

PaleoBios

OFFICIAL PUBLICATION OF THE UNIVERSITY OF CALIFORNIA MUSEUM OF PALEONTOLOGY

WESTERN ASSOCIATION OF VERTEBRATE PALEONTOLOGY ANNUAL MEETING



Cover Image: WAVP 2025 logo, designed by Jenny Borst

Citation: McCord, R., B. Adrian, J. Bevers, J. Borst, E. Churi, G. McCullough, S. Mohler, I. Sanchez-Morales, H. Smith (organizers). 2025. Western Association of Vertebrate Paleontology Annual Meeting Abstracts *PaleoBios* 42(3):1-16

DOI: <https://doi.org/10.5070/P9.48936>

Copyright: Published under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC-BY-NC-SA) license.

WESTERN ASSOCIATION OF VERTEBRATE PALEONTOLOGY ANNUAL MEETING

HOSTED BY

ARIZONA MUSEUM OF NATURAL HISTORY

MESA, ARIZONA



Arizona Museum of Natural History



at The Post, Mesa, Arizona

FEBRUARY 15, 2025

Host Committee: Robert McCord (chair), Brenton Adrian, Jeb Bevers, Jenny Borst, Eden Churi, Gavin McCullough, Sherman Mohler, Ismael Sanchez Morales, and Heather Smith

ABSTRACTS

Alphabetically by first author

A REVISED TURTLE FAUNA DEMONSTRATES INCREASED DIVERSITY IN THE MENELEE FORMATION (CAMPANIAN), NEW MEXICO, U.S.A.

ADRIAN, Brent¹, Heather F. Smith^{1,2}, and Andrew T. McDonald³

¹School of Human Evolution and Social Change, Arizona State University, Tempe, AZ, USA

²Department of Anatomy, Midwestern University, Glendale, AZ, USA

³Western Science Center, Hemet, CA, USA

Recent fieldwork in the Allison Member of the Menefee Formation (Fm.) of the San Juan Basin (SJB) in New Mexico sampled an understudied interval in the lower to middle Campanian of southern Laramidia. Previous expeditions revealed a diverse dinosaurian and crocodyliform fauna, including tyrannosaurid, nodosaurid, ceratopsian, hadrosaurid, and neosuchian taxa. Unidentified baenids and trionychid turtles were first reported from the Menefee Fm. in the mid-1990s. About twenty years later, additional trionychid material was reported, along with the oldest record of the baenid *Denazinemys nodosa*, a single specimen of the stem turtle *Naomichelys*, adocid fragments resembling the aquatic Asian immigrant *Adocus bossi*, and a partial plastron discovered in Chaco Canyon referred to the bothremydid *Elochelys perfecta*. Ten years after the publication of this paper, we present a revised turtle assemblage from the Menefee Fm. that includes eleven taxa, approximately doubling the previously known diversity. We confirm the presence of the baenids *Neurankylus baueri* and *D. nodosa*, and report new baenid occurrences of *Scabremys* sp. and *Thescelus* sp. We report multiple softshell forms such as “*Trionyx*” *robustus* and a larger congeneric that represent Trionychidae. Members of its sister clade Plastomenidae include a small indeterminate taxon and a larger species of *Helopanoplia*. Material of *Adocus* is identified, but its distinctive shell pattern is finer than that of the previously described specimens, more closely resembling *A. kirtlandius* from younger SJB deposits. We report the first evidence of the Asian immigrant *Basilemys* in the Menefee Fm., which is older than any named congenics from North America. An additional fragment from the stem turtle *Naomichelys* has been discovered from each of the oldest and youngest portions of our study area, confirming its rarity in New Mexico. Finally, we re-describe the purported bothremydid CHCU 81269 from

the Kin Klizhin area near Chaco Canyon and reassign the specimen to *N. baueri*. The updated Menefee turtle fauna has implications for turtle evolution in the SJB, paleobiostatigraphy in the Western Interior, and paleoenvironmental reconstructions prior to the late Campanian. The Menefee turtle record is clearly more similar to younger SJB strata than previously appreciated. Comparatively, the Menefee Fm. lacks a marine component (e.g., bothremydid), an additional large baenid (*Boremys grandis*), the early-diverging non-baenoid paracryptodire *Compsemys*, and a kinosternoid. It is dominated by baenids and soft-shell turtles of various sizes, indicating a broad range of aquatic environments in terrestrial deposits near the dynamic Western Interior Seaway shoreline. Baenid diversity also suggests niche partitioning in aquatic paleohabitats and clarifies paleobiostatigraphic patterns among southern Laramidian sites. Non-trionychid taxa of Asian origin are present, which arrived earlier in the Late Cretaceous. Particularly, evidence of a single species of *Adocus* confirms previous reports and suggests that a second species likely evolved in younger strata. The appearance of *Basilemys* is stratigraphically near that of *B. variolosa* from the Judith River Fm. in Montana, suggesting a broad early latitudinal dispersion in the Western Interior prior to the Late Campanian.

Funding: This project was funded by grants from the Western Interior Paleontological Society and David B. Jones Foundation.

ECOLOGICAL INTERACTIONS AND HABITS OF THE BOROPHAGINAE AND CAMELIDAE AT THE MILK CREEK SITE, YAVAPAI COUNTY, ARIZONA

BEVERS, Jeb¹, Ian Bevers^{1,2}, Giovanni Hernandez¹ and Carley Weideman^{1,3}

¹Yavapai College, Prescott, AZ, USA

²Northern Arizona University, Flagstaff, AZ, USA

³Arizona Game and Fish Department, Kingman, AZ, USA

Since 1949 surveys of the fossil mammalian fauna of the Milk Creek locality have taken place from institutions within and outside of Arizona. A biochronologic estimate of the mammalian taxa supports a Clarendonian NALMA age range (9.0 to 12.5 Ma) for the fossil deposits.

By far the most abundant fossil materials located in the Milk Creek deposits are two taxa of camelids (*Protolabis coartatus* and *Michenia yavapaiensis*). In a 1956 fossil survey of the Milk Creek formation, Ted Galusha recovered 313 identified mammal specimens of which 91.7% were these two camelid taxa. Estimated biomass

estimates of eleven *Protolabis coartatus* specimens from Milk Creek, using astragali area, ranged from 68 to 92 kg. Five specimens of *Michenia yavapaiensis* were calculated to range between 36 and 65 Kg.

Such abundant camelids would have provided rich food sources for large predatory species. One such predatory species known from the Milk Creek formation was the large canid Borophaginae *Epicyon haydenii*. Direct ecological interactions between the Borophaginae and Camelidae at Milk Creek were unknown until coprolites of Borophaginae were located in 2023 (I. Bevers) and 2024 (G. Hernandez and J. Bevers). The coprolites are composed of a mix of highly degraded bone matrix also containing clumped and randomly distributed discernable bone fragments. This material supports the bone crushing and digestive adaptations of *Epicyon haydenii*.

Prior notice of Borophaginae coprolites is practically nonexistent. The first publication of such is from the Hemphillian aged Mehrten Formation (5.3-6.4 Ma) of California (Wang et al. 2018), with coprolites supported from *Borophagus parvus*. Here we present on the first such coprolites located in Arizona, representing a prior North American Land Mammal Age and a distinct taxon of the Borophaginae.

The Borophaginae were a widespread North American group of canids with ecological overlap with the Hyainidae (Wang et al. 2018). Part of this was a convergent, though distinct, specialized morphological adaptations to bone crushing. This combined predatory and bone crushing scavenging niche is no longer present in any large mammalian species across North America.

Though all the Milk Creek coprolites located had surface exposure and weathering, three of these are suitably intact for diameter measurements and contain noted bone fragments. The maximum cross section in these coprolites (MC 236) is 42.7 x 30.8 mm. Two of the coprolites are extensively eroded and cannot be sized with any certainty. These have all been found in a single locality. This same Milk Creek formation locality is also noted for abundant camelid fossil materials. Identifiable bone fragments from the coprolites support that *E. haydenii* preyed and scavenged upon these ungulates.

SOMETHING FISHY IN THE DEVONIAN: AN ASTEROLEPIS BONE-BED NEAR PAYSON, ARIZONA

BOARDMAN, Grant S.^{1,2}

¹Arizona Museum of Natural History, 53 N. MacDonald, Mesa, AZ, USA

²Brightmont Academy, Scottsdale, AZ, USA

A fossil bone-bed from the MSM 00-51 locality, Upper Devonian (Frasnian) Martin Formation, near Payson, Arizona represents a mono-taxic mass death assemblage of the antiarch (Placodermi) *Asterolepis*. *Asterolepis* is a fairly cosmopolitan genus of fish with dermal skeletal armor enclosing the head, thorax, and pectoral appendages, and heavily scaled tails. The specimens at MSM 00-51 are identified as *Asterolepis radiata* based on the radiating rows of star-burst tubercles and ridges ornamenting dorsal thoracic and mixilateral plates.

As many as 62 individuals (NISP = 62) of various ages are represented in an area of ~14 m² (~154 ft²). Many are articulated, though portions of dorsal armor have been eroded from several specimens, and the majority are rightside up (i.e. not belly-up). The fossils were found in a thin layer of mudstone 4-5 cm thick, bounded above and below by limestone. No invertebrates have been noted in the fossil layer, and a lack of sedimentary structures (such as ripple marks or mudcracks) has led to a hypothesized scenario in which the fish died under anoxic conditions. A story we might tell is one in which, during river flooding, a mixed-aged group of *Asterolepis* swam into a tidal channel or oxbow on the tidal flats and as the water receded slowly suffocated and died *en masse*. Further lithological testing is necessary to establish facies, and some geochemical testing may also further gird this interpretation.

DIVERSITY OF OPHIOMORPHA AND AQUATIC FAUNA NEAR THE MENELEE FORMATION-CLIFF HOUSE SANDSTONE CONTACT (CAMPANIAN), NEW MEXICO, U.S.A.

BRAND, Harrison¹, Emelia Dolson¹, Heather F. Smith^{2,3}, Benjamin F. Mohler^{1,4}, Merlyn Heck¹, F. Joe Reavis¹, Tyler Greaves¹, and Brent Adrian²

¹Southwest Paleontological Society, Mesa, AZ, USA

²Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University, Tempe, AZ, USA

³Department of Anatomy, Midwestern University, Glendale, AZ, USA

⁴Department of Geosciences, University of Arizona, Tucson, AZ, USA

The Cliff House Sandstone (Sst.) in northwest New Mexico preserves a rich but underexplored marine fauna, including marine reptiles, invertebrates, fish, and trace fossils. Near its boundary with the underlying Menefee Formation, two *Ophiomorpha* ichnospecies (*O. nodosa*

and *O. annulata*), the bivalve *Inoceramus barabini*, and a tooth from the primitive goblin shark *Scapanorhynchus texanus* have been identified. The shark tooth, relatively large and likely from the upper anterior jaw, features a slender, straight cusp with mesiodistal narrowing of its base proximal to the jaw and without cusplets. This is the youngest occurrence of *Scapanorhynchus* from the San Juan Basin and the first report of the genus from the Cliff House Sst. Very little has been written on the diversity of fossil chondrichthyans in the Cliff House Sst. and future research should include a taxonomic analysis of the local assemblage. *Inoceramus barabini* is a pteriomorphian bivalve species resembling modern *Pteria* oysters. The genus *Inoceramus* was cosmopolitan in its range, likely due to their planktotrophic larval stage and were extremely successful in marine continental shelf and estuarine environments. While fossils of inoceramid bivalves are quite common in Upper Cretaceous strata, they are excellent paleoenvironmental indicators. Their occurrence suggests a shallow to mid-shelf marine or estuarine setting with soft, muddy substrates and potentially poorly oxygenated waters. Beds of *I. barabini* at the Menefee–Cliff House transition suggest a phase of nearshore marine conditions preceding the deposition of the larger sandstone units that characterize the latter formation. *Ophiomorpha* trace fossils, often attributed to crustacean burrows, can provide valuable paleoenvironmental insights. *Ophiomorpha annulata* burrows feature transverse rows of elliptical pellets forming continuous rings, while *O. nodosa* displays irregularly distributed, ovoid, discoid, or polygonal mammilliform pellets. Burrow fragments were measured and analyzed from two localities a mile apart, revealing significant differences in external and internal diameters. The flatter burrows from one locality were from horizontally-dominant systems potentially indicative of lower-energy environments. Both species were present at each locality, suggesting that burrow morphology can reflect depositional conditions as well as taxonomic differences. *In situ* burrow networks showed irregular maze and boxwork configurations. These findings provide a paleoecological glimpse into the Menefee–Cliff House transition in the south-central portion of the San Juan Basin. The presence of *Ophiomorpha* species highlights a more diverse burrow-inhabiting fauna than previously recognized. The ichnogenus is commonly associated with shallow marine settings influenced by waves and currents, supporting the interpretation of a transgressive-regressive

sequence. Horizontal beds of *I. barabini* indicate an underlying mid-shelf marine or estuarine phase transitioning from terrestrial Menefee deposits. The discovery of *S. texanus* provides evidence for deeper mid-shelf marine conditions in younger strata within the Cliff House Sst. As a predator with a high trophic position, its presence implies a food web that includes smaller prey species (teleost fishes, cephalopods, and crustaceans). Together, these findings refine our understanding of paleoenvironmental dynamics and marine ecosystems during the Menefee–Cliff House transition, and future work will aim to improve the resolution of taxonomy and depositional structure during this interval.

A NEW SPECIMEN OF *LATOPLATECARPUS WILLISTONI*

BURKE, Bethany¹, Trevor Rempert², Brennan Martens³, Alexander Vinkeles Melchers⁴, and Kyle Marson⁵

¹The Heritage Museum of Texas Hill Country, Canyon Lake, TX, USA

²Case Western Reserve University, Cleveland, OH, USA

³University of Alberta, Edmonton, AB, CAN

⁴Paleontica Foundation, The Hague, The Netherlands

⁵Independent researcher, Sheffield, UK

Plioplatecarpinae is a subfamily of mosasaurid squamates that were taxonomically diverse and biogeographically widespread in the oceans and intercontinental seas of the Late Cretaceous. Recent excavations in the upper Campanian of the Pierre Shale in southwestern South Dakota have produced a partial skeleton of the plioplatecarpine *Latoplatecarpus willistoni*.

L. willistoni is known from the Sharon Springs Member (ca. 80.5 Ma) and equivalent strata of the Northern Great Plains region. Within this layer, it is sympatric with the other Campanian Western Interior Seaway plioplatecarpines, *Plioplatecarpus peckensis* and "*L.*" *nichollsae*.

The new material is referred to *L. williston* based on the following suite of characters: frontal exhibiting a well-developed median dorsal keel; frontal preorbital width greater than interorbital width; frontal alae acuminate and transversely oriented; ventrolateral processes of the frontal anteriorly diverging; frontal involvement in the anterior border of the parietal foramen; parietal foramen pyriform (pear-shaped); dorsal border of the coronoid concave; coronoid posterior process low; tympanic cavity of quadrate planar; and marginal teeth tall, posteromedially hooked, and strongly striated.

THE CURIOUS CASE OF *APPALACHIOSAURUS* "LONG ARMS"

CURTICE, Brian¹

¹Arizona Museum of Natural History, 53 N. Macdonald Mesa, AZ 85201, USA

Appalachiosaurus montgomeriensis is a partial Campanian-aged (~78 mya) theropod skeleton excavated in 1982 as a "bloat and float" from the marine Demopolis Chalk Formation of Montgomery County, Alabama. It was formally described by Carr, Williamson, and Schwimmer in 2005 as a basal tyrannosaur and not an *Albertosaurus* contrary to all previous academic appearances. Carr et al. figured and described the remains of what is the most complete Appalachian theropod skeleton yet known, consisting of a reasonably complete skull, vertebrae, partial pelvis, and portions of the hind limbs from a not-fully-grown individual. No limb or shoulder girdle elements were found, yet forelimb material has been repeatedly referenced in cladistic analyses, academic papers, and popular media. The earliest suggestion of forelimb material appears to be in 2004, where a coracoid is scored as being present. Interestingly, the name *Appalachiosaurus* appears for the first time in the same matrix, a year before its formal publication. Lamb resumed working at the McWane Center in 2006 where the *Appalachiosaurus* bones are curated. Via personal communication in 2024, he stated "So, since the skeleton was almost identical in size to Triebold's *Albertosaurus* skeleton, I hatched a plan to modify the *Albertosaurus* to make it look like *Appalachiosaurus*. I scanned the humerus, modeled in missing portions, scanned the rest of Triebold's *Albertosaurus* arm and scaled it up to size and then 3-D printed it. I added the third digit, thinking it made sense if it was that primitive, it would have a third digit, and taking some clue from *Dryptosaurus* and its outsized manus claws. I then shipped the prototyped arm to Triebold to mold and cast." The bone he identified as a humerus is unequivocally a pubis. Yet, in 2008, a long-armed, three-fingered *Appalachiosaurus* was presented to the public. Given its close relationship to other Late Cretaceous tyrannosauroids, *Appalachiosaurus* likely exhibited proportionally short arms ending in two digits, consistent with the clade's overall trend toward reduced forelimbs.

Recently, *Appalachiosaurus* was scored as possessing an ulna, humerus, and forelimb, despite lacking any forelimb bones. When re-running their seven forelimb characters with "?" forelimb character states, the tree topology remains identical but becomes three steps shorter.

Additionally, this matrix scored *Dryptosaurus* and the Dinosaur Park tyrannosaurid as edentulous, and one character for *Deinonychus* was given a state out of range for the character. The importance of verifying the state of characters listed in a matrix can't be stressed enough; optimally, physically touching specimens would be the norm before scoring.

Another recent study noted a "supposed fossilized humerus" in their opening paragraph and indicated humerus measurements appeared in Tables 1 and 2. No measurements were provided, and no humerus reference appears in the paper aside from their introduction.

PALEOECOLOGY AND BIOGEOGRAPHY OF QUICK POCKET, A VERTEBRATE MICROFOSSIL ASSEMBLAGE FROM THE "MESAVERDE" FORMATION (CAMPANIAN) OF THE BIGHORN BASIN, PARK COUNTY, WYOMING, U.S.A.

FARKE, Andrew A. ^{1,2}, Andres Caballero², Lauren Duffy², Jared Heuck¹, Frances Hinch², Jarra Jallow², Bailey Jorgensen¹, Matthew Jung², Dorothy Ma², Kaitlyn Metz², Andrew Paik², Luke Smith², Wen Yang², and Christina Young²

¹Raymond M. Alf Museum of Paleontology at The Webb Schools, Claremont, CA, USA

²The Webb Schools, Claremont, CA, USA

The Campanian-aged "Mesaverde" Formation of the Bighorn Basin in Wyoming preserves an important geographic and temporal interval for understanding the ecosystems of Laramidia during the Late Cretaceous, but remains relatively undersampled. In 2019, a field crew from the Raymond M. Alf Museum of Paleontology (RAM) discovered the Quick Pocket locality (RAM V2019026), a vertebrate microfossil site from the middle third of the formation in Park County, Wyoming. Bulk samples were collected in 2021 for subsequent wet screening, with a team of Webb students focused on matrix picking and fossil identifications. A subsample of vertebrate microfossils extracted from *in situ* quarried rock is analyzed here (n=389), supplemented by observations from additional screenwashed samples of *in situ* and weathered surface material (n>1,100).

Actinopterygians dominate the overall assemblage, representing approximately 62% of identifiable elements. This includes *Paralbula* sp. (42% of total elements), *Vidalmiinae* (11% of total elements), and *Lepisosteidae* (8% of total elements), in addition to *Acanthomorpha* indet. Chondrichthyans are another common component of the assemblage (24% of total

elements), with the rhinobatoids *Cristomylus* and *Pseudomyledaphus* dominant (15% of total elements), followed by the orectolobiform *Cantioscyllium bighornensis* (7% of total elements) and rare specimens of the hybodonts *Lonchidion* sp. and *Meristodonoides* sp. Teeth referable to Mesoeucrocodylia and Eusuchia comprise 6% of the sample. Dinosaurs are dominated by Hadrosauridae (6% of total elements in the assemblage and 89% of all dinosaur elements). Small theropods include Dromaeosauridae indet., *Richardoestesia gilmorei*, and *R. isosceles*, in addition to Tyrannosauridae and Ornithomimidae. A single tooth from a non-cerapodan neornithischian may be orodromine. Turtles represented in the site include Trionychidae, Baenidae, *Adocus*, and Helochelydridae. Multituberculata indet., Scincomorpha indet., and Albanerpetontidae (a first record for the “Mesaverde” Formation of Wyoming), also occur in the site.

The trophic nucleus (top 80% most abundant taxa) is dominated by euryhaline taxa, and definitive marine taxa are absent. The Quick Pocket site is thus interpreted as a coastal plain environment, well inland from marine conditions but not completely disconnected. This is consistent with the site’s sedimentology and stratigraphic position within the “Mesaverde” Formation.

The rhinobatoids and helochelydrids at Quick Pocket are consistent with a middle Campanian age, roughly the same as the Wahweap Formation in Utah, lower Judith River Formation in Montana, and Foremost Formation in Alberta. The Quick Pocket site represents the known northern limit of *Lonchidion* for this age. The high abundance of *Paralbula* is more concordant with assemblages from the Foremost Formation than the Wahweap Formation, but orectolobiforms are much rarer in the Foremost Formation than in Quick Pocket. Unlike the Foremost or Judith River formations, champsosaurs are absent at Quick Pocket. These latitudinal differences might be attributed to variation in temperature, rainfall, or other parameters, but further study is required. This study shows the combined potential for occurrence and abundance data to understand latitudinal variation in the middle Campanian of Laramidia, and how vertebrate microfossils hold an understudied piece of this story.

Support: All fieldwork was completed under permit from the US Bureau of Land Management-Wyoming (permits PA19-WY-276, PA21-WY-288, PA21-WY-289). Funding was provided by the David B. Jones Foundation and the Augustyn Family Research Fund.

A COMPARISON OF DENTAL FEATURES BETWEEN OTODONTIDAE AND LAMNIDAE

GOODE, Ben¹

¹School of Education, Western Governors University, Salt Lake City, UT, USA

Lamniforms within the extinct family Otodontidae are often compared to those of the family Lamnidae, which includes iconic extant sharks such as the great white *Carcharodon carcharias* and the makos of the genus *Isurus*. While basal members of both the otodontids and lamnids feature a “mackerel shark tooth” type design that is characterized by a long median cusp with smaller lateral cusplets and a bilobate tooth base, their dentition structures are unlike. Among particular importance are two distinct differences: 1) the presence of parasymphyseal teeth throughout the family Otodontidae, which is not typical of any species within Lamnidae, and 2) all known members of Lamnidae possess a reduced UA3 tooth position that separates the anterior and lateral teeth; a reduced transitional tooth between anterior and lateral positions is not present in most otodontids, except for the basal *Kenolamna*, and possibly *Palaeocarcharodon*. These two key differences indicate that basal lamnids (i.e. *Isoalamna*) did not evolve from an otodontid and may have not shared a common ancestor with otodontids since the Early Cretaceous. Importantly, these dental dissimilarities strongly indicate diminishing reliability with using modern sharks (i.e. *C. carcharias*) as a proxy for *Carcharocles megalodon* in research, given that these animals may be more distantly related than previously thought.

INTEGRATION AND MODULARITY IN THE SLOTH SCAPULA

GRASS, Andy¹

¹ Department of Anatomy, A.T. Still University School of Osteopathic Medicine in Arizona, Mesa, AZ, USA

There are currently two extant genera of sloths, the three-toed *Bradypus*, and the two-toed *Choloepus*. Both of these genera exhibit a rather unusual suspensory lifestyle, and similar adaptations to their forelimbs and hindlimbs to facilitate this lifestyle. However, phylogenetic analyses do not place these two genera as closely related. Early morphological analyses of crania typically recovered *Choloepus* as part of the Megalonychidae family, which included the extinct sloth *Megalonyx*, and

Bradypus as a monotypic family basal to all other sloths. More recent molecular and total evidence analyses have grouped *Choloepus* with Mylodontids such as *Paramyodon*, and *Bradypus* as a megatherioid along with giants like *Megatherium*. Regardless of the specific phylogeny used, this continuous result of distant relation has led to conjecture that their shared suspensory lifestyle must be an example of convergence. However, evidence from dental patterns and scapula shape also indicate that heterochrony may be an issue as well.

One of the morphological differences between these two genera is that the scapula of *Bradypus* does not possess an ossified coracoacromial arch, where the acromion process and coracoid process fuse, a feature present in *Choloepus* and all other observed sloths. This unusual feature has only been observed in one other animal, a small bat from New Zealand. The fusing of two otherwise separate growth centers may have an effect on growth patterns in the scapula, particularly modularity and integration.

The scapula is generally divided into four modules based on ossification centers: the blade, the spine (including the acromion process), the glenoid fossa, and the coracoid process. Geometric morphometric landmark measurements, including sliding semi-landmarks, were taken on the scapulae of both modern sloth genera to determine if there were any differences in integration and modularity between these four modules in scapulae that possess a coracoacromial arch and those that do not. In most pairwise comparisons between the four modules, *Choloepus* scapulae were indeed more integrated than *Bradypus*. However, a few *Bradypus* scapulae, presumably from older individuals, actually do possess an ossified coracoacromial arch. When these specimens are added to the analysis, most pairwise comparisons of the four modules in *Bradypus* scapulae became more integrated. This result supports the idea of heterochrony between *Bradypus* and *Choloepus* and could possibly be responsible for some of the phylogenetic uncertainty between these two genera.

SLOTH UNGUALS AND CLAW SHEATHS: COMPARISONS BETWEEN TAXA AND IMPLICATIONS FOR XENARTHAN LOCOMOTOR HABITS

GRASS, Andy¹, Magda N. Muchlinski², Amanda D. Melin³, Carrie C. Veilleux⁴, and Heather F. Smith⁴

¹Department of Anatomy, A.T. Still University School of Osteopathic Medicine in Arizona, Mesa, AZ, USA

²Anatomical Sciences Center, Oregon Health and Science University, Portland, OR, USA

³ Department of Anthropology and Archaeology, University of Calgary, Calgary, AB, CAN

⁴ Department of Anatomy, Midwestern University, Glendale, AZ, USA

Despite the restricted morphology of modern sloths, extinct sloths showed a wider range of morphologies and locomotor habits. This includes hypotheses of fossorial behavior, a trait that they share with the other xenarthran clades, anteaters and armadillos, both of which are well known for digging and burrowing. Extinct sloths have been associated with digging for food, as well as possibly being responsible for large paleoburrows with distinct claw marks on the walls. This potential behavior has been studied by assessing forearm anatomy and musculature, as well as curvature of the ungual phalanges, and, when available, the claw sheath. These studies have both supported and refuted the hypotheses of giant ground sloth burrowing ability, depending on the taxon. This anatomy may also have been well suited to being co-opted to the current suspensory lifestyle of modern sloths.

This study uses microCT scans of both extant and extinct sloth and other xenarthran unguals with the claw sheaths still attached to compare the shapes and relative volume of the bony core and the sheaths. In general, modern sloths have a higher claw sheath volume compared to the ground sloths, with the tip of the sheath extending farther out from the bony core. Additionally, in ground sloths, more of the sheath volume is located along the dorsal surface of the claw, while in modern suspensory sloths more of the sheath volume is located on the ventral surface of the claw. Both of these characteristics fit with what might be expected from a transition from digging and burrowing to hanging from tree branches. During digging, much of the force is concentrated on the ventral surface of the claw, so the bony core being closer to the sheath on this side may help reinforce it against those forces. The longer and higher ventral volume sheath of modern sloths would be more prone to breakage during higher stress activities like burrowing and digging but better suited to lower energy hanging and climbing. Additionally, while *Choloepus* and *Bradypus*, the two genera of modern sloths, both show the same patterns described, *Bradypus* seems to have a more extensive claw sheath than *Choloepus*. This morphology could potentially reflect their differing ancestries. In most recent phylogenies, *Choloepus* is more closely related to ground sloths that have been associated with digging behavior, and *Bradypus* to those that are interpreted as having been less fossorial.

Funding: This work was supported in part by the National Science Foundation (#2218023).

A NEW LATE PERMIAN YOUNGINID BEARING A TYMPANIC FOSSA CLARIFIES THE EVOLUTION OF THE EARLY NEODIAPSID SKULL

JENKINS, Xavier A.^{1,2}, Valentin Buffa⁴, Enele Twala⁴, Cy Marchant², David P. Ford^{3,5}, Claire Browning⁶, Vincent Fernandez^{4,7}, Kathleen Dollman^{4,7}, Jennifer Botha³, Jonah N. Choiniere⁴, Roger B. J. Benson^{4,8}, and Brandon R. Peacock^{1,2}

¹Idaho Museum of Natural History, Idaho State University, Pocatello, ID, USA

²Department of Biological Sciences, Idaho State University, Pocatello, ID, USA

³GENUS: DSTI-NRF Centre of Excellence in Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

⁴Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, South Africa

⁵Natural History Museum, South Kensington, London, UK

⁶Iziko Museums of South Africa, P.O. Box 61, Cape Town, 8000, South Africa

⁷European Synchrotron Radiation Facility, 71 Avenue des Martyrs, 38000 Grenoble, France

⁸American Museum of Natural History, New York, NY, USA

Crown reptiles are descended from a common ancestor that lived in the late Permian alongside several lineages of stem reptiles, including their closest relatives, the ecologically diverse non-saurian Neodiapsida. Understanding this larger radiation is central to understanding the origins of derived characteristics that set crown reptiles apart from their contemporaries, including key adaptations for tympanic hearing. However, the highly-specialized ecomorphology and two-dimensional preservation of most non-saurian neodiapsids has complicated interpretations of their anatomy. Here, we describe a new taxon of late Permian neodiapsid represented by several complete skeletons preserved in a burrow aggregation from the Karoo Basin of South Africa (~258 Ma). This taxon displays a surprising combination of seemingly primitive and derived anatomy, including multiple rows of teeth on the transverse flange of the pterygoid, a cluster of denticles on the parabasisphenoid, and a tympanic fossa on the quadrate. Phylogenetic analysis recovers this taxon as sister to the well-known *Youngina capensis*, expanding the hitherto monospecific Younginidae, and

establishing it as the earliest-diverging group of neodiapsids. A comprehensive restudy of several classical non-saurian neodiapsid taxa and other Paleozoic stem reptiles demonstrates that many 'saurian' features (e.g., the cephalic condyle and tympanic fossa on the quadrate, and loss of the lower temporal bar) originated amongst crownward stem-reptiles. This anatomical and phylogenetic framework sets the stage for future investigations on the subsequent radiations of the reptile crown group in the Triassic, including the lines leading to dinosaurs, crocodylians, and lepidosaurs.

NEW TYRANNOSAUR TEETH FROM THE CAMPANIAN MENELEE FORMATION OF NEW MEXICO

KUDLINSKI, Jake¹, Benjamin F. Mohler^{1,2}, Brent Adrian³, and Heather F. Smith^{3,4}

¹Southwest Paleontological Society, Mesa, AZ, USA

²Department of Geosciences, University of Arizona, Tucson, AZ, USA

³Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University, Tempe, AZ, USA

⁴Department of Anatomy, Midwestern University, Glendale, AZ, USA

Recent fieldwork in the lower to middle Campanian Allison Member of the Menefee Formation in northwest New Mexico has uncovered theropod dental material consistent with tyrannosaurid morphology. The Menefee Formation is part of the Mesaverde Group located in northwest New Mexico and southwest Colorado. Menefee sediments have yielded a diverse array of dinosaur taxa, including the ankylosaurian *Invictarx zephyri*, the brachylophosaurin hadrosaur *Ornatops incantatus*, and the oldest known centrosaurine, *Menefeeeceratops sealeyi*. *Dynamoterror dynastes*, a medium-sized tyrannosaurine, is the largest known Menefee terrestrial predator and the only tyrannosaurid species recognized from the formation. Notably, its hypodigm lacks a dental component. Other Campanian tyrannosaurid species from southern Laramidia include *Teratophoneus currieri* from the Late Campanian Kaiparowits Formation of Utah and *Bistahieversor sealeyi* from the Late Campanian Fruitland and Kirtland Formations, in addition to a small tyrannosaurid *Suskityrannus hazelae*, known from earlier Turonian deposits of the Moreno Hill Formation in the nearby Zuni Basin of New Mexico. Tyrannosauridae were large, predatory theropods that thrived during the Late Cretaceous in North America, with species distributed across both Laramidian and Appalachian land masses. While these

apex predators are well-represented beginning in the middle Campanian, their presence in older deposits is less well-documented. Contemporaneous, yet unnamed, tyrannosaurid species have also been reported from the Aguja Formation of Texas and the Wahweap Formation of Utah.

The two new dental specimens described here were collected in 2024 from the apex of a hill containing other theropod bone fragments, adocid and trionychid turtle pieces, and other unassociated vertebrate fossils. The new dental fragments can be referred to Tyrannosauridae based on their relatively large size compared to other coeval theropods (i.e., troodontids and dromaeosaurids) and a labio-lingually compressed crown. Fragments were reconstructed to form the apex of a tooth with preserved mesial and distal carinae and a crown that is lenticular in cross-section, consistent with tyrannosaurid morphology. Denticles are well preserved along each carina and consistent with previously published tyrannosaur teeth. Following a published terminology for non-avian theropod teeth to facilitate future comparisons, we qualitatively described the new tooth material in detail. While the teeth of the known Menefee tyrannosaurid *D. dynastes* have not been described, and therefore we cannot unequivocally attribute the new dental specimens, there is currently no evidence of multiple tyrannosaurid species in Menefee deposits. The new fossils represent the first described tyrannosaurid dental material from the Menefee Formation, which supplements and improves the local theropod record and provides additional morphological data for comparisons with related specimens. Dental discoveries are rare for all taxa in the Menefee, but future occurrences may further expand our knowledge of tyrannosaurs in the Menefee Formation and inform regional paleobiogeographic models.

FROM THE SCANNER TO THE CLASSROOM: SKULL RECONSTRUCTION TECHNIQUES VIA μ CT SCANS AND 3D DIGITAL MODELS

MARCHANT, Cy J.¹, Xavier A. Jenkins^{1, 2}, and Brandon R. Peacock^{1, 2}

¹Idaho State University, Department of Biological Sciences, Pocatello, ID, USA

²Idaho Museum of Natural History, Pocatello, ID, USA

Rigorous scientific illustrations play a pivotal role in visual communication, both in drawing attention and clarifying ideas. Paleontology, in particular, strongly benefits from illustrated reconstructions of fossil animals that provide a glimpse of the probable life appearance of

long-dead species. While large, charismatic fossil taxa often receive considerably more attention and are easier to visualize, reconstructing the arguably more scientifically informative anatomies of small specimens poses distinct challenges resulting from their fragility and intricacy. High-resolution micro-computed tomography (HR μ CT) is an increasingly familiar technique that can help to address these obstacles. Here, we present a workflow from digitization to reconstruction, using a case study of HR μ CT scans of a new diminutive neodiapsid reptile from the late Permian (~258 Ma) of the Karoo Basin, South Africa. This new taxon is represented by several associated individuals with articulated skulls that were scanned at the European Synchrotron Radiation Facility, providing unprecedented detail into its internal anatomy.

After scanning and segmentation, each bone was exported to Blender to assemble the majority of the three skulls. To address taphonomic damage to the skulls, we rearticulated skewed fragments and smoothed deformed surfaces. For optimal clarity in our composite reconstruction, we identified the most complete and least distorted bones among the three individuals and reassembled them in approximate life position based on 1) observable facets; like those on the post-orbital skull (i.e. postfrontal, postorbital, jugal); and 2) established bony contacts. To balance presentation and fidelity to the preserved anatomy, the final 3D model features a right half perfectly mirrored from the "idealized" left side for all paired elements. When 3D-printed and enlarged, models such as these have many important uses in research, education, and museum collections, allowing visiting researchers and general audiences to better understand its morphology. The model was then screen-captured in key anatomical views (e.g., lateral, dorsal, occipital), from which we derived simplified 2D line reconstructions. In concert with raw and processed 3D digital representations, line illustrations help facilitate further anatomical study in a more accessible format. Quality line drawings of skull reconstructions can be helpful for the interpretation of fossils, even when a high-quality scan/model is available, and facilitate comparisons with closely related animals.

Funding: European Synchrotron Radiation Facility; The David B. Jones Foundation; Idaho State University

FRONTOPARIETAL MORPHOLOGY OF *XENODENS CALMINECHARI* REVEALED BY A NEW SPECIMEN FROM THE MAASTRICHTIAN PHOSPHATES OF MOROCCO

MARTENS, Brennan¹, Trevor Rempert², Bethany Burke³, Alexander Vinkeles Melchers⁴, and Kyle Marson⁵

¹University of Alberta, Edmonton, AB, CAN

²Case Western Reserve University, Cleveland, OH, USA

³The Heritage Museum of Texas Hill Country, Canyon Lake, TX, USA

⁴Paleontica Foundation, The Hague, The Netherlands

⁵Independent Researcher, Sheffield, UK

Commercial phosphate excavation in the Maastrichtian of Morocco has yielded several new specimens of the bizarre mosasaurid *Xenodens calminechari*, a rare species previously known from a single maxilla. Here, we describe a partial skull consisting of the maxillae, frontal, parietal, postorbitofrontal, and temporal elements, as well as an unassociated dentary and isolated teeth found within the same horizon.

The newly discovered frontal is approximately rectangular in shape, with parallel preorbital margins, constriction between the orbits, and expansion at the posterior alae. Alae are acute and posterolaterally oriented. The parietal foramen is ovate and without contribution from the frontal. The postorbitofrontals buttress the frontal posteriorly and the parietal laterally. The squamosal processes of the postorbitofrontals diverge, producing an expanded temporal region.

Consistent across all specimens is the remarkable dental adaptation of squaliform-like cutting teeth. Tooth crowns are close-packed to two tooth crowns per alveolar crypt and sit elevated from the dental parapet by fused tooth roots collectively forming a continuous ridge of bone. These elevated “tooth pedicles” suggest a potentially unique implantation and dental replacement strategy. Isolated teeth are typically found in pairs as adjacent crowns are shed with a section of the tooth pedicle.

Preliminary analysis of the new material suggests a close relationship with durophagous mosasaurids in the tribe Globidensini. CT imaging of mandibular elements is forthcoming to better understand tooth attachment, development, and replacement.

THE EARLIEST XANTUSIIDS, WITH MUSINGS ON TAXONOMY, PHYLOGENY, ALLOMETRY, AND PAEDOMORPHOSIS

McCord, Robert D. ¹

¹Arizona Museum of Natural History, 53 N. Macdonald St. Mesa, AZ, 85201, USA

This study presents the discovery of *Paleoxantusia* specimens from the Black Toe local fauna in the Nacimiento Formation of the San Juan Basin, New Mexico, collected by University of Arizona field teams in 1976 and

1977. The Black Toe local fauna is dated to the earliest Paleocene, specifically the Puercan North American Land Mammal Age, making these specimens the earliest known *Paleoxantusia*—and by extension, the earliest members of the Family Xantusiidae proper.

A total of ten *Paleoxantusia* specimens were recovered, comprising eight splenio-dentaries and two maxillae. These specimens are most similar to *P. fera* but also show significant differences that suggest they may represent a distinct species. No formal phylogeny for *Paleoxantusia* exists, likely due to the paucity of characters found in a splenio-dentary, the dominant element known, although development of a phylogenetic hypothesis remains a valuable and important goal. If it were easy, someone would have done it.

The complexity of character states within the Family Xantusiidae is further compounded by issues of allometry and potentially paedomorphosis. Within a genus, characters often exhibit allometric variation — changes in form that preserve function. Between genera, the slope remains similar but the intercept changes — leading to similar forms serving different functions. Additionally, there is evidence suggesting the possible role of paedomorphosis in Xantusiidae, which may be a driver of these intergeneric differences.

In conclusion, the Black Tow Local Fauna specimens are xantusiids, specifically *Paleoxantusia* as presently understood. They are the earliest *Paleoxantusia* and the earliest xantusiids *sensu stricto*. They are likely a new species. The phylogenetic position of these specimens and indeed within and among the *Paleoxantusia* have not been determined due to the lack of characters and confounding factors of allometry and likely pedomorphosis.

THE GOLDEN SHORES MAMMOTH (*MAMMUTHUS COLUMBI*) FROM THE COLORADO RIVER CORRIDOR, MOHAVE COUNTY, ARIZONA

McCULLOUGH, Gavin ¹, Phil Gensler², Augustine P. Potor³, and Robert D. McCord¹

¹Arizona Museum of Natural History 53 N. Macdonald St. Mesa, AZ, 85201, USA

²Bureau of Land Management, New Mexico State Office, 301 Dinosaur Trail, Santa Fe, NM, 87508, USA

³Bureau of Land Management, Lake Havasu Field Office, 1785 Kiowa Ave. Lake Havasu City, AZ, 86403, USA

A relatively complete specimen of *Mammuthus columbi* was excavated along the eastern slopes of the Colorado River valley on Bureau of Land Management land near Golden Shores, Arizona in 1991 after its discovery by a

local Gem and Mineral Society in 1989. At the time, this was one of the few mammoths known from the Colorado River corridor and still stands as the most complete. Excavations of the mammoth were undertaken under the direction of Dr. Larry Agenbroad and Dr. Jim Mead from Northern Arizona University, where they were housed until the closure of NAU's Quaternary Sciences Program, leading to its transfer to the Arizona Museum of Natural History. Vertebrate fossils other than mammoth were not noted from the locality at the time, though invertebrate fossils such as freshwater clams were observed within the sediments above the mammoth. Although the discovery and excavation were covered extensively by the media, and the specimen has been mentioned briefly in literature, the Golden Shores Mammoth itself has evidently not been officially reported. This may be due to the condition of the mammoth, which is generally stable but in need of more current conservation and preparation techniques. Screenwashed sediments from the locality are unknown, and BLM-permitted excavations and collections have not been undertaken in the intervening years. Future work with the Golden Shores Mammoth should include not only preparation/conservation of the existing material but also renewed field visits to the locality for additional collection and sampling.

A NEW COMPREHENSIVE PHYLOGENY FOR INVESTIGATING THE EVOLUTIONARY RELATIONSHIPS OF TRIASSIC MARINE REPTILES

McGAUGHEY, Gary A.¹, Xavier A. Jenkins^{1,2}, and Brandon R. Peacock^{1,2}

¹Idaho State University, Department of Biological Sciences, Pocatello, ID, USA

²Idaho Museum of Natural History, Pocatello, ID, USA

Ichthyosauromorphs and sauropterygians were two of the first tetrapod clades to enter the marine realm and evolve derived aquatic characteristics early in the Triassic. These clades' explosive evolutionary radiations and rapid ecomorphological diversity have created challenges in understanding their evolutionary relationships with other reptiles. The lack of transitional forms for these marine reptile clades that would document the marine transition has further complicated these issues, which makes it difficult to differentiate phylogenetically important features from convergent traits related to aquatic lifestyles. Currently, there are two primary hypotheses for the evolutionary relationships of these marine reptiles: 1) the origination of a single monophyletic clade of the major Triassic marine reptiles (Sauropterygia +

Ichthyosauromorpha) that has been dubbed the "marine reptile super clade"; 2) the two clades belong to different branches of the larger reptile radiation of the late Permian and Triassic. Most recent phylogenies tend to support the marine reptile super clade hypothesis, but the clade is poorly supported and these studies lack the taxonomic and morphological sampling of earlier-diverging Paleozoic stem reptiles. To address these issues we have incorporated Sauropterygia and Ichthyosauromorpha into a comprehensive phylogenetic dataset targeting all major radiations of Carboniferous, Permian, and Triassic reptiles. This matrix robustly samples the anatomical characteristics defining these reptile clades, including other aquatic reptile clades such as the Mesosauridae and Tangosauridae, allowing us to make broader inferences as to the influence of aquatic ecology on the reptile skeleton. Our preliminary phylogenetic analysis provides evidence that Ichthyosauromorpha and Sauropterygia are only distantly related, sharing a common ancestor with other Triassic reptiles in the late Permian. This hypothesis echoes previous hypotheses of their relationships, and does not find the marine reptile super clade as valid, contradicting the current leading hypotheses and suggests that reptiles invaded the marine realm through multiple independent transitions in the Early Triassic. Continued work adding more taxa and collecting more anatomical data is needed to fully understand the relationships between these two scientifically and culturally important clades.

MENEFEE MICROPALAEONTOLOGY: PRELIMINARY MICROFOSSIL ASSEMBLAGE REVEALS NEW PALEOECOLOGY AND LIKELY MARINE INFLUENCE IN THE ALLISON MEMBER, MENEFEE FORMATION (UPPER CRETACEOUS) OF NEW MEXICO

MOHLER, Benjamin F.^{1,2}, Harrison S. Brand², Jake R. Kudlinski^{2,3}, Heather F. Smith^{3,4}, and Brent Adrian³

¹The University of Arizona, Tucson, AZ, USA

²Southwest Paleontological Society, Mesa, AZ, USA

³Arizona State University, Tempe, AZ, USA

⁴Midwestern University, Glendale, AZ, USA

An ongoing annual survey of western exposures of the Menefee Formation (Juans Lake Beds, Allison Member), encompassing only a few square miles of badlands inspected over 14 years, has yielded significant fossil material. This work has greatly enhanced our understanding of paleoecology in the San Juan Basin of New Mexico in the early to middle Campanian. However, contrary to expectation in a terrestrial Late Cretaceous-aged

Laramidian deposit, vertebrate teeth and other microfossils have proven rare within our study area. This taphonomic bias towards large skeletal elements has resulted in a known faunal assemblage mostly populated by medium-sized and large terrestrial and semi-aquatic reptiles, while much is still unknown about the smaller animals that inhabited this same ecosystem. Dinosaurs (e.g., nodosaurids [*Invictarx*], brachylophosaurins [*Ornatops*], ceratopsids [*Menefeeeceratops*], and tyrannosaurids [*Dynamoterror*]) are well-represented, as are turtles, which include representatives of the families Trionychidae, Plastomenidae, Baenidae, Helochelydridae, Adocidae, and Nanhsiungchelyidae.

In contrast, invertebrate fossils are nearly absent in the study area, and fish fossils were similarly rare until 2023. Mammals, amphibians, small reptiles, and pterosaurs are also expected components of this ecosystem, though their fossils have not yet been found here. Since its discovery and initial excavation in 2023, a microsite dubbed the “Fishing Hole” has yielded durophagous teeth attributable to the alligatoroid *Brachychampsia* sp. as well as the rhinobatid fish *Pseudomyledaphus*. The “Fishing Hole” microsite is composed of fine-grained mudstones with inclusions of charcoaled petrified wood, and has also yielded carnivorous dinosaur teeth, as well as fossils of the terrestrial nanhsiungchelyid turtle *Basilemys*. In addition, two nearby harvester ant nests (both constructed by wild colonies of *Pogonomyrmex* sp.) have yielded numerous fish teeth belonging to the amiid fish *Melvius* sp., as well as a few lepisosteidid (gar) scales.

Microfossils were obtained from the “Fishing Hole” microsite through dissolution and sifting of sampled mudstone, followed by picking of the resulting material under a microscope. The ant hill microsites were initially sampled by surface collecting fossils from the exterior of the nest, and then by picking through matrix that was bulk sampled from the surface of these same nests. The presence of both terrestrial reptiles (*Basilemys* and carnivorous dinosaurs), semi-aquatic reptiles (*Brachychampsia* sp.), as well as marine fish (*Pseudomyledaphus* sp.) and aquatic, brackish tolerant turtles (adocids and trionychids) indicate a mixed-influence depositional setting for the “Fishing Hole”. In addition, the presence of both a brackish-tolerant marine rhinobatid fish (*Pseudomyledaphus* sp.) and a freshwater amiid fish (*Melvius* sp.) within very close geographic and stratigraphic proximity indicates likely marine influence into, and fluctuating salinity levels within, the aquatic Laramidian coastal habitats represented by the Juans Lake Beds sequence of the upper Menefee Formation.

Continuing research will involve additional sampling of microsites in the study area, as well as investigation into the fossil harvesting behavior of *Pogonomyrmex* to help determine the provenance of microfossils discovered on the surface of their mounds (i.e., mined during construction of the nest, collected on the soil surface within a certain radius of the nest, or both).

HOT-BLOODED PHYTOSAURS? A PARSIMONIOUS INTERPRETATION OF THE EVOLUTION OF ECTOTHERMY WITHIN CLADE PSEUDOSUCHIA SUGGESTS ENDOTHERMY WITHIN PHYTOSAURIA

NGUYEN, Brandon A. ¹

¹Chronicle Heritage, Phoenix, AZ, USA; Arizona State University, Tempe, AZ, USA

True endothermy within modern vertebrates is restricted to birds and mammals. Today, although crocodilians are the closest living relatives of birds, they are ectothermic, semi-aquatic ambush predators restricted generally to environments with warm climates. Morphological analyses suggest the ancestors of crocodilians were endothermic, with an endothermic metabolism possibly appearing as the ancestral condition within the clade Archosauria. Traditionally it has been thought that an evolutionary reversal to ectothermy was achieved by the neosuchians upon transitioning to the semi-aquatic ambush predator lifestyle that defines the group among extant members today.

Despite their frequent occurrence in the fossil record, phytosaurs — a clade of basal pseudosuchians distantly related to modern crocodilians — remain poorly understood. Based on an assumption that the semi-aquatic lifestyle was the driving catalyst for an evolutionary reversal to ectothermy, it would appear reasonable to assume that phytosaurs were ectothermic. Paleohistological studies however, show that several terrestrial species of notosuchians exhibited ectothermic metabolic rates. These results suggest that ectothermy evolved within Crocodylomorpha during the Middle Jurassic period, predating the semi-aquatic adaptations of neosuchians. If a semi-aquatic lifestyle is not directly linked to ectothermy in crocodyliforms, then the assumption that phytosaurs were ectothermic would require a second, independent reversal to ectothermy to have occurred within the basalmost members of Pseudosuchia — despite multiple histological studies suggesting that these early pseudosuchians were endothermic. Therefore, a phylogenetic and parsimonious perspective indicates that Triassic phytosaurs were endothermic. However,

direct paleohistological studies on phytosaurs are necessary to confirm this hypothesis. At present, there is no definitive evidence suggesting phytosaurs were ectothermic, in contrast to the well-documented reversal seen in neosuchians.

CAUDAL AUTOTOMY IN TANYSTROPHEIDS (REPTILIA, TANYSAURIA): THE FIRST KNOWN OCCURRENCE OF TAIL-SHEDDING IN ARCHOSAUFOMORPHS

PITTINGER, Dakota¹, Adam Marsh², Ben Kligman³, and Yara Haridy⁴

¹Department of Biological Sciences, Idaho State University, Pocatello, ID, USA

²Department of Science and Resource Management, Petrified Forest National Park, Petrified Forest, AZ, USA

³Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington DC, USA

⁴Department of Organismal Biology and Anatomy, The University of Chicago, Chicago, IL, USA

Caudal autotomy (tail shedding) is a defense mechanism observed in living lepidosaurs and salamanders. In salamanders and some lepidosaurs, the tail breaks through intervertebral autotomy, wherein the separation occurs between the tail vertebrae. Intravertebral autotomy, however, is the more common form of caudal autotomy in lepidosaurs and is facilitated via the breakage through transverse fracture planes near the center of individual vertebrae. Outside of living lizards and the tuatara, no other extant tetrapods exhibit this form of caudal autotomy. However, within the fossil record, there are tetrapod lineages outside of Lepidosauromorpha that possess transverse caudal septa that may have functioned as fracture planes. Transverse septa have been found in the caudal vertebrae of microsaur, captorhinids, mesosaurs, and tanystropheids. The aim of this study is to survey the latter clade (Tanystropheidae) for further evidence of caudal autotomy. Caudal autotomy in tanystropheids was first proposed in 1973 in a redescription of *Tanystropheus*. Since this time, other tanystropheids from around the world have been identified with caudal vertebrae containing transverse septa, including numerous specimens from the Intermountain West. For this study, 48 tanystropheid caudal vertebrae from the Upper Triassic strata of western North America were examined and photographed at Petrified Forest National Park and The Museum of Northern Arizona. This data set consisted of 43 specimens from PFV 456 (Thunderstorm Ridge) in Petrified Forest National Park, AZ, and five

from the *Placerias* and Downs quarries (MNA 207) near Saint Johns, AZ. In addition to the 48 Arizona specimens, photographs of tanystropheid caudal vertebrae from Ghost Ranch, NM, the Cow Branch Formation, VA, and the Besano Formation of the Southern Alps (including the specimens redescribed in the 1970s) were examined for the presence of septa as evidence of autotomy. In addition to macroscopic observation, tanystropheid caudal vertebrae from Petrified Forest National Park and the Argana Formation, Morocco, were scanned using X-ray microcomputed tomography (μ CT). The scans demonstrate that, in some specimens, the transverse septum extends through the entirety of the centrum dissimilar to captorhinids, but comparable to extant lepidosaurs. Nevertheless, there has been some doubt surrounding tanystropheids having autotomous tails, partially due to the aquatic to semi-aquatic lifestyle and caudal propulsion hypothesized for these reptiles. However, based on their limb proportions and pes anatomy, it is likely that tanystropheids relied on hindlimb-driven propulsion through the water instead of relying predominantly on tail-driven propulsion. Therefore, a tanystropheid's ability to navigate its environment would not be drastically inhibited if it were to shed its tail to evade a predator. Additionally, caudal autotomy provides further evidence in support of the hindlimb-driven propulsion hypothesis. These insights into tanystropheid locomotion, along with the transverse caudal septa identified in this study, indicate that tanystropheids may have been capable of shedding their tails, making this the first known occurrence of this defense mechanism in archosauromorphs.

GOMPHOTHERES ON THE MENU: THE TERMINAL PLEISTOCENE ARCHAEOLOGICAL AND PALEONTOLOGICAL RECORD AT EL FIN DEL MUNDO, A CLOVIS KILL SITE IN THE SONORAN DESERT OF NW MEXICO

SÁNCHEZ-MORALES, Ismael¹, Kayla B. Worthey², Guadalupe Sanchez³, and Vance T. Holliday⁴

¹Arizona Museum of Natural History, 53 N Macdonald, Mesa, AZ, 85201, USA

²American School of Prehistoric Research, Harvard University, 11 Divinity Ave, Cambridge, MA, 02138, USA

³Instituto Nacional de Antropología e Historia, Boulevard Hidalgo, El Centenario, 83260 Hermosillo, Sonora, MX

⁴School of Anthropology, University of Arizona, 1009 E South Campus Dr, Tucson, AZ, 85721, USA

El Fin del Mundo is a multi-locality archaeological site in central Sonora, Northwest Mexico. The site preserved

a Clovis megafauna kill buried in remnants of wetland deposits and scatters of Clovis and later lithic materials on the deflated surface of the uplands nearby. Locality 1 preserved the Clovis kill feature consisting of the skeletal remains of at least two gomphotheres (*Cuvieronius* sp.) associated with diagnostic Clovis stone tools. The stone artifact classes and tool types recovered from the uplands are indicative of a Clovis campsite, or campsites, established in better drained areas near locations with water, animal prey, and lithic resources. Additionally, a lower bonebed of paleontological nature was exposed approximately 20 cm below the buried Clovis feature in Locality 1, consisting of the remains of multiple taxa in secondary context, including a rare association of mammoth (*Mammuthus columbi*), mastodon (*Mammut americanum*), and gomphothere (*Cuvieronius* sp.). In this presentation, we provide background on El Fin del Mundo and an updated summary of the main results of our investigations. We discuss the significance of the archaeological and paleontological record from this site for our understanding of the terminal Pleistocene human and environmental histories of what is now the Sonoran Desert.

A NEW SANDOWNID TURTLE JAW FROM THE LEWISVILLE FORMATION (WOODBINE GROUP, CENOMANIAN) OF TEXAS

SMITH, Heather F.^{1,2}, Madison Berg¹, Brent Adrian², Ronald S. Tykoski³, and Christopher Noto⁴

¹Department of Anatomy, Midwestern University, 19555 N. 59th Ave., Glendale, AZ, 85308, USA

²School of Human Evolution and Social Change, Arizona State University, P.O. Box 872402, Tempe, AZ, 85287-2402, USA

³Perot Museum of Nature and Science, 2201 N Field St., Dallas, TX, 75201, USA

⁴University of Wisconsin-Parkside, 900 Wood Rd, PO Box 2000, Kenosha, WI, 53141, USA

Sandownidae were an unusual clade of rare, globally distributed marine turtles that persisted from the Early Cretaceous through Paleocene. Until recently, the clade was known from a limited number of specimens each representing a single species from: Aptian of England (*Sandownia harrisi*), Turonian of Angola (*Angolachelys mbaxi*), Paleocene of Morocco (*Brachyopsemys tingitana*), and Barremian-lower Albian of Colombia and Texas (*Leyvachelys cipadi*). Sandownids are united by uniquely derived palatal and lower jaw morphology involving extensive expansion of the triturating surface.

A partial sandownid lower jaw, DMNH 18146, was collected from the south slope of Grapevine Lake Emergency Spillway in Grapevine, Texas. The dam spillway exposes small sections of the Lewisville Formation (Woodbine Group, middle Cenomanian), an identification partly based on the presence of *Ostrea*-like oysters. This part of the Lewisville Formation was deposited in a transitional shoreline or near-shoreline setting along a coastal plain environment. The specimen includes both dentaries, right coronoid, and most of the right surangular and angular. It was microCT-scanned (North Star Imaging X5000) and digitally segmented in Aviso 3D 2024.2.

The triturating surface is broad, flat, homogeneous, and extends posteriorly to the level of the coronoids, as in other sandownids. The anterior margin of the jaw is subtriangular, and the two dentaries are fused at the midline with no dentary hook. Serrations are absent, as are distinct labial and lingual ridges. The processus coronoideus is tall, narrow, rod-like, slightly hooked posteriorly, and is composed exclusively of coronoid bone, as in *S. harrisi*, *B. tingitana*, and *L. cipadi*. The lateral surface of the jaw contains a deeply embayed adductor fossa as in *L. cipadi* and *B. tingitana*.

Digital segmentation revealed extremely large canals for branches of the mandibular artery and mandibular division of the trigeminal nerve (CN V3) indicating extensive neurovascular supply to the triturating surface and a well-vascularized oral cavity. The broad fossa Meckelli houses a large foramen alveolar inferius suggesting an expanded internal alveolar branch of the mandibular artery and/or nervus alveolare inferius of the mandibular nerve. An enlarged foramen dentofaciale majus lies in the anterior adductor fossa, indicating a large dentofaciale branch of the mandibular artery. It leads into a wide canal that courses dorsomedially to converge with the inferior alveolar canal, off which numerous smaller canals ramify interconnecting with one another and forming the appearance of an extensive aponeurotic network within the dentary. Many canals open into small foramina on the dorsal surface of the triturating surface where they likely supplied the inferior rhamphotheca.

Although its upper jaw is absent, the broad dentary plate of DMNH 18146 is consistent with occlusion against a similarly expanded palate, as in other sandownids. The expanded surface area in the adductor fossa for attachment of the adductor musculature primarily responsible for jaw closure, supports previous suggestions that sandownids were capable of powerful bite forces, and is evidence for assumptions of their durophagous dietary proclivities. This adaptation likely facilitated their ability

to feed upon armored prey, such as mollusks, and may represent functional convergence with dietary adaptations of some extant cheloniids.

Funding: MicroCT scanning was funded by NSF Division of Earth Science Instrumentation and Facilities Program (NSF EAR-1762458) and NASA (80NSSC23K0199).

A NEW STUDY OF THE FLORISSANT FAUNA AND ITS DIVERSITY

TKACIK, Stephanie M.¹, Jaelyn J. Eberle¹, and Herbert W. Meyer²

¹University of Colorado, Boulder, CO, USA

²Florissant Fossil Beds National Monument, CO, USA

The late Eocene (Chadronian NALMA) Florissant Formation in Colorado records a large biological diversity, with almost two thousand species of plants and animals. Despite its overall great diversity, its terrestrial mammals are not well known. Renewed collecting in recent years, particularly 2022 and 2023, has yielded new mammalian specimens. These represent an additional family, an artiodactyl genus, and two rodent genera, all new to Florissant. The previously documented genus *Mesohippus* is now referred to the species level. Notable specimens are an oligorictyd tooth fragment, cheek teeth from rodents *Hesperopetes thoringtoni* and *Namatomys*, an upper molar from ruminant *Hendryomeryx*, and an upper premolar from *Mesohippus bairdi*. New, additional specimens have also been recovered of *Adjidaumo*, *Paradjidaumo*, *Pelycomys*, *Ischyromys*, *Megalagus*, *Centetodon*, *Pseudoprotoceras*, and the talpid *Oreotalpa florissantensis*. The increased quantity of specimens lends itself to an analysis of species richness and diversity. Many prior studies by others hypothesize that the late Chadronian elevation of the Florissant Formation was comparable to the elevation of the Florissant Fossil Beds National Monument today at 2.5km (8,200ft), other studies hypothesize that it was at 1,000km (3,300ft). The Florissant mammal fauna from UCM Loc. 92179 was compared to two coeval White River Formation localities from Colorado via rarefaction. This analysis shows that the mammalian fauna at Florissant is higher in overall diversity than the other localities. This could be explained by the Florissant Formation being between the elevation of the two White River Formation localities in the late Eocene, by sampling bias, or by a combination thereof.

Funding: 2023-Museum Student Research award via CU Boulder Department of Museum Field Studies, and 2023- stipend via Friends of Florissant organization, and

2024-Spetzler Research Award via CU Boulder Department of Geology.

A NEW VERTEBRATE TRACKSITE FROM THE UPPER CRETACEOUS (CENOMANIAN) DAKOTA SANDSTONE IN MESA COUNTY, COLORADO, USA

TOSCANINI, Marcello¹, Zach Fitzner¹, Janet Bertog¹, and Joshua A. Smith¹

¹Western Slope Paleontological Services, Grand Junction, CO, USA

The Upper Cretaceous Dakota Sandstone is notable for hosting numerous vertebrate tracksites on both sides of the Continental Divide, with many of these tracksites described from Colorado's "Western Slope" over the last two decades. A recent paleontological survey of the Gunnison River Bluffs Extensive Recreation Management Area in Mesa County, Colorado, near the city of Grand Junction adds to the record of Dakota Sandstone sites on the Western Slope.

Numerous dinosaur footprints in various modes of preservation were discovered at the bottom of fluvio-deltaic channel sandstones overlying coal and tidal shale deposited on an upper delta plain. Three dinosaurian ichnogenera (*Tetrapodosaurus*, *Caririchnium*, & *Magnovipes*) typical of other Western Slope Dakota Sandstone tracksites were identified, along with turtle swim traces and various invertebrate trace fossils. This newly discovered locality adds to the known occurrence of vertebrate tracksites in the Dakota Sandstone of western Colorado and contributes to an understanding of the depositional environment and regional variations in dinosaur distribution.

THE PALEONTOLOGICAL RESOURCE POTENTIAL, CORRELATION CHALLENGES, AND REGIONAL IMPORTANCE OF UNDIFFERENTIATED "MID"- TO LATE CRETACEOUS STRATA IN THE EASTERN MOGOLLON HIGHLANDS OF ARIZONA

WOLFE, Douglas G. ^{1,2}

¹Zuni Dinosaur Institute for Geosciences (ZDIG), Springerville, AZ, USA

²Northland Pioneer College, Show Low AZ PO Box 953, Springerville, AZ, USA

The Paleontological Resource Protection Act (PRPA) provides guidance to develop criteria for the survey, risk assessment, and mitigation of vertebrate fossils on Federal Lands, especially fossil resources subject to

human or natural disturbance. The Potential Fossil Yield Classification system (PFYC) outlines criteria pertaining to fossil occurrence and risk of disturbance; including the principle that documented occurrence of fossil resources in correlative strata should heighten awareness of the fossil resource potential at nearby locations subject to assessment or disturbance.

Cretaceous Strata have been noted in the eastern Mogollon Highlands region of Arizona for over 100 years; but are mostly shown as undifferentiated "Cretaceous Sediments" (Ks) on geologic maps. Pike (1947), who provided the basis for much of the Dakota-Mancos stratigraphic architecture applied regionally, noted that Cretaceous sediments near Pinedale, AZ likely correlated with the "Benton" sequence. Based on the coal units, Pike also suggested correlation with the "Mesa Verde" Formation in western New Mexico, recognized later as a much older terrestrial unit (Moreno Hill Formation).

A hydrogeological cross section constructed recently by this author extends roughly west-to-east near the Mogollon Rim from approximately Pinedale, to Whiteriver, AZ; and includes limited surface mapping and topographic control, diagnostic fossil identification and stratigraphic descriptions, also using archived ADWR drilling logs and real time logging of several new exploratory boreholes. At the surface Cretaceous strata

are poorly exposed, extending across private, municipal, state and federal lands, largely forested and/or covered by younger volcanic deposits. The Rim Cretaceous strata lie unconformably atop the Permian Coconino sandstone and are composed of minor to massive highly arkosic, steeply crossbedded, sandstone channel and nearshore marine deposits, fossiliferous marine calcareous sandstones, concretions, and minor limestones, dolomite lenses, calcareous and non-calcareous shale units and lignitic coal units. Fossil wood is abundant, large, highly recrystallized, and closely associated with the marine fossils. Diagnostic ammonite fossils indicate a late Cenomanian age for the marine units. A meter thick bentonite unit can be traced from the Pinedale area eastward into Show Low. Fossil shark teeth are noted but not common. Based on sedimentology, faunal similarities, and projected stratigraphic relationships, these coastal facies are partly correlative to the dinosaur bearing deposits of the Zuni Plateau.

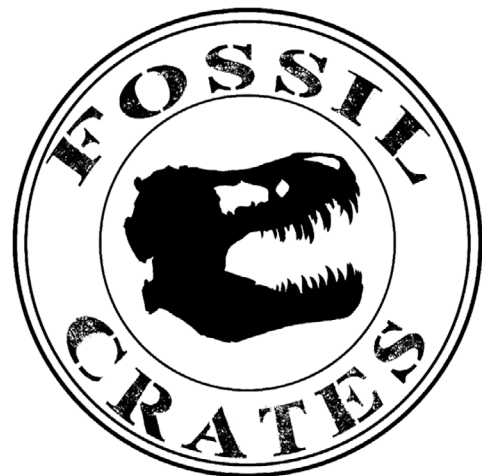
Although forested exposures make detection of vertebrate fossils difficult, the Rim Cretaceous section may have a high fossil resource potential. Future work will include a multidisciplinary study of the Rim Cretaceous particularly marker beds that may help to align the Rim strata with the Cretaceous timescale.

WITH THANKS TO WAVP 2025 EVENT SPONSORS



The Anatomical Record

www.anatomicalrecord.com



www.fossilcrates.com