assemblage is of particular interest because Fantasia is found at a higher modern elevation than better-known basin center Bridgerian sites in the greater Green River Basin and the Bighorn Basin. The timing of eruptive events in the AVP, as well as ongoing oxygen isotope paleoaltimetry studies in the region, suggest that this site documents a faunal community that lived at a relatively high elevation, with modern elevation not significantly altered by local Laramide uplift. Modern biogeographic patterns suggest that high elevations should document substantially different faunas than lowland basins and sampling such sites should provide new insight into regional diversity patterns.

Here I report the preliminary results of renewed collecting at Fantasia in 2017, which approximately doubled the number of fossil specimens known from the site. Microvertebrate fauna are extremely common at this site and erode out of the fossiliferous matrix and accumulate along a broad deflation surface. The most common taxa in the sample reported here are rodents (36%), euarchontans (28%), including particularly abundant *Microsyops* species, *Hyopsodus* (7%), and *Orohippus* (6%). Additionally, a crocodylian vertebra was collected, which is the first archosaur recorded from this site. This finding suggests that during the early middle Eocene, crocodylians may have been able to occupy a broader range of elevations than seen in modern representatives of the clade. Increased sampling of high-elevation sites such as Fantasia provides an opportunity to critically examine sampling biases favoring lowland depositional environments in the North American Eocene. The degree to which this bias has impacted our understanding of faunal community change over time is explored here in light of new data from Fantasia.

Grant Information
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Technical Session VIII (Thursday, October 18, 2018, 2:45 PM)

MORPHOLOGICAL DISPARITY ACROSS THE SYNAPSID FORELIMB: SUBORDER-LEVEL PATTERNS ACROSS 80 MILLION YEARS OF SYNAPSID EVOLUTION

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Synapsid evolution can be characterized by three successive radiations: the Permo–Carboniferous pelycosaurs, the Permo–Triassic Therapsida, and the Triassic Eucynodontia. Previous geometric morphometric research at the clade level revealed a continuous increase in humeral morphological disparity in Therapsida, in contrast to their pelycosaur forebearers. Here we present associated data on ulnar morphological disparity, as well an an overall taxonomic expansion of the analyses. This increase in sample size brings the dataset to 765 specimens from which functional units across the forelimb were analyzed. Further, it allows for a more detailed discussion of variance within nearly every major group of early Synapsida, as well as across 80 million years of geologic history.

Groups were analyzed for Procrustes variance in 5 million year time bins from 305–225 Mya (Carboniferous–Triassic). In all analyzed functional units—the proximal humerus, distal humerus, and proximal elbow—within group disparity is higher in therapsid families than in pelycosaur families. In addition, therapsid family level disparity is much more variable between groups and across time. Ulnar variance values are higher than humeral values for the entire study period. Procrustes variance for the forelimb decreases across the End Permian Mass Extinction Event in the major therapsid groups that survived it—Anomodontia and Cynodontia.

Macroevolutionary changes observed in Synapsida have historically been associated with ecological diversification. Cynodontia and Anomodontia have the highest variance in Therapsida, while Gorgonopsia has the lowest. The high values in Anomodontia, as one of the most taxonomically and ecological diverse clades of Therapsida, suggests that forelimb variance is linked to aspects of ecological diversification. Further, within pelycosaurs Sphenacodontidae has the lowest variance through time, while Ophiacodontidae has the highest. The finding of uniquely high variance levels in Ophiacodontidae, hypothesized by some to be semi-acquatic, is suggestive of a potentially unique forelimb ecomorphology. This research provides evidence that along with major shifts in forelimb morphology, within-family disparity dynamics may have been critical to the evolutionary success of individual synapsid sub-orders.

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Poster Session IV (Saturday, October 20, 2018, 4:15 – 6:15 PM)

WHEN ECOLOGY AND PHYLOGENY ARE AT ODDS: EXTRAPOLATING RESTING AND STANDARD METABOLIC RATES OF AETOSAURS (ARCHOSAURIA, AETOSAURIA) FROM EXTANT SAURIANS

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Although much of what we know of the biology of extinct organisms can be inferred directly from the fossils themselves, other characteristics must be extrapolated from comparisons with living animals. This is especially true of metabolic rate (MR) in fossil vertebrates. Previously many workers have attempted to understand the metabolism of dinosaurs, but there has been little to no work on more basal archosaurs, in spite of the fact that it was the diversification of archosauromorphs over the first 30 million years of the Triassic that set the stage for dinosaur dominance during the latter Mesozoic.

Here we report our estimates of the MR of several well preserved aetosaur specimens. Our method relies on the fossil record for body mass estimates, but otherwise extrapolates aetosaurian MR from an array of empirical measurements of extant saurians pulled from the literature. We subdivide our approach in two different analyses, one performed on a dataset emphasizing ecological role, the second emphasizing phylogenetic position, and running two different multiple linear regressions to obtain resting metabolic rate (RMR) and standard metabolic rate (SMR) for each. For example, we find for a 120 kg (live weight mass estimate) specimen of Typothorax coccinarum an RMR of 1871 mL O2h−1, and an SMR of 973 mL O2h−1 utilizing the ecological analysis. On the other hand, the saurian-based estimation for the same specimen we find substantially higher values, with an RMR of 2253 mL O2h−1 and an SMR of 1619 mL O2h−1. In both analyses metabolic rate is most strongly influenced by body mass, but, from a relative weight analysis we obtained estimates of the relative weights of other dependent variables involved in MR prediction, as well as a corroboration of the importance of phylogeny (6.6%), feeding mode (2.2%) and environmental adaptation (8.6%) of the total variance in the analysis based on the saurian dataset.

As we expected from the literature, the ecology-based equation yields the lower MR. We attribute this difference to the presence of armor, emphasized in this analysis, in comparison to the saurian based estimation. However, our extant saurian based estimation could be a useful tool to estimate MR of extinct ectothermic saurians that are not as heavily armored.

Poster Session IV (Saturday, October 20, 2018, 4:15 – 6:15 PM)

Podium Symposium (Wednesday, October 17, 2018, 10:45 AM)

THE ROLE OF CLIMATE IN SHAPING MAMMALIAN BODY SIZE DISTRIBUTIONS OVER THE CENOZOIC

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Understanding how ecological communities are organized and how they change through time is critical to predicting the effects of climate change. Studies on modern communities find that the shapes of body size distributions are weakly related to climatic variables and more strongly to habitat type, with flat distributions common in temperate habitats and peaked distributions common in tropical ones. In essence, increased habitat structure and productivity lead to more peaked body size distributions presumably because a greater number of 'medium' sized mammals can be supported. Because there have been major changes in mammalian community composition, body size, and global climate over the last 65 million years, we ask how these patterns play out over geologic time. We created a database of Cenozoic mammal communities that spans multiple continents and habitats using the Paleobiology database augmented with additional literature sources. Species level body sizes were collected from the literature and estimated from measurements on fossil teeth. Our database contains 226 communities with 6713 species occurrences. For 103 communities, we were able to classify them into general habitat types. Global climate data were taken from the Zachos curve. We analyzed the shapes of community body size distributions and their relationships to habitat type and global climate. We find that 1) local body size distributions of Cenozoic mammals are weakly correlated with climate and more strongly with habitat type, 2) archaic and modern mammals show similar patterns in their body size distributions, and 3) maximum body size of local communities increases as mammals evolve larger body sizes and is correlated with climate change. The remarkable similarity in these patterns and their relationship to climate over the last 65 million years suggest a fundamental role of body size in community assembly, and that modern and archaic mammal faunas respond in similar ways to the environmental template.

Grant Information
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Poster Session I (Wednesday, October 17, 2018, 4:15 – 6:15 PM)

THE SKULL ANATOMY AND FUNCTIONAL DISPARITY OF OVIRAPTOROSAURS

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Theropod dinosaurs had diverse skull morphologies and attained a wide variety of diets. Oviraptorosaurs are a group of bird-like theropods which have a general skull shape that diverged from that of most other theropods – their skulls are anteroposteriorly short but dorsoventrally deep, edentulous, and possess a rhamphotheca beak in crownward forms. Over the last decade, the known diversity of oviraptorosaur has greatly increased thanks to new fossil discoveries, particularly in Ganzhou, Jiangxi province of southern China. Despite this, little is known about how skull shape and function vary among oviraptorosaurs.

This is the first comprehensive investigation into the anatomy and functional disparity of oviraptorosaur skulls using quantitative techniques. First, we use two-dimensional geometric morphometrics to quantify skull shape. Homologous landmarks were plotted on images of oviraptorosaur crania, mandibles and beaks (premaxillae and dentaries) obtained from published literatures and first-hand photographs. These data sets were then subjected to principal component analysis (PCA) to generate a morphological morphospace for each data set. The PCA results show that the crania of oviraptorosaurs (excluding caenagnathids) mostly vary in the anteroposterior length of the external naris and the depth of the premaxilla-maxilla region. The mandibles of oviraptorosaurs differ primarily in the size of the external mandibular fenestra, the height of the coronoid process region and the depth of the dentary. We find significant correlations between mandible/beak shape and phylogeny. Second, we developed a list of mandibular characters likely to have functional relevance in oviraptorosaurs, based on studies of other extant and extinct animals. After the measurements were standardised, they were subjected to principal coordinate analysis (PCoA) to obtain a functional morphospace. The Ganzhou oviraptorosaurs are relatively spread out in the functional morphospace, indicating that dietary-related niche partitioning might have facilitated their coexistence. Skull function shows significant and moderate correlations with mandible and beak shape. The results show that both phylogeny and function may have been important factors in influencing oviraptorosaur skull morphologies. This study clarifies the skull shape and function variation patterns in oviraptorosaurs, which is important for understanding the complex dietary evolution in oviraptorosaurs, and theropods in general.

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