of the exposed side revealed the ilium's complete but extremely thin and fragile blade. To remove the ilium and prepare the other side, a smaller temporary jacket had to be created to support the specimen during matrix removal properly. This support needed to be strong, sturdy, removable, easy to handle during preparation, and also smooth and solid. Any gaps or cracks would cause the shattering of thin bone when worked against them. Two attempts were made to achieve this: one with a plaster bandage and the second with a thick molding plaster. In both cases, plastic film was used as a separator. The initial results proved to be ineffective as such support. The plastic film separator created wrinkles and gaps on the plaster surface. Thus, our support jacket needed an additional smooth solid layer that the bone could be safely worked on against.

To solve this problem, a thin layer of epoxy putty was added over the plaster jacket, and then the specimen was gently pushed against it to create an impression. 30 g of Apoxie Sculpt was used in the layer ranging from 1 to 5 mm in thickness. A plastic film separator was used between the plaster jacket and the epoxy layer, and between the putty and the specimen. After the putty hardened completely, we were left with a temporary support consisting of a sturdy plaster jacket and a separate, smooth, solid layer of epoxy putty. The specimen fits snugly into the support and may be held like a sandwich with finger pressure as the matrix is removed.

We also used a layer of Japanese Kizuki Paper adhered to the non-working side of the specimen with Butvar B-76 in acetone. This ensured the preservation of broken bone during the preparation, with all the fragments remaining aligned. Depending on the researcher's needs, this Japanese paper could be permanent or temporary, as it is easily removable.