remains of ancient life, which are studied to further the understanding of how the evolution of species has occurred in response to an ever-changing natural world. This project focuses on the reconstruction and anatomical analysis of a nearly complete skeleton of a 11,700 +/- 40-year-old mammoth specimen originally excavated from a site at the El Paso Products phosphate plant northeast of Soda Springs, Idaho in 1966. The specimen is currently being studied at the University of Idaho in Moscow, Idaho. In reference to the locality of its discovery near Soda Springs, the mammoth was nicknamed 'Cola'. Aims of this study are to: (1) Discern whether the remains belong to a male or female mammoth, and (2) Interpret the specimen's approximate size and age at the time of its death. Analytical methods have included taking measurements of Cola's tusks, molars, and frontal limb bones, both fragmented and complete, as well as determining the extent of dental and skeletal maturation through the assessment of epiphyseal fusion in the limbs and the number of dentin layers and lamellar frequencies on the molars. Calculations made based on humerus measurements indicate that this mammoth was approximately 8.7 feet tall at the shoulder. Tusks were measured to be approximately 8.6 feet long and dental analysis suggests that it had likely been on its fourth set of molars. Assessments of the limb bones have revealed that none of its epiphyses had yet fused. Based on these observations, Cola is currently hypothesized to have been a juvenile or young adult male between 10–18 years old. In contrast, adult mammoths were 13 feet tall at the shoulder with tusks of males reaching 13–16 feet long, while the tusks of females were only 5–6 feet long. This mammoth was living not long before the extinction of its species, thus, broader objectives of this research include making inferences as to what caused their extinction, how they responded to climatic and environmental changes, and their relationship to extant proboscideans.

Paleozoic Tetrapods & Lissamphibians

THE UNEXPECTED PRESENCE OF A CARIBBEAN FROG IN THE LATE OLIGOCENE OF FLORIDA

Vallejo-Pareja, Maria C.[1], Bloch, Jonathan I.[2], Blackburn, David C.[2]
[1]Department of Biology and Florida Museum of Natural History, University of Florida, Gainesville, Florida, U.S.A., [2]Florida Museum of Natural History, University of Florida, Gainesville, Florida, U.S.A.

Biogeographic analyses of phylogenomic data suggest that the extant native anuran faunas of North America have three different geographic origins. Components of the current faunas originated in North America during the Mesozoic whereas others were established during the Cenozoic from Asia or South America. Yet, direct evidence to evaluate these geographic origin scenarios is scarce due in part to a poorly documented fossil record of late Mesozoic and early Cenozoic anurans. During the past few decades, several studies on extinct faunas have suggested similarities between mid-Cenozoic anurans and extant Caribbean taxa, suggesting that more extensive systematic studies of the anuran fossil record could provide new insights into the North American faunas during the Cenozoic. Here we document the anuran faunas of three fossil localities from the Oligocene of Florida: I-75 (early Oligocene, Whitneyan North American Land Mammal Age [NALMA]), Live Oak (SB 1A), and Brooksville 2 (late Oligocene, Arikareean NALMA). Fossils were identified using comparative specimens that included previously identified fossils, dry skeletal preparations of extant anurans, and digital three-dimensional models of alcohol-preserved specimens based on data derived from X-ray computed microtomography (microCT scans). We identified and cataloged 351 anuran fossils representing seven families and ten genera that are similar to those present today in Florida, with the exceptions of two genera, *Spea* (Scaphiopodidae) and *Rhinophrynus* (Rhinophrynidae). Unexpectedly, the most abundant fossil morphotypes can be clearly classified in the genus *Eleutherodactylus* (Eleutherodactylidae), a highly diverse clade of Caribbean origin that was established in the Antilles by the early Oligocene. These 150 fossils include ilia, sacral vertebrae, urostyles, humeri, and radioulnae that are morphologically distinctive from other taxa in the Oligocene of Florida and represent individuals of small body sizes. These newly described fossils represent the earliest records of *Eleutherodactylus* in North America and the second oldest for the genus, which raises questions about the early geographic distribution of this species-rich clade. Together, these results point to the possibility that *Eleutherodactylus* dispersed to North America much earlier than previously thought and provides further evidence suggesting dispersal from the Great Antilles into peninsular Florida during the Oligocene.
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Biomechanics & Functional Morphology

INTRODUCING THE NATURAL FREQUENCY METHOD: TAIL BIOMECHANICS PREDICT ENERGETICALLY OPTIMAL WALKING SPEED OF *TYRANNOSAURUS REX*

van Bijlert, Pasha A.[1], van Soest, A.J. ("Knoek")[1], Schulp, Anne S.[2]
[1]Human Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam, Netherlands, [2]Naturalis Biodiversity Center, Leiden, Netherlands

Animals minimize locomotor energy expenditure by selecting gaits tuned to the natural frequencies of relevant body parts. We demonstrate that this allows estimation of the optimal step frequency and walking speed of *Tyrannosaurus rex*, using an approach we introduce as the Natural Frequency Method. *T. rex* is reconstructed with a predominantly horizontal spinal posture. Its largest muscle, M. caudofemoralis longus (CFL), retracted the femur to produce forward propulsion during locomotion. The tail was constantly subject to flexion torque due to gravity and CFL contractions, and the caudal interspinous ligaments counteracted this torque at zero metabolic cost. Tail heaving with each step caused cyclical peaks in the strain of the caudal ligaments. Therefore, these ligaments were an important site for elastic energy storage, greatly improving metabolic efficiency of this mode of locomotion. The well-preserved adult *T. rex* specimen RGM.792000 allowed high fidelity 3D scans of the caudal vertebrae. Subsequently, we employed a biomechanical reconstruction of the ligament-suspended tail to determine its natural frequency (0.72 s^{-1}, 0.62–0.87), and combined it with step lengths from trackway data to find an optimal walking speed (1.39 m s^{-1}, 1.21–1.70) for *T. rex.*
This is the first time the energetically optimal walking speed of a dinosaur has been estimated, and our method can be applied to any specimen with a well-preserved tail. As such, it opens up a new research avenue within paleo-biomechanics. Reconstructing locomotor ability of extinct dinosaurs is difficult, and various methods have led to conflicting results. Due to the uncertainties involved in any method of dinosaur speed estimation, it is important to explore independent lines of evidence. Our results suggest that trackway calculations may overestimate walking speed, owing to the high spread in the original data used for the regression equation. A major advantage of our approach is that predicted speed is independent of the muscularity of the reconstruction. Steady-state locomotion has a large effect on an animal's ecological niche. Therefore, the Natural Frequency Method can provide us with new insights into possible gait patterns, habits and locomotor ability of dinosaurs.

Mesozoic & Early Cenozoic Mammalian Evolution

THE CRETACEOUS–PALEOGENE FOSSIL MAMMAL PROJECT: DIGITIZING AND SHARING WYOMING'S RARE FOSSIL MAMMAL COLLECTION FOR UNDERSTANDING MAMMAL EXTINCTION AND RECOVERY THROUGH ECOSYSTEM COLLAPSE

Vietti, Laura A.[1], Wright, Susannah[2], McKim, Shadow[1], Clementz, Mark[2], Hutchen, Chad[3]
[1]Geological Museum, University of Wyoming, Laramie, Wyoming, U.S.A., [2]Geology & Geophysics, University of Wyoming, Laramie, Wyoming, U.S.A., [3]Coe Libraries, University of Wyoming, Laramie, Wyoming, U.S.A.

The University of Wyoming's (UW) Fossil Vertebrate Collection houses a rich and rare fossil mammal collection originating from before and after the Cretaceous–Paleogene (K–Pg) mass extinction (n = 26,277 specimens). The UW K–Pg Fossil Mammal Collection is understudied and underutilized due to our geographical remoteness, the physical size and fragility of our specimens, and the invisibility of our collection. Furthermore, imaging small mammal teeth is challenging due to their small size and high vertical relief. In an effort to promote the use of the UW K–Pg Fossil Mammal Collection, we partnered with the UW Libraries for a two-year project to digitize and make globally accessible a significant portion of the UW K–Pg Fossil Mammal Collection. Here we present the results of this major digitization project including our solution to imaging small mammal teeth specimens at the collections scale, our final digitization workflow, and examples of images from the final digitization project.
In summary, we captured 15,000 research-quality images of 5,000 tooth elements representing ~500 mammal species spanning the K–Pg interval (Cretaceous, Paleocene, Eocene, and Oligocene). Specimen selection was challenging, and we ultimately chose specimens that were complete and unworn dental elements representing all tooth positions for each identified species in the collection. We also imaged multiple teeth of the same species and tooth position but from different localities to enable paleogeographic studies. For imaging, we used a Keyence VHX-5000 imaging station that is capable of automated focal stacking and image tiling at high magnifications (20–200x) as well as in-program annotation and scale-bar insertion. We took three images per specimen at orientations best suited for research purposes including the occlusal (chewing surface), the medial (towards the tongue), and lateral (towards the check) orientations. Original K–Pg specimen images in TIFF format were then archived on UW's petaLibrary, and derivative jpegs were published on our online Specify Database as well as shared with the large data aggregator and web-portal iDigBio.
Generating and mobilizing research-quality images of the UW K–Pg fossil mammal material will make globally available for the first time, a comprehensive record of mammal collapse and recovery associated with the K–Pg extinction event, which will promote its use for broad applications in research, museums, education, and the general public.
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Permo-Triassic Tetrapods