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Technical Session VIII, Thursday 2:45

EXPERIMENTAL TAPHONOMY AND MICROANALYSIS OF CROCODYLIAN BITE MARKS

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While the presence of reptilian bite marks has been cited from the fossil record throughout the literature, they have not enjoyed the same level of actualistic and experimental study as their mammalian counterparts. Since crocodylians are both important top predators in their own right and popular proxies for a wide variety of extinct organisms in biomechanical, paleoecological, and paleobehavioral research, this clade is a perfect starting point for studies of bone modifying behaviors and the types of traces that reptilian actors create. A survey of bite marks from twenty of the twenty-three currently recognized species of extant crocodylians was collected under controlled conditions. Age, sex, weight, and a variety of length measurements were recorded for each animal in order to address additional variables and biases in any patterns of the bite marks' morphology. Visually, the samples exhibited the expected types of marks including hook scores and bisected pits and scores, which have previously been assigned to members of *Crocodylus niloticus* and *cf. Rimasuchus lloidi.* However, other marks were identified under microanalysis, including a variety of bisected structures that were not visible in hand samples and a new feature, which is characterized by three parallel subscores. These results help support the assumption that the creation of hook scores and bisected bite marks is a clade-wide phenomenon, and adds quadrisected scores to the list of features that can be used to diagnose similar structures in modern samples and the fossil record. Future correlation with morphological features of the jaw, such as bite radius and tooth shape, might be able to further refine identification to specific clades or suites of characters related to niche partitioning. When used in a phylogenetic context, the features of these modern bite marks can also be used to make informed predictions about the types of bone modifications that extinct members of Crocodylia might have caused, a tool that might help identify not only the marks themselves, but also presage the presence of these animals in preserved ecosystems.

Technical Session VIII, Thursday 1:45

ONTOGENY AND PHYLOGENY OF THE TYMPANIC PNEUMATIC SYSTEM OF CROCODYLIFORM ARCHOSAURS

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Both groups of extant archosaurs (birds and crocodylians) possess a highly elaborated configuration of pneumatic diverticula derived from the pharyngotympanic air space. It is not clear whether this characteristic is homologous or if it represents two independent trajectories of diverticular development. In fact, among archosaurs, tympanic pneumaticity is not at all well understood with regard to its ontogeny, morphological variability, and phylogenetic distribution. Moreover, the relationship of true tympanic pneumaticity to other pneumatic systems in the braincase (e.g., the median pharyngeal system) has been completely unexplored. We present here a survey of the development of these diverticular systems both as an ontogenetic trajectory in Alligator mississippiensis and as a phylogenetic pattern within Crocodyliformes. We also present criteria for the identification and discrimination of individual diverticula, allowing tests of hypotheses of homology-both within crocodyliforms as well as archosaurs generally. Methods include computed X-ray tomography (CT), microCT, and 3D visualization of the CT data, which together provide a detailed characterization of the pneumatic recesses relative to the skeleton, otic labyrinth, and brain cavity. To shed light on the highly derived condition of adult crocodylians, the ontogeny of pneumatic sinuses is traced via microCT in a growth series of American alligator. Morphological similarities between sampled fossils and extant taxa are examined in a phylogenetic context, allowing tests of hypotheses of homology. Focal fossil taxa include the protosuchian *Eopneumatosuchus*, the thalattosuchian *Pelagosaurus*, the goniopholidid *Eutretauranosuchus*, and the sebecid *Hamadasuchus*. Three groups of paratympanic diverticula are identified: the pharyngotympanic sinus, the intertympanic sinus, and the median pharyngeal sinus. Some sinuses show relative expansion during ontogeny (intertympanic diverticulum), while others become relatively reduced (laterosphenoid and quadrate diverticula) or even lost in the adult (pterygoid diverticulum). This same pattern of reductions and expansions are observed across the phylogeny of crocodyliforms.

Evolutionary History of Bats Symposium, Thursday 8:00

FLIGHT AND THE EVOLUTION OF FEEDING IN BATS

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Roughly a quarter of all mammal species are bats and they occupy all but the coldest and most remote habitats on earth. Flight was certainly a key innovation behind their success and adaptations for aerial locomotion are clear in the postcranial skeleton, where the form and composition of skeletal elements are uniquely modified to enhance aerodynamic function. Has flight had an equal impact on the structure of the skull and, if so, how might it have affected the evolution of feeding? Here I present data on the density and scaling of skull bones in bats, passerine birds, rodents, and "insectivorans" (i.e., erinaceomorphs, soricomorphs, and afrosoricids). Skull bone volume and mass scale with isometry in all groups, illustrating that skull bone density is constant across these disparate vertebrate taxa. Surprising patterns emerge when skull mass is regressed on brain mass. Both bats and birds exhibit low skull mass relative to brain mass but they accomplish this in very different ways. Skull mass scales with strong positive allometry in birds, rodents and insectivorans; birds simply have much less bone. Bats, on the other hand, are unique in that skull mass and brain mass scale with only very slight positive allometry. Thus, although the skulls of bats aren´t as lightweight as those of birds, they clearly bear the mark of selection for weight minimization. With respect to feeding, the skulls of bats are more likely to be tuned to the mechanical demands of feeding and less likely to be "overbuilt" than the skulls of other mammals. Links between skull structure and the loads encountered during feeding are explored using finite element models of New World leaf-nosed bats (Phyllostomidae) that exhibit very different skull shapes and feeding behaviors.

Student Poster Session (Thursday)

RESULTS FROM A PRELIMINARY STUDY OF THE BONE HISTOLOGY OF THE EARLY CRETACEOUS ALLOSAURID *ACROCANTHOSAURUS ATOKENSIS*

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The bone microstructure of many large theropods has been described, and the presence of lines of arrested growth (LAG's) has been used to estimate the relative age and maturity of these animals, as these features are deposited annually in closely related extant taxa. The results of microstructural analyses of a rib and tibia of one of the largest and most complete specimens of *Acrocanthosaurus atokensis* from the North Carolina Museum of Natural Sciences are reported here. Although LAG's are not well preserved in either the tibia or rib, extensive remodeling in both of these load- and non-load bearing bones suggests NCSM 14345 was a mature, full-sized individual. Intense remodeling in the rib's mid-shaft is supported by the presence of dense, multi-generation Haversian bone, although a region of primary fibro-lamellar bone lies along the dorsal margin. The shaft of the tibia is also heavily reconstructed, as evidenced by a trabecular marrow cavity surrounded by dense Haversian bone. The periosteal surface of the cortex shows a layer of primary fibro-lamellar bone with longitudal canals transitioning to plexiform bone with circular and radial canals. Near the periosteal surface, approximately seven closely spaced lamellae and a decline in the vasculature suggest the presence of an External Fundamental System (EFS), marking a cessation of growth that usually accompanies sexual maturity. This further supports the hypothesis that NCSM 14345 was a full-grown individual. By comparison, long bones from many large *Allosaurus* specimens show animals that were still growing, as their thin sections preserve LAG lines surrounded by primary bone, highly vascularized cortices, and an absence of the EFS. Therefore, NCSM 14345 may be one of the few fully mature allosaurid specimens, or, alternatively, indicate the potential for *Allosaurus* and *Acrocanthosaurus* to have undergone different growth patterns. Mid-shaft histological samples of load-bearing elements from NCSM 14345 and other *Acrocanthosaurus* specimens will help resolve this problem.

Student Poster Session (Thursday)

PALEOBIOLOGY OF AN EXCEPTIONALLY WELL PRESERVED FOSSIL OF THE MODERN WHITE SHARK *(CARCHARODON CARCHARIAS)* FROM THE PISCO FORMATION (NEOGENE) OF PERU

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Due to the lack of a calcified skeleton, the fossil record for cartilaginous sharks is based almost exclusively on unassociated teeth. In rare instances, however, vertebral centra and small pieces of cartilage can be preserved. In extremely rare circumstances, sets of associated shark teeth can be found in conjunction with vertebral centra and other cartilage fragments. Here we report on an exceptionally well-preserved specimen of the white shark, *Carcharodon carcharias* (Lamnidae) from the Pisco Formation near Sacaco, Peru. The Pisco Formation is exposed along the southern coast of Peru. It is composed of a terrestrial and marine sequence that spans the Miocene and Pliocene (14.0-2.0 million years ago). The Sacaco region is well known for its abundance of shark and marine mammal fossils. The material from this specimen includes: a complete associated dentition still within the fossilized jaws, portions of the endocranium, and approximately 25 to 30 vertebral centra. Such a complete specimen provides a unique opportunity to study size and growth, as well as a more detailed look at an early example of the modern *Carcharodon carcharias.* Based on tooth morphology and the growth curve of the extant white shark, this specimen was approximately 5.2 meters long, which is at the upper range of living examples. Growth annuli found within the vertebral centra were also analyzed using x-ray photography and isotopic signatures. In addition, samples of fossilized cartilage from the endocranium were found to contain preserved organics. This important specimen allows us to look at the paleobiology of the white shark in ways that have never been accomplished before.