MEETING PROGRAM & ABSTRACTS

SVP
SOCIETY OF VERTEBRATE PALEONTOLOGY

November 5 – 8, 2014 • Estrel Berlin • Berlin, Germany

Poster Session I (Wednesday, November 5, 2014, 4:15 - 6:15 PM)

GIGANTISM OF STEGOSAURIAN OSTEODERMS

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Stegosaurs have evolved huge and/or bizarrely shaped osteoderms. Despite a long history of stegosaurian research, it remains controversial how their osteoderms evolved to extreme size and what their functions were. This controversy may be due to the focus of most previous studies only on the North American genus *Stegosaurus*. In this study, we explored the maturation of osteoderms of several stegosaurs with respect to body growth to understand the developmental process and the possible function of these osteoderms. Bone growth of both the skeleton and osteoderms was analyzed using thin sections from different sized osteoderms of the stegosaurs *Stegosaurus*, *Kentrosaurus* and *Miragaia* and compared with osteoderm growth of the ankylosaur *Pinacosaurus* and of living alligators as the outgroup.

The histological comparison between the body skeleton and osteoderms of the large-plated stegosaur *Stegosaurus* shows that the osteoderms continue to grow well after skeletal maturity has been reached. In contrast, the small-plated and/or spiked stegosaurs *Miragaia* and *Kentrosaurus* respectively, show delayed timing of growth of the skeletal elements relative to the osteoderms. Additionally, late juvenile ankylosaurs of the genus *Pinacosaurus* lack large postcranial osteoderms. This developmental delay of osteoderm formation with respect to the body skeleton is similar to that of living alligators. Contrary to this, a juvenile large-plated *Stegosaurus* already has well-developed dorsal plates.

In terms of evolutionary heterochrony, these observations indicate predisplacement and hypermorphosis in large-plated stegosaur osteoderm evolution (as in *Hesperosaurus* and *Stegosaurus*), but the change did not occur in small-plated stegosaurs. In Stegosauridae, the plesiomorphic condition is smaller osteoderms. The growth of the osteoderms in *Miragaia* and *Kentrosaurus* contrasts with that documented for *Stegosaurus*, as the timing of growth of osteoderms is accelerated relative to the skeletal elements in the latter. The increasing size and ability of the plates to function as display organs from *Miragaia* to *Stegosaurus* may account for these growth history variations.

Symposium 5 (Saturday, November 8, 2014, 4:00 PM)

HERPETOMETRICS: TESTING SIZE-BASED METABOLIC THERMOMETRY OF RECENT AND FOSSIL COLUBROID SNAKES ACROSS NORTH AMERICA

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Body size is a primary ecometric variable for examining the relationship between organism and environment, and the constraints of mass specific metabolic rate and ambient temperature on body size accurately predict maximum size for a given minimum environmental temperature in extant poikilotherms. This relationship has been extended to infer paleotemperatures based on body sizes of fossil taxa (metabolic paleothermometry), but the fundamental assumptions of the thermometric model, including conservation of both metabolic rates and thermal ecology, have not been tested for large diverse clades. As a result, extreme physiological and ecological novelty in response to climate maxima and minima has the potential to strongly misestimate paleotemperature. To test the effects of extreme ecometrics, we modeled maximum body size (measured as Snout Vent Length, SVL) changes with ambient Mean Annual Temperature (MAT) for extant North American colubroid snakes using the largest, most cold-tolerant taxon, *Thamnophis sirtalis parietalis* from Manitoba, and the largest, heat-tolerant taxon, *Drymarchon couperi* from Florida as separate calibration points. We then compared these models to maximum SVLs for colubroids from the modern Great Plains, and the Miocene fossil record of Nebraska.

Differences in model temperature values between the two taxa ranged from approximately 12°C at smallest body sizes (SVL =10-60 cm) to 3.4°C at larger sizes (SVL > 200 cm). Overall, the *Drymarchon* model performed better at estimating size-temperature relationships across North America, especially for larger taxa. The comparatively poor estimation from *T. sirtalis* likely reflects its unique adaptations to extreme cold, including short annual activity cycles and elevated metabolic rates; however, the *Thamnophis* model more accurately predicted the maximum SVL-MAT relationship for the largest extant Great Plain colubroid (*Pituophis cantifer*). Application of both models to estimated maximum SVL for a well-preserved colubroid record from the middle Miocene (Clarendonian) Ashfall site of Nebraska resulted in minimum MATs equivalent to or slightly higher than modern temperatures (8-10°C) for the *Drymarchon* model, but implausibly lower for the *Thamnophis* model (-2--4 °C). These results indicate the need for careful selection in model choice for paleothermometric reconstruction. Alternate approaches, including probabilistic models incorporating species distributions may provide a more comprehensive estimate of paleotemperature for fossil reptile faunas.

Education and Outreach Poster Session (Poster displayed November 5 – 8)

AIM-UP! MUSEUM-BASED APPROACHES TO INCREASING CORE COMPETENCIES IN UNDERGRADUATE EDUCATION

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Natural history collections provide invaluable resources for undergraduate education, allowing teachers and students to explore biodiversity directly through examination of specimens and quantitative analyses of diverse specimen-associated data sets. AIM-UP! is a US National Science Foundation-funded Research Coordination Network (NSF-RCN) developed to increase awareness of natural history collections as critical resources for undergraduate education. Specific goals include: (1) training undergraduates in museum-based research; (2) developing instructional tools based on freely-accessible online museum databases; (3) informing educators at non-museum institutions regarding the instructional power of museum collections; and (4) interacting with the public to increase awareness of the educational importance of natural history museums. Preliminary data indicate that undergraduates—including students at our own institutions—are largely unaware of the immense repositories of information contained in natural history collections. To address this gap and to promote enhanced learning opportunities for undergraduates at diverse institutions, AIM-UP! is developing multiple concept-based, hypothesis-driven educational modules that allow students to use existing museum databases to explore multiple topics in biology—including biodiversity and systematics, geographic variation, genome evolution, global climate change, and co-evolutionary relationships among diverse taxa. These modules require students to engage in experiential learning activities that address core competencies in the process of science, quantitative reasoning, and statistical analysis in an interdisciplinary context. Currently in year 4 of a 5-year award, AIM-UP! modules are freely accessible online. Instructional materials are developed for 4-year undergraduate institutions as well as junior and community colleges. Because modules revolve around queries of dynamic museum databases, they can be tailored to fit specific conceptual, geographic, temporal, or taxonomic interests. Using intensive pre- and post-implementation surveys of student participants, as well as extensive interaction with instructors, we are evaluating the effectiveness and outcomes of these modules in: (1) promoting core competencies; (2) enhancing understanding of evolutionary and environmental biology; and (3) increasing awareness of the vast educational potential of natural history museums.

Technical Session I (Wednesday, November 5, 2014, 8:30 AM)

ARTIFICIAL EXTINCTION AND THE IMPACT OF MISSING DATA ON THE PHYLOGENY OF CERVIDAE (MAMMALIA, RUMINANTIA)

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Fossils with substantial missing data may impede accurate phylogenetic reconstructions, although some previous studies of missing data have shown that inclusion of incomplete taxa can be beneficial. Here we present an approach where morphological information in extant taxa is non-randomly deleted using the missing data of a fossil as template, representing genuine preservation bias.

We sampled 21 extant cervids (including all 19 living genera), plus one tragulid to root topologies, and 13 fossil cervids ranging from the early Miocene (20 Ma) until the Pleistocene (10 ka). Both living and fossil cervids are represented by 119 craniodental characters and living taxa are also represented by mitochondrial genomes and four nuclear markers. To create an artificial fossil, characters of a living taxon (the subject) were degraded to possess only characters exhibited in a given fossil (the template). This resulted in 273 (21 subjects, 13 templates) artificial fossil topologies, analysed using maximum parsimony.

The results from comparing the artificial fossil topologies with an unaltered extant combined topology based on the same data set showed that, for this particular taxon and character sample, more missing data do not necessarily lead to more topological disarrangements; even with the inclusion of taxa with more than 70 % missing data the extant combined topology could be produced at least once with each template fossil. The resolution was lost in only one third of the cases, whereas an accurate topology was established in 24 out of the 273 cases.The type of character missing seems to play a more important role than the quantity of question marks in the matrix. Adding incomplete fossils to a dataset can be beneficial, because such taxa break long branches. Based on these results and observations we encourage that decisions about inclusion or exclusion of taxa for an analyses should not be made a priori, but after reconstructing the phylogeny and evaluating the incomplete fossil appropriately according to its potential beneficial effects.

Poster Session I (Wednesday, November 5, 2014, 4:15 - 6:15 PM)

A GEOMETRIC MORPHOMETRIC APPROACH TO QUANTIFYING THE INTERACTION BETWEEN BIOLOGIC AND TAPHONOMIC INFLUENCES ON FOSSIL SHAPE VARIATION USING *PSITTACOSAURUS*

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Two- and three-dimensional geometric morphometrics (GM) are useful tools for quantitatively characterizing shape. These techniques have only recently been applied to understanding shape variation in the fossil record of dinosaurs. The vast majority of diagnosable dinosaur taxa are known from one or two fragmentary specimens. Therefore, it is paramount to understand the range of intraspecific variation within dinosaur taxa and how shape is related to both ontogeny and taphonomy before applying GM at broader taxonomic levels, especially as previous analyses have shown that taphonomic distortion plays a large role in determining the location of dinosaur taxa in morphospace. To examine this issue, we applied GM to multiple views of the scapulae, humeri, ilia, and femora of an intraspecific sample of *Psittacosaurus lujiatunensis*. The multiple view approach permits better quantification of three-dimensional forms and should always be used when undertaking two-dimensional GM in order to account for error generated by the z-axis. Corresponding left and right elements of the same specimen often presented obvious differences in shape related to taphonomic distortion, so we created two complementary datasets: one that included both sides of the skeleton and one that only included the less deformed side. The bilateral dataset allowed us to quantify primary biological asymmetry and taphonomic distortion by calculating Procrustes distances between both sides of the same animal. We found that left-right pairs often did not plot near each other in morphospace, indicating definitive influence of taphonomic distortion on our shape data. The dataset comprising only the less deformed side provided clearer