2015 Preparators' Session Abstracts

OBSERVATIONS ON PROSPECTING FOR FOSSILS IN EXPANDING CLAYS

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Over the last 85 years, fossil prospecting of vertebrate material within Petrified Forest National Park (PEFO) has been dominated by surface collection or extraction of isolated specimens. There have been relatively few examples of bone bed localities with high concentrations of material that create locally extensive quarries. New evidence suggests this may have more to do with the characteristics of our matrix and the weathering profile rather than lack of resources or effort.

Many paleontologists are used to finding specimens by locating fragments of fossils and prospecting uphill to where the last remnants are found. The next logical step is then to start above the last fragment and excavate down to that level on the slope. This has led PEFO field crews in the past to find relatively few fossils in situ and wonder about the root cause of high surficial concentrations of bone. At PEFO it was recently discovered that expanding clays of the Upper Triassic Chinle Formation, which form 'popcorn' textured low hills, require a different technique of excavation. Counterintuitively it is necessary to dig 15-30 cm below and inward from bone found floating on the surface in order to locate in situ specimens. It was also found that the level of these 'sunken' quarries sometimes coincides with a transition zone between two distinct lithologies that appear on the surface of the hill to be below the fragments of fossils. In one case, the predominance of fossil remains is found directly on such a contact, which might reflect transportation and burial processes of the original fluvial depositional system. Further, bones found at these transition zones can be altered diagenetically owing to the differences in the physical properties of the two lithologies.

Six quarries have been found since 2013 using this technique and some are monodominant bone beds, possibly representing mass mortality events. Bone beds offer different preservational and associational opportunities than surface collection or general excavation and have produced taxa new to the park in only the last few years. This in turn allows researchers to gain a more complete knowledge of the biota in the region during the Late Triassic. Using these new insights may lead to greater quantities of quarry localities not only at PEFO but anywhere with expanding clays.

CONSOLIDATION OF WET AMAZONIAN SPECIMENS USING PRIMAL/RHOPLEX WS 24: FIELD AND LABORATORY APPLICATIONS

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AMNH expeditions to river localities in the Peruvian Amazon have provided opportunities for experimentation with Primal/Phoplex (or Acrysol) WS 24 ("Phoplex" here), an acrylic colloidal dispersion that sets through the evaporation of water. Field conditions on these expeditions are extremely wet and provide challenges for both collection and field stabilization of fossil material. Swift excavating, often during downpours, and jacketing in situ are often necessary for specimen retrieval. Field consolidation is trickier still, since solvent-based consolidants like Paraloid B72 and Butvar B76 are ineffective in wet conditions. Additionally, the acquisition of solvents such as acetone and ethanol is difficult in this part of the world, making the use of waterbased consolidants rather practical. The use of Rhoplex on fossil material is not well documented, but neither are many other methods for wet consolidation. Here, we present the results of our field experimentation. Our findings indicate qualitative improvements in surface stability when Rhoplex is applied at well-timed intervals during the drying process-mainly, reduced surface cracking and flaking that can occur as specimens dry. International travel requires some planning since Rhoplex is a liquid and is unavailable for purchase in Peru. However, its water-solubility eliminates the need to travel with restricted organic solvents like acetone and ethanol. Ideally, Rhoplex

should be diluted in purified water, but compromises are made when using it in the field, where it is mixed with local tap water, or even with stream water on site. Solutions applied range between 15:1 and 20:1 parts water to concentrate. This method requires forethought and careful timing, but is easy to implement in both the field and laboratory.

Treatment occurs at the localities or at our lodgings, which double as ad hoc 'field labs.' Specimens are treated as follows: 1) only during the damp phase, not when specimens are sodden; 2) specimens exposed in half jackets receive several applications in the 'field lab'; 3) once dry, specimens are further consolidated with Butvar B76. Proper application hinges on monitoring consolidant coloration and its interaction with the specimen during the damp phase. No negative interactions have been observed in the application of either Butvar B76 or Paraloid B72 once the specimens are dry. Although specimen preservation is excellent at these Amazon sites, consolidation during both wet and dry phases notably improves specimen conservation and stability.

EXCAVATION AND COLLECTION OF A NINE-TON FIELD JACKET CONTAINING FOSSILS OF NUMEROUS IGUANODONT AND *UTAHRAPTOR* DINOSAURS FROM THE EARLY CRETACEOUS YELLOW CAT MEMBER OF THE CEDAR MOUNTAIN FORMATION IN EASTERN UTAH

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In 2005, the Utah Geological Survey began excavation of a site in the Early Cretaceous upper Yellow Cat Member of the Cedar Mountain Formation. This site, located high on a cuesta in eastern Utah, contained a number of well-preserved bones of iguanodont and *Utahraptor* dinosaurs. Because of the number of delicate elements preserved in close association with one another, efforts to isolate and collect individual elements became unfeasible so an effort was made to isolate larger blocks. In 2006, a roughly 1000-pound (450 kg) block was jacketed and flipped off of the top of this dense accumulation of fossils and slid down the cuesta on a car hood. In subsequent years, efforts were made to isolate blocks of a size that were practical to collect by hand but the number of bones present made this difficult to achieve. We decided that the only way to proceed was to collect a very large block. During excavation it became apparent that the bones were confined to a lensoidal-ovoid shaped green sandstone mass within a red mudstone unit that we hypothesize was a dewatering feature (quicksand) that trapped, killed, and preserved at least two iguanodont and numerous *Utahraptor* dinosaurs. A massive amount of hand digging and rock removal using an electric hammer drill was accomplished over a number of field seasons, resulting in the isolation and plaster jacketing of a large block from the surrounding unfossiliferous mudstone. The block measured over 10' x 9' x 3' (3 m x 2.7 m x 0.9 m), too large to be transported by all but the largest helicopters, so we decided to construct a temporary track to the site, and build a wooden frame under the block. A wooden frame was designed, pre-assembled off site, and disassembled for transport. We bolted four 10" x 10" (25 cm x 25 cm) crossbeams to two underlying 8" x 8" (20 cm x 20 cm) beams at the base, and reinforced the assembly by using three 6' x 1.5" (180 cm x 3.8 cm) steel rods encased in 2" (5 cm) diameter pipe. We pedestalled the jacket and then tunneled under the center so that it was sitting on two pillars, allowing us to slide two crossbeams through the center. Once the frame was constructed the pillars were removed, additional wood and plaster were used to shim the block, and heavy-duty strapping was used to secure the block. The block and frame were then pulled down the steep temporary track using a hydraulic excavator (track hoe). At the base of the hill, the rocky terrain was damaging the wooden skids so metal guard rails where attached under the skids, for the remainder of the 1.6 km journey to where it could be loaded onto a semi truck trailer for transport to Salt Lake City.

THE RIGGING TECHNIQUES IMPLEMENTED FOR THE DEINSTALLATION OF THREE CHALLENGING PLAQUE MOUNTS AT THE SMITHSONIAN INSTITUTION NATIONAL MUSEUM OF NATURAL HISTORY

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During the planning stages of the de-installation of exhibits at the Smithsonian Institution National Museum of Natural History, we identified three specimens that presented unique challenges. Typical de-installation challenges include layers of plaster, and aging adhesives and consolidants, but these three specimens had their own challenges and required new strategies for removal.

Both *Edmontosaurus* and *Albertosaurus* were plaque mounts located on a platform approximately 25 feet from the exhibit hall floor. The obvious challenges of these two specimens were the sheer size, weight and logistics of removing them from the current exhibit location. In addition to the specimens themselves, there were challenges with floor loading restrictions and earthquake damage. The presence of asbestos in the wall directly behind the two plaques meant that material could not be disturbed.

Xiphactinus was another plaque mount that was located roughly 30 feet from the exhibit hall floor and 5 feet above a ramp that connected the mezzanine in the dinosaur hall to a geology gallery containing the Hope Diamond. The original plan was to use material handling lifts to remove the plaque from the wall while being supported by the ramp or to use a spider crane from the floor below to lift the specimen from the wall and over the ramp to the gallery floor below. Given that the floor would not support the point load of the crane and the specimen we could not use this method. The ramp suffered damage during the 2011 earthquake that ended up closing the ramp and mezzanine to the public and rendering it unstable to lift from.

After identifying all of these challenges, we developed a method for removing the specimens. We created a custom modular system with various components that could be interchanged and used in all 3 rigging procedures. The safety of those performing the work and the preservation of the specimens were our first considerations. Through coordination, planning, and preparation, these three specimens were successfully lowered to the ground for shipping and storage.

COMPARISON OF QUANTITATIVE ASSESSMENT METHODS FOR POLYMER CONSOLIDANT PENETRATION ON ROCK AND FOSSIL SUBSTRATES

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A key objective for fossil preparators is to select the best consolidant for a given specimen, usually from a handful of consolidants whose properties are qualitatively observed through practice, including solubility, aging, and penetration depth from the application surface. We compared quantitative evaluation methods for consolidant penetration: iodine staining (IS), hydrophobicity comparisons (droplet test), and direct observation in petrographic thin section. We tested these methods on samples of Gobi Desert sandstone, Chilean ignimbrite, and Amazonian mudstone, and the fossil bone these rock types contain, capturing a range of porosities and shear strengths.

Samples from each substrate type were consolidated with 2 solution-based consolidants, and penetration depth was measured with each of the methods. Sample blocks were cut after the consolidant had dried completely, and the flat surfaces assessed using the IS and droplet tests. Exposure to iodine vapor stains consolidant polymers, and polymer saturated substrate is more hydrophobic than unsaturated, producing water drop sphericity variation. Both of these test results were assessed visually with a binocular microscope; the depth of iodine staining and the diameters of water drops along the section were both measured in microns. A thin section was produced from each sample for the third test.

The refractive index (RI) of different consolidant polymers is an optical property of their molecular structure, and a goal of this study was to test whether polymer RI is consistent enough to observe penetration with a petrographic microscope. The thin section method enabled us to observe and map fine scale variation in penetration, and quantify it relative to specimen porosity.

The droplet test is the simplest method and requires minimal special instrumentation, but is subject to imprecision and subjectivity. The IS test is more replicable, and depth measurements are quick to make, so for comparison between many different substrates and polymer types it is recommended. To map fine scale characteristics of consolidant migration through a specific substrate, thin sections are promising, but require differentiation between the RIs of consolidant and slidemaking epoxy, facilities for thin section production, and ability to destructively sample the specimen.

DESIGN AND USE OF A LARGE ADJUSTABLE TENT FOR DOING AIR ABRASIVE WORK ON LARGE DINOSAUR SPECIMENS

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Air abrasive machines have become an integral part of the fossil preparation lab over the past few decades. They are useful for detailed matrix removal on small and large fossils. Because they send very small particulate-sized dust into the air, the work must be done in a work chamber with a proper dust collection system attached. While most fossils are small enough to be air abraded in a standard issue work chamber, larger articulated specimens may need a custom made work chamber. Custom work chambers range in size from shoe box sized to complete room size.

In 2004, the Tate Geological Museum collected an articulated partial hadrosaur skeleton lovingly named “Dead Sheep 148” (DS-148). The skeleton was left articulated and a special sand-blasting tent was built to do the air abrasive work on a specimen that is roughly 8 feet long by three feet wide. The DS-148 Tent is made of PVC tubing, wood, glass, and assorted hardware. It is adjustable in many different dimensions so it can be used on other specimens, and can be shifted as work progresses along the specimen. As work was being done on the dinosaur, it sat on a sturdy table with wheels, so the table can also be moved under the tent. This presentation will cover how the tent was designed and made, how it is set up, its limitations and what could be done better the second time around.

COMPARISON OF NESTED SIEVES, TRADITIONAL SCREEN BOXES, AND PAINT SIEVES FOR THE RECOVERY OF MICROVERTEBRATE FOSSILS

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Traditional methods for screen washing sediment to recover microfossils involve the use of bulky ‘screen boxes’ and/or expensive, nested sedimentary sieves. Although nested sieves offer a wide range of benefits such as modular capability, sorting of sediment and fossils by size, and durability, we have investigated using paint sieves as an alternative because they are lightweight and easily transportable in the field. Paint sieves are inexpensive (~$2.50 each) and can be found at any local hardware store, whereas the nested sieves can cost more than $200 for a functional set and screen boxes have to be custom built. In initial tests, the 5-gallon paint sieves (Bluehawk® brand found at a local home center) can hold a larger load (up to 2.5 kg of benonitic sediment) than the nested 8 in (~20 cm) sieves, which quickly become clogged at ~1 kg. The paint sieves offer a continuous 3-dimensional surface area, compared to the nested sieves, which only filter on one side, and the typical 3-5 screened sides of traditional boxes. Paint sieves are designed to handle heavy liquid loads such as viscous paint, whereas traditional sedimentary sieves are intended for dry sediment. An elastic band on the paint sieve facilitates use with a

variety of containers. The soft fabric of paint sieves is another positive feature because it is less likely to damage either delicate microfossils or skin. Paint sieves can be effectively labeled, employed with desired sediments, and then disposed of to avoid cross contamination. With reused nested sieves, there exists the risk of cross contamination between samples. Even with these benefits, the paint sieves have some drawbacks relative to the nested sieves. Nested sieves are standardized and can effectively sort sediment by size, and offer the ability to easily observe what has been left after washing before removing the sediment and fossils from the mesh. T hey are durable and can be reused almost limitless times, while the paint sieves have a limited number of uses (but are surprisingly long-lasting). Microscopic analysis of the paint sieves indicates that when 'relaxed' they have irregular polygonal openings with an average aperture area of 0.16 mm^2 and maximum aperture length of 0.6 mm. With the fabric stretched (e.g., under load, the more relevant measure) the actual aperture area appears to remain the same or even shrink due to the design of the interwoven fibers, and decreases to an average area of 0.15 mm^2. In practice, one of us (LM) reports finding fossils as small as 0.1 mm long, and frequently only 0.25 mm long, in concentrate from paint sieving.
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PREPARATION OF DESICCATED IVORY: CASE STUDY OF *MAMMUT AMERICANUM*

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Ivory is high in organic content and because it is hygroscopic it is especially vulnerable to fragmentation in arid environments. In particular, poorly mineralized subfossil ivory from *Mammuthus columbi*, *Mammuthus exilis*, and *Mammut americanum* from the marine terraces of southwest California and the Channel Islands are often too fragmented to prepare with conventional methods.

Subfossil ivory is different from permineralized bone because of its unique physical properties. Including its light-sensitive color, luster, relative softness, and sensitivity to temperature and humidity. Though durable in life, tusks fracture in three distinct patterns following desiccation in an arid environment. The most prominent of these fracture regimes cleaves the tusk into a series of concentric conical laminae. Irregular transverse fractures and radial fractures intersect these concentric laminae and collectively reduce it to myriad tabular units.

The restoration of a highly fragmented subfossil tusk from *M. americanum* inspired the development of new preparatory techniques. By replacing and rejoining the most surficial tabular units with an Auqazol-200 based filler, the fractures of the outermost conical lamina can be sealed and the interior can be consolidated without any leaks. Final consolidation with Butvar B-72 dissolved in acetone left our tusk rigid enough to be moved and bear its own weight. Removing debris from the surface finishes the preparation process. By developing new preparatory techniques, we have restored structural integrity to desiccated ivory tusks, so that they can be available for researchers, artists, and exhibition.
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BRINGING A CONCRETE DINOSAUR SKELETON BACK TO LIFE

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The Carnegie *Diplodocus* skeleton, collected in the late 1800s and later described by John Bell Hatcher, became known as 'Dippy' after ten casts of the skeleton were distributed to museums around the world. In the 1950s, the Italian-made molds were donated to the Vernal Field House (now Utah Field House of Natural History) as plans for an outdoor cast of the beast was desired. After much experimentation, a concrete and aragonite mixture was used to cast the large dinosaur. In 1956, this *Diplodocus* cast was unveiled on the Field House's grounds where it stood for decades until plans to have a new museum building with an indoor fiberglass skeleton was approved. Prior to construction of the new building and after 45 years of exposure to seasonal weather conditions, the skeleton was disassembled and stored. In 2013, the old cast, with a wide variety of external and internal damage, was donated to the Utah State University (USU) Eastern Prehistoric Museum. Grant monies from the Utah Arts & Museums in 2014-15 provided financial support to clean, repair, reconstruct, stabilize, and seal the concrete material. Planned fundraising to construct new steel armature and mounting the repaired skeleton on the USU Eastern campus in Price, UT, will begin Fall of 2015.

Substantial amounts of epoxy paint and sealant coated every concrete bone thus requiring removal using industrial sandblasting methods. After analyzing and testing several brands of concrete repair and resurfacing materials, Permacrete was selected as the product of choice due to its strength in all weather conditions, its history of successful airport tarmac repair, as well as its use in coating several concrete sculptures in the United States. Once sandblasted, each concrete bone was repaired and reconstructed using the concrete repair products along with steel rods and fiber cloth. The next step required each bone to be resurfaced and sealed using other Permacrete products following manufacturer's specifications. Tests performed on the concrete bones indicated that these applications increased durability and greatly lessened breakage from significant impacts as compared to previous products used for repair on the skeleton. Heat and cold does not damage or warp the material; therefore, the repaired skeleton will be able to withstand exposure to varying weather conditions-an important consideration as this skeleton will be remounted outside in eastern Utah, a land of extremes. The condition of this historic dinosaur cast is now better than ever and ready to see the sun again after 15 years in storage.

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VIRTUAL *AQUILOPS*: DIGITALLY RECONSTRUCTING A TINY CERATOPSIAN

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Recently described, *Aquilops americanus* is the oldest named ceratopsian from North America. It is based on a partial, slightly crushed skull, predentary, and most of the left dentary. The remains represent an immature individual and is small by ceratopsian standards, with a skull length of less than 10 cm and an estimated body mass of about 2 kilograms. Prior to publication, the Oklahoma Museum of Natural History undertook to make an uncrushed reconstruction of the skull and jaws together with a life reconstruction of the animal for exhibit purposes. This was done virtually using ZBrush, a 3D sculpting program. Both skull and body were done as straightforward virtual models. Phylogenetic analysis places *Aquilops* among basal Neoceratopsia. Accordingly, missing parts of the skull, where not present on either side, were reconstructed after structurally similar taxa also lying near the base of Neoceratopsia, especially *Auroraceratops* from China. The projected body, which lacks skeletal representation and hence is entirely conjectural, was similarly based on close relatives. Sculpting proceeded rapidly enough to send draft versions of the digital reconstructions to the authors describing the specimen prior to its publication, allowing corrections to be made and providing a basis for adjusting the published reconstruction of the skull and jaws. The virtual skull was printed out in 3D for final exhibition and also displayed with an Occulus Rift 3D visualization system using goggles on a temporary basis. Both models were placed on the museum's website as an interactive viewing experience.

A RELATIVELY INEXPENSIVE METHOD TO PRODUCE GOOD QUALITY PHOTOGRAMMETRIC MODELS OF VERTEBRATE MICROFOSSILS IN THE 1-2 MM SIZE RANGE

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I have developed a protocol to produce photogrammetric models of vertebrate microfossils, in the 1-2 mm size range, using relatively inexpensive hardware and readily available software. Many institutions are likely to already have access to suitable equipment and the necessary software. The microscope and microscope accessories I use are manufactured by Dino-Lite and consist of: a 5 MP Extended Working Distance digital microscope (model no. ADL7013MTL); a Rigid Table Top Pole Stand (MS35B); and an Adjustable Staging Holder (MSAK815). The cumulative retail price for these three items is approximately $1,200 US. With respect to the hardware, the key to this protocol is the adjustable stage, which consists of a small, manually-rotated turntable that can be used to change the orientation of a pin-mounted specimen along three axes relative to the microscope. A dual gooseneck illuminator is also required to provide indirect illumination.

Before any photographs can be taken the specimen must be whitened with ammonium chloride. This classic photographic technique serves two purposes: it improves the contrast and detail apparent in each photograph; and most importantly eliminates surface reflections on the specimen.

The limited depth of field, at the high magnifications involved, requires the use of focus-stacked images. Two to four hundred photographs, each one a focus-stacked composite composed of between 10-20 individual photographs taken at various angles relative to the specimen, are necessary to achieve good results. A series of scripts is then used to automate the focus-stacking of the composite images in Adobe Photoshop. Once focus-stacking is complete the composite images are loaded into VisualSFM where a point cloud is generated. The point cloud file can then be imported into Meshlab to create a texture mapped surface model.

Currently, this is a labor intensive process that would not be practical to use to digitize large collections. It is useful in creating digital models of important or unique specimens, such as types, that can then be made available online for reference, research, and educational purposes.

GETTING 2D X-RAY SYSTEMS TO YIELD 3D IMAGES VIA CONE BEAM COMPUTED TOMOGRAPHY

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X-ray computed tomography (CT) has rapidly become commonplace as a nondestructive imaging and research tool in paleontology. Many researchers benefit from their own CT systems or have costly access to off-site medical facilities, but two-dimensional (2D) X-ray imaging systems are affordable, common, and accessible in remote locations. We present techniques and best practices for using a 2D X-ray imaging system to generate tomographic images for the construction of three-dimensional (3D) models. Since 2010, the Field Museum's Siemens Axiom Multix MT 2D digital X-ray has been used by the anthropology department to investigate the internal materials of mummies and wooden statues, and by the geology department to identify fish fossils from the Green River Formation and field jackets that are missing proper labels from the Cedar Mountain Formation. The resulting images from the 2D X-ray lack z-axis depth and clarity to assist in diagnoses. We overcome this limitation by rotating a specimen on a turntable to generate a series of 2D X-ray images, which are used to compute the tomographic image data, and generate a 3D digital model. Our tomographic slices were computed from the 2D X-ray images using a cone beam approach with the Bruker microCT freeware NRecon v1.6.9.18. For successful computation, several variables need to be held constant throughout the 2D image collection: the distances from the X-ray source to detector, and from the X-ray source to specimen, the axis of specimen rotation relative to the X-ray source, and the rotation angle of the specimen. Imaging the Cedar Mountain Formation material is most successful when the specimen to detector distance is minimized, and a 360 degree scan in 10 degree increments, at 60kv, 22mA, 220ms exposures are used to produce a 0.002 mm3 voxel size. The workflow for our protocol from the initial X-ray scan set-up to the rendered 3D digital model is on the order of one to two hours, much faster than if we used an off-site CT facility. In summary, the protocol unites common low-tech resources and free programmatic solutions to produce a highly effective and accessible 3D imaging solution. The resulting 3D data is of sufficient quality to aid the triage, planning, and preparation of vertebrate fossil material.

DIGITAL TO PHYSICAL: CONSIDERATIONS FOR FABRICATION OF PALEONTOLOGICAL REPLICAS FROM DIGITAL FILES

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CT digitization of paleontological specimens has impacted preparation, research, archiving, data sharing, and exhibition. Likewise, machining and printing digitized files based on fossil specimens has emerged as another frontier for research and exhibition. Yet, there exists no universal or recognized workflow for the process of digitizing one or more fossils and then generating a physical model. Complicating factors include different scanning techniques and software, and different rapid prototyping methods and materials. Important considerations outlined below are based on the fabrication from digital data of an adult *Spinosaurus* skull for exhibition.

After CT-scanning an adult snout of *Spinosaurus*, the Computer Numerical Control (CNC)-machined rostrum was inadvertently mirrored because the jpg stack did not contain metadata on orientation. An important consideration is thus to make sure that Digital Imaging and Communications in Medicine (DICOM) header information is preserved in CT data files. As the project progressed, we adopted another software package for CT data processing. Models generated using Amira software produced an unexpected ten-fold mismatch in the size of elements of the same specimen vs. those that were generated using Mimics software. Careful measurements of fossil specimens thus were necessary to accurately resize the bones. A digitally reconstructed skull file was transferred to a company specialized in model-making. They used CNC-machine software to divide the file into machinable sections but ended up carving accessory details, such as internal spaces that were later in-filled prior to traditional molding and casting. Clearly communicating the desired end-product with a 3D printing company thus is very important to avoid wasted time, labor, and materials. Consideration of the stock material for the prototype is also important. It must support the weight of molding rubber and a fiberglass mother-mold. Finally, assembly and touch-up of the prototypes ought to match the aim of the project, be it for display or research. For display all evidence of the manufacturing process might best be smoothed away, whereas the unmodified prototype might be more appropriate for a research collection.

MULTI-PART STORAGE JACKET FOR LARGE VERTEBRATE FOSSILS

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Very large bones, such as sauropod limb bones, may be in several heavy pieces. This can make it difficult to maneuver the specimen. By following the Yale Peabody Museum Vertebrate Paleontology Lab's previously published protocol for making storage jackets using Hydrocal and Hydrocal FGR plasters, fiberglass, and medium density fiberboard (MDF) and adding a few new steps, a multipart jacket is made that lines up exactly. Large bones supported in the jacket can be studied as if they were in one unbroken piece.

Separations in the jacket are placed along pre-existing breaks in the element. Before anything else, the bone sections are lined up exactly in the sand box. A piece of ¾ in MDF cut to the size of the bone in the assumed single piece is then cut again at the separation points. 'Feet' are added per our usual method. The cut MDF pieces are laid on a large flat surface and 2 X 4s running the full length of the entire base are attached onto the 'feet' of the MDF base, joining it together as if the base is one solid piece.

The exact break is offset slightly so that the bone overhangs the jacket and the base by approximately ? in. A piece of cardboard fit closely to the plastic and clay covered bone acts as a separator between the parts and creates this space. The cardboard wall is coated with petroleum jelly to ensure the plaster from one section does not attach to another section. The jacket is then made using our usual method. Once the jacket is completed, the sections are removed, and each is treated as an individual base. All the completed bases will line up exactly. Aside from enabling easier and more accurate measurements, the individual bases can help when moving and storing the specimen.

Grant Information Save America's Treasures, National Park Service, U.S. Department of the Interior

THE BADLANDS NATIONAL PARK FOSSIL PREPARATION LAB: BUILDING RELATIONSHIPS WITH POSITIVE OUTCOMES

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The development of a new fossil preparation lab in 2012 has forged strong relationships for Badlands National Park. Open to public view, the fully functioning lab is an accessible interface into the science of paleontology, often reaching those who otherwise would not be reached. Interactions with visitors, staff, researchers, artists, students, and other federal entities have generated synergies with positive and sometimes unexpected outcomes.

By encouraging protection of fossil resources, the fossil preparation lab has produced a sense of conservation stewardship, manifested in a number of ways. One of the park's most successful collaborations is the Visitor Site Report (VSR) program. Visitors are encouraged not to disturb fossils in the park and report their finds by submitting a VSR. As a direct result of the lab's influence, the program has increased to well over 250 reports per year and has led to a number of scientifically significant discoveries. Subsequently, the park has developed an interpretive display where visitors who complete a VSR are featured, and their photos and names are posted. Many of the fossils prepared in the lab are from VSRs, offering a visitor the experience of a direct and almost immediate contribution to paleontology. After four seasons of successful operation, the fossil preparation lab has witnessed an increase in visitation of over 40% and has become a central focus of park interpretive programs. It was recently featured in *Parents Magazine* as a must-see destination while visiting South Dakota. Additionally, the establishment of the lab now provides an opportunity for scientific illustration which has been utilized by the park's Artist in Residence program. The lab also provides a meeting place for researchers, where fossils can be prepared and images projected onto a SMART Board, facilitating discussion and topical research. Other fossil parks are also served by the lab, addressing their backlog of unprepared fossils.

Construction contractors often work in the park, unfamiliar with paleontological resources or the regulations which protect them. By spending time in the lab, workers develop a sense of responsibility for park fossil resources and are much more willing to cooperate with NPS paleontological monitoring personnel.

The Badlands fossil preparation lab provides a tangible model of paleontological resource conservation and protection. Bridging the gap from abstract concepts to physical examples, the lab has fostered a deeper understanding and appreciation of the significance of fossil resources.