MEETING PROGRAM & ABSTRACTS

SVP
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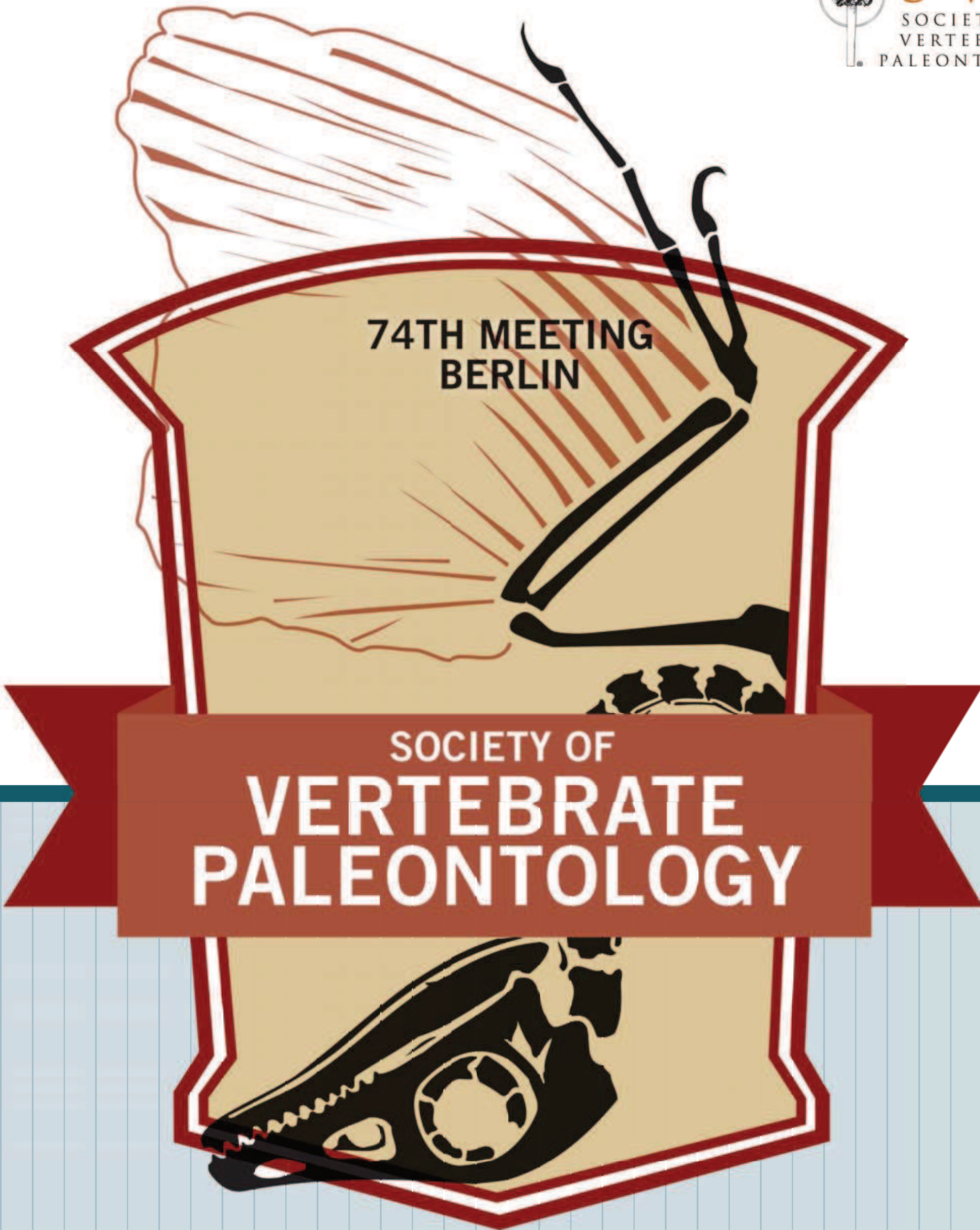

November 5 – 8, 2014 • Estrel Berlin • Berlin, Germany

Technical Session XIII (Friday, November 7, 2014, 2:30 PM)

THE DIVERSITY OF COPULATORY STRUCTURES AND REPRODUCTIVE STRATEGIES IN STEM GNATHOSTOMES

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Placoderms (stem gnathostomes) preserve the earliest evidence of vertebrate reproductive structures in the fossil record. Newly discovered pelvic and reproductive structures in antiarchs (sister-group of all other gnathosotmes), ptyctodonts and arthrodires (more crownward members of the stem ganthostomes) challenge established ideas on the origin of the pelvic girdle and reproductive complexity, in particular the position of the pelvic fin and the relationship of the male clasper to the pelvic girdle. Absence of articular surfaces between the clasper and girdle in the Arthrodira, along with evidence from the Ptyctodontida, indicate these are separate structures along the body, with claspers representing a third set of paired appendages serially homologous to pectoral and pelvic fins; the zone of fin competence was thus more extensive when these appendages first evolved. The discovery that placoderm claspers were not part of the pelvic skeleton led to a re-examination of the antiarchs, a group that, with the exception of the yunnanolepids, have lost the pelvic girdle and fins; absence of these had previously suggested that antiarch reproductive biology was indeterminable. We describe new antiarch dermal copulatory structures, including retractable claspers closely associated with trunk armor plates, again independent of the pelvic skeleton. Thus claspers in placoderms and sharks develop in different ways; in sharks, claspers develop from the pelvic fin while the claspers in placoderms develop separately, in the expanded zone of fin competence.

Further information on early gnathostome reproductive processes is preserved with additional embryos recovered from ptyctodonts and arthrodires, including that multiple embryos were the norm, but also for the first time, embryos of differing sizes, and that marked sexual dimorphism occurred at the embryonic stage (e.g., male claspers preserved in some embryos). By comparison with other gnathostomes, these observations suggest more complex reproductive strategies in placoderms than previously appreciated. Thus sexual dimorphism, copulatory reproduction, internal fertilization and large offspring with substantial maternal investment originated at the base of the gnathostome radiation, providing the first evidence of K-selected reproductive strategies within the vertebrates. Funding: Australian Research Council.

Poster Session IV (Saturday, November 8, 2014, 4:15 - 6:15 PM)

NEW DATA FROM THE LOWER CRETACEOUS THEROPOD TRACKWAYS IN MUENCHEHAGEN (LOWER SAXONY, GERMANY)

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Berriasian sandstones from the Bueckeberg Formation in Lower Saxony, northern Germany have produced dinosaur tracks for more than two centuries. Muenchehagen, about 50 km west of Hannover, is one of the key localities, yielding the only Lower Cretaceous sauropod tracks found in Germany, as well as abundant ornithopod and theropod trackways. While the geological profile in the active Wesling Quarry adjacent to the Dinosaurier-Park Muenchehagen is just 5.62 m in thickness, it contains at least six track-bearing strata. Most tracks are reasonably well preserved in fine-grained quartz sandstones (thickness: 0.1-1 m), but one horizon (Lower Level, lithological unit [LU] 7) yields excellently preserved trackways in a silty mudstone layer, probably representing the background sedimentation. Within the last ten years, at least eight trackways of theropod dinosaurs with a total of >100 footprints have been found, documented and (as far as possible) excavated in Muenchehagen. In most cases, footprints as well as their natural casts can be excavated. The theropod trackways suggests two size-classes. The abundant smaller size-class is typically around 30 cm in footprint length; with associated pace lengths often >100 cm which indicate fast moving animals. The larger size-class is represented by only one trackway with 40 consecutive tracks; footprint length is >35 cm and mean pace length 114 cm. Another area in the Upper Level (LU 16) shows theropod and a few ornithopod tracks going in four different directions, forming the only trampled area in Muenchehagen. Changes in substrate composition have caused variations in footprint outline and especially the preserved claw impressions. The consistent documentation of all finds with digital photography allows the photogrammetric creation of 3D models of the trackways which currently serve as an objective dataset for our research regarding speed reconstructions and ichnotaxonomy. At least two theropod ichnotaxa are already known from the Bueckeberg Formation: the large *Bueckeburgichnus* and the medium sized *Megalosauripus*. The latter is a common ichnotaxon, e.g., also found in the contemporaneous Huerteles Formation in Spain; and many tracks in Muenchehagen can be assigned to that ichnotaxon. Some tracks also have similarities with the two large ichnotaxa *Irenesauripus* and *Eubrontes* as well as the smaller ichnotaxon *Anchisauripus*.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed November 5 – 8, judging occurs Thursday, November 6)

MORE THAN ONE WAY TO BE A GIANT: CONVERGENCE AND DISPARITY IN SAURISCHIAN DINOSAUR HIP JOINTS DURING BODY SIZE EVOLUTION

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Reconstructing joint anatomy and function is critical to understanding posture, locomotor behavior, ecology, and evolution of extinct vertebrates. Saurischian dinosaurs evolved a wide diversity of hip joint morphology and locomotor postures, as well as seven orders of magnitude in body size. The very largest saurischians possess incongruent hip joints in which the subchondral surfaces differ in shape and size, suggesting that large volumes of soft tissues mediate hip articulation during locomotion. This study tested the relationships among hip joint dimensions, morphological characters, body mass, and locomotor postures of sauropodomorph and theropod dinosaurs. Femora and pelves of 84 taxa were digitized using 3D imaging techniques. Discrete and continuous characters were analyzed using phylogenetically corrected correlation to reveal trends in body size evolution. Unlike smaller, basal dinosaurs, giant theropods and sauropods convergently evolved highly incongruent bony hip joints by reducing supraacetabular ossifications and medially deflecting the proximal femur, such that only the femoral head region inserted within the acetabulum. In sauropod femora, the head and antitrochanter possess irregularly-rugose subchondral surfaces for thick hyaline cartilage whereas the neck has a transversely-striated surface for thin fibrocartilage. In contrast, osteological correlates suggest theropods covered their femoral head and neck with thinner hyaline cartilage whereas the antitrochanter was instead covered in fibrocartilage. These findings indicate that the femoral articular cartilages of giant sauropods were built to sustain heavy compressive loads whereas those of giant theropods experienced compression and shear forces. Additionally, sauropods used thick hyaline cartilage for maintaining joint congruence, whereas theropods relied primarily on acetabular soft tissues such ligaments and cartilages rather than femoral articular cartilages. These data indicate that saurischian hips underwent divergent transformations in soft tissue morphology reflective of body size, locomotor posture, and joint loading.

Poster Session III (Friday, November 7, 2014, 4:15 - 6:15 PM)

A SPECIMEN-LEVEL CLADISTIC ANALYSIS OF *CAMARASAURUS* (DINOSAURIA, SAUROPODA) AND A REVISION OF CAMARASAURID TAXONOMY

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Camarasaurus is considered one of the best known sauropod dinosaurs from the Upper Jurassic Morrison Formation of the USA. Numerous finds are referred to four widely accepted species: *C. supremus* (type species), *C. grandis*, *C. lentus*, and *C. lewisi*. The osteology of the genus is considered completely known, but this knowledge is mostly based on specimens referred to *Camarasaurus* without using phylogenetic methods. The state of the holotypic material is often deemed unfavorable for phylogenetic methods. Type specimens were found mingled with other specimens (AMNH 5760 with 5761; YPM 1901 with 1902 and 1905), and two species are based on juvenile material (*C. grandis*, *C. lentus*). Phylogenetic studies thus generally include *Camarasaurus* as genus. As such, intrageneric variation is excluded a priori, and the possibility that some specimens used for scoring might be erroneously referred to the genus is ignored.

In order to assess the species taxonomy of *Camarasaurus*, a specimen-level cladistic analysis was performed with all holotype specimens formerly proposed to belong to *Camarasaurus*, and the most complete referred skeletons. The ingroup counts more than 20 specimens, all but one (GMNH-PV 101) scored based on personal observations. Outgroup taxa cover early eusauropods, Diplodocoidea and titanosauriforms.

The final cladogram shows the classical type specimens of *Camarasaurus* as sister-clade to a group with the *Cathetosaurus* type specimen, and the specimens GMNH-PV 101 and SMA 0002. In order to assess taxonomic issues, two earlier proposed numerical approaches were tested: apomorphy counts between sister-clades (proposed in diplodocids), and character dissimilarity (proposed in plesiosaurs). Additionally, homoplastic rates for the diverging characters were incorporated in the apomorphy counts, in order to include a value for taxonomic significance of the trait in question. These methods support the validity of the three historic *Camarasaurus* species (*C. supremus*, *C. grandis*, *C. lentus*), and corroborate proposals for the re-establishment of *Cathetosaurus* as distinct genus. The revised character scoring for genera and species refines their diagnoses, and will help to resolve the phylogenetic position of unstable taxa like *Europasaurus*, *Jobaria*, or *Haplocanthosaurus*.

Technical Session X (Friday, November 7, 2014, 10:45 AM)

NEW APPROACHES TO CHARACTERIZING FEEDING SPECIALIZATION AND RECONSTRUCTING ITS EVOLUTIONARY PATHWAYS BASED ON COMPARATIVE BIOMECHANICS OF LIVING AND FOSSIL CARNIVOROUS MAMMALS

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The ability to capture and process prey is critical to the survival of predatory species, and therefore is thought to represent a main locus of selection in their craniodental evolution. A complex link between the morphology of the masticatory apparatus and its mechanical properties and performance is demonstrated in a wide range of living vertebrates, but the generality of such form-function relationships is still unclear and poorly explored. Here we introduce an integrated approach to studying form, function and the links in their evolution using comparative biomechanics. We describe craniodental form using 3-D geometric morphometric analyses and reconstruct craniodental function using 3-D finite element analysis within a phylogenetic context. A preliminary dataset of seven extant and fossil carnivorous mammal species is used in this pilot study. Our findings indicate that despite strong phylogenetic signal in both craniodental form and function, a link between extant dietary groups and cranial mechanical properties can nevertheless be established after accommodating phylogenetically conservative similarity due to common ancestry. Such a link is then applied to interpreting diet in two extinct species. In addition, analyses of reconstructed ancestral cranium models at internal nodes of the phylogeny of Carnivoramorpha indicate a decoupling of the mechanical properties that characterize inferred evolutionary pathways at internal nodes versus known dietary groupings of terminal taxa. Taken together, the results derived from these new analyses provide a refined basis for