ABSTRACTS

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Speaker's name in boldface. Abstracts will be added as they are received and accepted.

DENTAL MESOWEAR AND TRENDS IN PALEODIETARY ABRASION IN THE UNGULATE FAUNA OF FLORIDA FROM THE OLIGOCENE TO EARLY HOLOCENE

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Mesowear, a macroscopic measure of apical cusp morphology, serves as a proxy for dietary abrasion. Using mesowear analysis we documented paleodietary trends in the ungulate fauna of Florida from the Oligocene to the early Holocene to investigate the relationship of ungulate paleoecology with climate change and important paleoclimatic events postulated to have been important in the evolutionary paleoecology of ungulates, such as the spread of grasslands and the onset of glacial conditions, and to compare these paleodietary trends mesowear data for ungulates collected from other regions on North America. Essentially utilizing the entire Florida Museum of Natural History collection, mesowear scores were recorded on 2,491 fossil specimens including Equidae, Rhinocerotidae, Merycoidodontidae, Protoceratidae, Camelidae, Palaeomerycidae, Antilocapridae, Moschidae, Gelocidae, Cervidae, and Bovidae.

Overall, Florida ungulate data generally appear to have mesowear values indicating low abrasion diets prior to the Clarendonian, at which time the mesowear values of horses appear to broaden. In the late Miocene/early Pliocene, camels broaden slightly to mesowear values indicative of slightly more abrasive diets, particularly the late Miocene camel *Megatylopus*. At this time equids appear to shift to all having mesowear scores indicative of much more abrasive diets.

Mesowear suggests rhinos and artiodactyls maintained lower abrasion diets than horses from the late Miocene to early Holocene. Compared to studies of horse mesowear from elsewhere in North America, particularly the Great Plains, Florida horses appear to show similar patterns of shifting with climate change in the late Miocene to Holocene. The cervid *Odocoileus* and bovid *Bison* from the Pleistocene are the only artiodactyls with mesowear indicative of slightly more abrasive diets than other artiodactyls at this time, though they never reach the range or absolute highest values of the equids. Compared to other ungulates, horses show a much clearer trend and appear to have a stronger and more predictable response to paleoenvironmental change.

TAPHONOMY OF MIOCENE CETACEAN VERTEBRAE FROM CARMEL CHURCH QUARRY, VIRGINIA

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Carmel Church Quarry (CCQ), a granite quarry in Caroline County, Virginia, exposes six Tertiary formations within a 10-m-thick section, including the Calvert Formation. Published research on this site is limited and much of it involves systematic descriptions of organisms that have been found at the quarry. The research presented here contributes to the understanding of cetacean taphonomy, understanding the depositional environment at this site, and allows comparison of more western, near-shore Calvert deposits with more common eastern exposures. To evaluate the taphonomy of the cetacean material from the Calvert Formation at CCQ, I examined 288 prepared vertebrae housed at the Virginia Museum of Natural History. This study focuses specifically on determining whether preferential preservation is occurring among the four sections of the cetacean vertebral column (cervical, thoracic, lumbar, and caudal) and determining whether the environment is influencing the preservation of the vertebrae.

The vertebrae were measured for size (volume of centrum) and several anatomical and preservational observations were recorded: part of the vertebral column to which each belongs; whether it was found isolated, associated, or articulated with other vertebrae; preservation state on a scale of 1 (pristine) to 4 (heavily abraded); and presence or absence of epiphyses. We found that there are no biases in the preservation likelihood by vertebral region, with the exception of the atlases, which are over-represented relative to axes within the sample collection (X^2_2=47.067, p<0.0001). Adult vertebrae tend to be better preserved than juvenile and calf vertebrae (X^2_2=37.109, p<0.0001). Articulated and associated vertebrae tend to be better preserved and larger than isolated vertebrae (X^2_2=73.958, p<0.0001). Articulated vertebrae and those in more pristine condition came from adults (i.e., both epiphyses present). Some aspects of the sedimentology suggest a low-energy environment, e.g., the presence of angular sand grains and well-preserved and articulated vertebrae; however, the abundance of large, well-rounded cobbles suggests a high-energy environment. Overall, preservation state may be more related to the size of individuals than to the energy of the environment.

THE FOSSIL RECORD OF THE DIAMONDBACK TERRAPIN, *MALACLEMYS TERRAPIN* (TESTUDINES: EMYDIDAE)

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The fossil record of the diamondback terrapin (*Malaclemys terrapin*) is scant. Prior to this investigation, the only published reports included two late Pleistocene carapace fragments recovered from South Carolina, a late Pleistocene faunal list inclusion from the Page-Ladson locality in the Aucilla River of Florida, and Holocene shell and postcranial elements from Bermuda. Here we describe new fossil material of the diamondback terrapin from Edisto Beach, South Carolina, the South Brunswick River, Georgia, and specimens from the Aucilla and Wekiva Rivers in Florida. In total we identify 16 previously undescribed individual shell elements, expanding the fossil record for the genus *Malaclemys* into Georgia and central Florida. Specimens represent isolated carapacial bones from a number of different individuals. Fossils are identified as *Malaclemys* based on the features of scute sulci and the presence of annuli scars on most specimens. Today, diamondback terrapins occur along the Atlantic and Gulf coasts of the United States from Cape Cod, Massachusetts to south Texas, with a disjunct population of curious origin existing in the Bahamas. Unlike other emydids, *Malaclemys* is completely adapted to brackish water salt marshes, estuaries, and tidal creeks. The fossil localities appear to reflect historical shorelines during Pleistocene glacial-interglacial cycles.

THE OSTEOHISTOLOGY OF HADROSAURID DINOSAUR TEETH– REPTILES THAT EXCEEDED MAMMALS IN DENTAL COMPLEXITY?

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Horses, bison, and elephants have grinding dentitions for finely titrating extremely tough and abrasive plants. Their teeth are among the most sophisticated ever to evolve, being composed of intricate multi-tissue complexes that self wear to create the coarse chewing surfaces needed for this type of diet. Reptilian teeth are considerably more simplistic. Nevertheless, one group, the duck-billed dinosaurs (Hadrosauridae), evolved a similar dentition. This innovation allowed them to become the first animals to broadly exploit flowering plants and dominate Laurasian herbivorous niches for over 35 million years. Did these reptiles somehow evolve advanced mammal-like dental sophistication? We used modern histological techniques to reveal that hadrosaurid cheek teeth were much more complex that previously realized, and actually exceeded mammals in complexity. Six tissues were present on the occlusal surfaces of their dental batteries. These include coronal cementum, a tissue often cited as evidence for the advancement of mammalian dentitions beyond those of reptiles. Variance in the distributions of these tissues within teeth and between taxa allowed for changes in form and function relevant to feeding ecology.

PHYLOGENETIC ANALYSIS OF THE SLOTH FAMILY MEGALONYCHIDAE (MAMMALIA, XENARTHRA, FOLIVORA) BASED ON CRANIAL DATA

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Megalonychids are the only family of sloths that includes both extinct and extant taxa. The family first appeared in the Oligocene of South America, yet is poorly known from the Plio-Pleistocene of that continent relative to other sloth families. It is characterized by early dispersal to North America, becoming geographically widespread in the Pleistocene, and encompassing an endemic West Indian radiation that persisted well into the Holocene. Despite the family's paleobiological significance, megalonychid phylogeny has remained poorly understood. The goal of the present study is to reexamine phylogenetic relationships within the family based on a detailed study of cranial skeletal anatomy. We examined representatives of the sole extant genus, *Choloepus*, along with 11 extinct genera from North and South America and the West Indies. A matrix of 54 discrete osteological characters and 13 taxa was constructed and analyzed using PAUP 4.0b10. Characters were polarized via comparison to a single monophyletic outgroup, *Hapalops*, an early, relatively plesiomorphic megatherioid sloth. All characters were equally weighted and 15 of the 20 multistate characters were ordered along numerical, positional, or structural morphoclines. A branch-and-bound analysis resulted in four most parsimonious trees (TL = 190, CI = 0.549, RI = 0.503). In the strict consensus tree, the South American Santacrucian taxa *Megalonychotherium* and *Eucholoeops* formed successive sister taxa to other megalonychids. The remaining late Miocene–Recent taxa fell into a basal multichotomy that included the South American *Pliomorphus*, the continental North American taxa *Pliometanastes* and *Megalonyx*, a clade including two newly discovered taxa from the South American Pleistocene, and a crown clade. The crown clade united *Choloepus* with the endemic radiation of West Indian sloths. *Choloepus* nested inside this clade, in an unresolved trichotomy with the small-bodied genus *Acratocnus* and the Megalocninae, a monophyletic grouping of large-bodied Antillean sloths.

PALEOECOLOGICAL IMPLICATIONS OF PLEISTOCENE MICROMAMMALS FROM SOUTHWEST CHINA

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Spatial, temporal, and ecological patterns of Quaternary micromammals in China remain largely unknown. A lack of literature in English, poor sampling of modern specimens, and paucity of microfossil recovery have all contributed to this problem. However, the recent systematic excavation of an important hominin bearing locality in southwest China has yielded a diverse assemblage of small mammals which highlights their potential as ecological indicators. The locality, called *Homo sapiens* Cave, is located in Mulan Mountain, Chongzuo, Guangxi Province. U-series dating places the fossil bearing deposit between 111,000 and 100,000 years old. In addition to the site bearing an early occurrence of *Homo sapiens*, the time period is suggestive of a changing environment, as it falls around the transition of the middle to late Pleistocene in China. Because the locality is within the oriental zoogeographical region, most species are expected to have a tropical or subtropical affinity. However, because of the time frame, the climate may have been changing from wet (forested) to dry (savannah) conditions due to the monsoonal fluctuation. It is well known that oscillating environments and non-analogous communities were common during the Pleistocene, but more research is required to understand how climactic changes influence the biota of tropical localities in southeast Asia. Small mammal identification and their relative abundances at *Homo sapiens* Cave will add to the slowly but surely growing knowledge of micromammal distribution and possible range expansions or contractions during the Pleistocene.

PHYLOGENETIC AND PALEOBIOGEOGRAPHIC IMPLICATIONS OF NEW FOSSIL CAIMANS (CROCODYLIA, ALLIGATORIDAE) FROM THE MIOCENE OF PANAMA

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Fossil crocodylians of Central America have been limited to fragmentary postcranial and mandibular remains. Two new fossil crocodylian partial skulls were recently recovered from the Panama Canal Zone, in central Panama. These skulls represent the oldest well-preserved cranial crocodylian fossils recovered from Central America. The older of the two skulls, from the Early Miocene Culebra Formation, includes much of the left snout, mandible, and braincase including many teeth in articulation. This new skull clearly exhibits primitive morphology common to caimans and alligators including an enlarged external mandibular fenestrae, supratemporal fenestrae with imperforate walls, and dermal bones not overhanging the supratemporal fenestrae. However, it also has an enlarged exposure of the supraoccipital, a derived synapomorphy of Caimaninae, the group that includes all fossil and living caimans. A slightly younger crocodylian skull was discovered in the early/middle Miocene Cucaracha Formation. This skull, with nearly complete braincase and interorbital section, has supratemporal fenestrae with overhanging dermal bones, a more derived feature common to crown group Caimaninae. More derived caimans have been found in older formations in the Paleocene of South America and Eocene of North America. Given the probable origin of the common ancestor of alligators and caimans in North America, many have interpreted the caiman origin as having occurred in North America, with a Paleocene or earlier immigration into South America. The presence of basal caimans in the Miocene of Panama suggests an approximately 40-million-year ghost lineage of primitive caimans. Given the likely separation of Central and South America at the time, the ancestral population of the Panamanian taxa was likely present in the undersampled Paleogene of Central America, while other members of its population immigrated into northern South America. Alternatively, basal caimans may have arrived in northern South America in the Paleogene and then immigrated back into Central America in the Miocene.

AN UPDATE ON THE *MEGALONYX JEFFERSONII* MATERIAL FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA

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From the summers of 1985 to 1987, workers with the former Red Mountain Museum collected the remains of multiple individuals of Jefferson's Ground Sloth, *Megalonyx jeffersonii,* from one cave, ACb-3 in Colbert County, Alabama. The original excavation team believed that they had found a minimum number of 16 ground sloth individuals ranging from juvenile to adult. When the Red Mountain Museum closed, all of the fossils from ACb-3, including hundreds of other specimens, were transferred to the McWane Center in Birmingham. Only minor research has been done on the geology of the cave with no published articles on its fauna. A recent visit to the cave locality provided insight into where the individual sloths were excavated and to determine if published dates could be associated with ground sloth individuals. New speleothem samples were collected at the locality, dated, and compared to previously published dates from the cave in an attempt to provide a relative age to some of the ground sloths. The recovered sloths range in individual age from fetal to adult and provide the best known evidence of denning and possible maternity use of caves by ground sloths. An ontogenetic sequence from the cave will be examined to see how the osteology of *Megalonyx* changes with age.

MILLENIUM PARK, A NEW RANCHOLABREAN SITE FROM CENTRAL FLORIDA: EVIDENCE OF THE ELUSIVE SOUTHEASTERN PLEISTOCENE PRAIRIE FAUNA

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In 2007, tens of thousands of vertebrate fossils were recovered near modern sea level in an urban park located in southwestern Pinellas County, Florida. Many were found in situ over a 120-meter-long interval in the banks of a small creek, while others had eroded out of the bank and were recovered in the stream bed. The in situ specimens came from a stratigraphically narrow interval of about 25 cm and were locally concentrated to form a bone bed. Three distinct time intervals are represented by the fossils: two different ages (early Miocene and early or middle Pleistocene) of reworked, primarily marine bony fish, sharks, and rays; and a late Pleistocene terrestrial-freshwater community. The latter, termed the Millennium Park Local Fauna (LF), is the primary focus of this investigation. The presence of *Sigmodon hispidus*, *Oryzomys palustris*, *Microtus pinetorum*, *Neofiber alleni*, and *Bison antiquus* constrain the age of the Millennium Park LF to the late Rancholabrean (ca. 120-11 ka). About 50 species have been identified from the Millennium Park LF to date, including 12 members of the extinct Pleistocene megafauna, e.g., *Smilodon fatalis*, *Glyptotherium floridanum*, *Holmesina septentrianalis*, *Mammuthus columbi*, *Equus* sp., *B. antiquus*, and *Hesperotestudo crassiscutata*. The vast majority of the recovered fossils experienced a high degree of pre-burial breakage, such that less than 5 percent can be identified. The fragments show no evidence of rounding caused by fluvial transport, nor bite marks or other indications of scavenging by bone-crushing carnivores. A high frequency of weathering cracks suggests instead that they were damaged by long-term (i.e., years) exposure in an open, dry habitat, perhaps coupled with some trampling. Most of the fossils that survived relatively intact are those that are most robust, such as isolated teeth and carpal and tarsal elements. But an unusual aspect to the fauna is the high incidence of complete, well-preserved osteoderms, both reptilian and mammalian, that make up about a third of the identifiable specimens. The Millennium Park LF is dominated numerically by species that prefer relatively dry, open habitats. The widespread presence of 'prairies' in the Southeast during the Pleistocene is supported by palynological evidence, but vertebrate sites composed primarily of prairie species are rare due to taphonomic biases favoring preservation in more mesic habitats. Millennium Park is the first late Pleistocene fauna known from Florida in which both small (*Sigmodon*, *Sylvilagus*) and large (*Bison*, *Equus*, *Mammuthus*, *Glyptotherium*) mammals are dominant (> 75% of identified fossils) members of the prairie fauna. Likewise, the herpetofauna is numerically dominated by terrestrial taxa (*Hesperotestudo*, *Terrapene*, Colubrinae) rather than the freshwater taxa that are often very abundant at Florida Pleistocene sites.

PROBLEMS WITH THE CLASSIFICATION OF FOSSIL EMYDIDS (TESTUDINES: EMYDIDAE) AND THE NEED FOR RE-EVALUATION OF *TRACHEMYS*

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The genus of river turtle known as *Trachemys* (Testudines: Emydidae) has had a tumultuous history. The Emydidae is the largest and most diverse family of extant Testudines and includes 2 subfamilies (Emydinae and Deirochelyinae) currently comprised of 12 genera. The Deirochelyinae, which includes *Deirochelys*, *Chrysemys*, *Graptemys*, *Malaclemys*, *Pseudemys*, and *Trachemys*, has had frequent problems with its members and relationships, specifically with those of *Chrysemys*, *Pseudemys*, and *Trachemys*. There have been numerous combinations and divisions of these taxa at one time or another. While *Trachemys* is now considered a valid genus, many of its apomorphic characters are valid only for extant turtles. Fossils of *Trachemys*, however, create further problems. The discovery of a fossil emydid reported to be *Trachemys* from the Mio-Pliocene Gray Fossil Site in eastern Tennessee has forced a re-evaluation of the identification of deirochelyines based on osteology. Presently, systematics of extant turtles is heavily weighted towards outer shell morphology (i.e., scutes), color, behavior, and especially DNA sequencing. This, of course, is not very helpful with fossil specimens, and the osteology is commonly under-represented or neglected in studies on modern taxa. Characters of the posterior shell morphology, particularly the notching between the peripherals and the marginals, once thought to be diagnostic of *Trachemys*, have been found in other emydid taxa such as *Graptemys pseudographica*. Morphology of the triturating surface of the jaws, also thought to be useful in distinguishing *Pseudemys* from *Trachemys*, has a high degree of intraspecific variation, limiting its use in identification. Before fossil emydids can be securely identified to one of the extant genera, diagnostic osteological characters must be derived from large, geographically broad samples of modern specimens that represent all known species in each genus. Features of the shell will be more useful for identifying fossils, as elements from the plastron and carapace are far more commonly recovered than cranial or post-cranial material. Once these diagnostic characters are discovered, then the many fossil species attributed to the various extant emydid genera can be re-evaluated.

A SKULL OF THE EXTINCT RIGHT WHALE *BALAENULA* FROM LAKE WACCAMAW STATE PARK, NORTH CAROLINA

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A nearly complete balaenid skull was collected in May 2008 from the late Pliocene Bear Bluff Formation exposed at the bottom of Lake Waccamaw, North Carolina. The skull was preserved ventral-side-up, with the dentaries apparently having fallen to each side of the cranium. The ventral-most portions of the skull are abraded and largely missing, including the glenoid fossae and postglenoid processes, most of the palatines, and the anterior ends of the premaxillae and dentaries. The bone in these areas is highly pitted, presumably from boring invertebrates. Numerous circular scars attributable to barnacles are also located on the ventral surfaces. No postcranial remains from the specimen were recovered.

The cranium as preserved is 165 cm in length. It has the extreme telescoping, arched rostral bones, and dorsoventrally compressed tympanic bulla typical of balaenids. In addition, the dentary possesses an anterior torsion and lacks a distinct coronoid process, again typical of balaenids. The tight closure of most of the cranial sutures suggests that this was a mature animal at the time of death. Several features indicate that it is referable to the genus *Balaenula*, including: 1) small overall size; 2) large, block-like nasals; 3) approximately right angle between posterior and anterior processes of the petrosal; 4) anteriorly oriented squamosal; and 5) right angle formed between supraorbital processes of frontals when viewed anteriorly. The Carolina specimen differs from *Balaenula astensis* from Italy in the following characters: 1) exocciptials not angled posteriorly; 2) supraoccipital not hidden by lambdoidal crest in lateral view; 3) rostrum more strongly arched; and 4) anterior and posterior supraoccipital fossae absent. Comparison of the Lake Waccamaw specimen with *Balaenula balaenopsis* from the Pliocene of Belgium is underway.

This specimen represents the first report of *Balaenula* from the Bear Bluff Formation, which has an approximate age of 2.75 Ma. All other specimens of *Balaenula* reported from the east coast of North America were recovered from the Sunken Meadow Member of the Yorktown Formation, with an approximate age of 4.5 Ma. *Balaenula balaenopsis* from Belgium and undescribed *Balaenula* specimens from Japan and California are Pliocene in age, but their ages are poorly constrained, while *B. astensis* from Italy has an approximate age of 3.5 Ma. The Lake Waccamaw specimen is thus possibly the youngest known occurrence of *Balaenula*.

PHYLOGENY OF *PANTHERA*, INCLUDING *PANTHERA ATROX,* BASED ON CRANIAL AND MANDIBULAR CHARACTERS

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Over the past twenty years both morphological and molecular phylogenies have been proposed for extant and extinct members of the family Felidae. However, there remain several discrepancies, particularly within the genus *Panthera* (Figure 1), likely due to the very recent diversification within the family. These inconsistencies suggest the need for further analysis and perhaps even different methodology to truly understand pantherine evolution. Therefore, we propose to morphologically analyze *Panthera* (including all extant and one extinct taxa) to gain a better understanding of pantherine phylogeny. Results will provide a better idea of what cranial characters/character suites define each taxon, as well as a better understanding of the phylogeny within the genus; specifically, the placement of the extinct American 'lion' *Panthera atrox*, as its evolutionary relationships are still debated. In order to create an accurate reflection of the phylogeny of the pantherine cats, multiple specimens of each extant member of *Panthera*, including: *P. leo* (African lion), *P. tigris* (tiger), *P. onca* (jaguar), *P. pardus* (panther), *Uncia uncia* (snow leopard), and *Neofelis nebulosa* (clouded leopard) will be analyzed. The latter two taxa are considered pantherine, though not in the genus *Panthera*, due to their consistent placement in various phylogenetic trees as ancestral to the *Panthera* group.

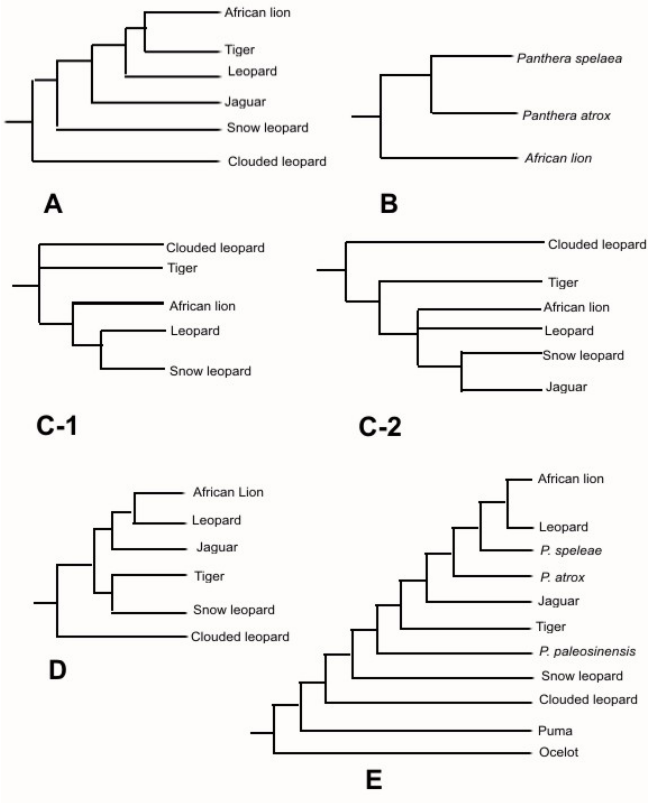

Figure 1. Phylogenetic trees from previous studies using either morphological or genetic data from *Panthera*. (A.) mitochondrial DNA (modified from Johnson and O'Brien, 1997); (B) mitochondrial DNA (modified from Barnett et al., 2009); (C) 1- β-fibrogen and 2- mt ND2 and ND4 (modified from Yu and Zhang, 2005); (D)Y- specific haplotypes (modified from Davis et al., 2010); and (E) morpho-logical characters (modified from Christiansen, 2008).

FORELIMB POSTURE AND INFERRED FEEDING ECOLOGY OF THE EXTINCT GIANT SHORT-FACED BEAR (*ARCTODUS SIMUS*): A POSTCRANIAL, GEOMETRIC-MORPHOMETRIC APPROACH

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The locomotion style of the Pleistocene North American giant short-faced bear (*Arctodus simus*) has intrigued paleontologists for decades. Envisioning *A. simus* as a cursorial predator has excited the imagination ever since Kurtén in 1967 interpreted this species as an enormous pursuit predator rather than a lumbering omnivorous wanderer like most modern bears. He based this inference on the shortened rostrum, gracile and elongate limbs, and more parasagittal orientation of the manus that seemed convergent with large felids. In fact, the first hinting at an atypical locomotion for *A. simus* arose in 1925 when Merriam and Stock noted that metacarpal I appeared to be less medially divergent than in extant ursids. A locomotion and dietary debate has since ensued that has invoked many lines of evidence including geometric morphometrics, stable isotope analyses, morphological comparisons, and Pleistocene home range and food production models. To date, *A. simus* has been called predaceous, omnivorous, herbivorous, and an obligate scavenger. The majority of studies thus far have focused attention on the skull and dentition of *A. simus*, neglecting those characters of the manus observed many decades ago. However, it has long been understood that the morphology of the forelimb is in an "arms" race between locomotion and feeding ecology. Thus, it is hypothesized that the forelimb of *A. simus* should contain much insight into dietary behavior. To address this question in *A. simus*, the elements of the forelimb, including carpals and metacarpals, will be compared with a variety of extant carnivorans that represent a wide range of locomotion and feeding behaviors: the modern lion (*Panthera leo*), spotted hyena (*Crocuta crocuta*), gray wolf (*Canis lupus*), American black bear (*Ursus americanus*), sun bear (*Helarctos malayanus*), polar bear (*Ursus maratimus*), and spectacled bear (*Tremarctos ornatus*), the closest living relative of *Arctodus*. Principle components and step-wise discriminant function analyses will be used to statistically determine which extant species the forelimb skeletal morphology of *A. simus* most closely resembles. Three different types of data will be collected and analyzed including linear ratios and angular measurements, digitized element outlines, and three-dimensional landmarks. By running three separate analyses using each set of data, more robust conclusions can be drawn and the merits and success of each data type can be assessed.

A HALF-CENTURY OF FIELD AND RESEARCH DISCOVERIES IN VERTEBRATE PALEONTOLOGY AT THE FLORIDA MUSEUM OF NATURAL HISTORY

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Since the middle of the 20th century, a hallmark of the Vertebrate Paleontology (VP) program at the FLMNH has been the integration of active field programs linked to research. This talk will review some (but certainly not all) of the important localities and biochronologic sequences from Florida that have become associated with our program, as well as advances to knowledge that have resulted from these activities. The success of this program is largely a result of the hard work and vision of the VP curators, staff, students, volunteers, and supportive private collectors in Florida.

Late Eocene limestones of the Ocala Group preserve early evidence of archaeocete whales and sirenians. The first terrestrial vertebrates documenting the emergence of the northern core of peninsular Florida comes from the middle Oligocene (Whitneyan) I-75 Local Fauna (L.F.) discovered in 1965 during excavations for the I-75 interstate highway in Gainesville. Late Oligocene (Arikareean) discoveries are represented by the White Springs L.F. and Buda L.F. from northern peninsular Florida. The early Miocene (Hemingfordian) is represented by the classic Thomas Farm L.F. The middle Miocene (Barstovian) is represented by several smaller localities from both central Florida and the panhandle. Late Miocene localities are represented by the Clarendonian Love Bone Bed L.F. and early Hemphillian Moss Acres L.F. and McGehee Farm L.F., and from the classic Hemphillian localities (some also of earliest Pliocene age) of the Bone Valley phosphate mines of central Florida. Early Pleistocene localities (Blancan and Irvingtonian) include Santa Fe River, Haile 7C, Inglis, the Desoto Shell Pit and the extraordinarily rich Leisey Shell Pit. Late Pleistocene (Rancholabrean) localities are found from about 500 localities throughout much of the state.

The vertebrate fossils collected from this relatively rich and continuous sequence in Florida spanning almost 40 million years provides important and/or unique evidence of marine and non-marine correlations, phylogeny, and faunal evolution at the southeastern limits of North America. The Florida sequence during the Neogene provides evidence for theoretical concepts and major biotic events such as biogeographic refugia, the Neotropical Gulf Coastal Savanna Corridor, herbivore responses to the spread of grasslands, the Great American Biotic Interchange, and late Pleistocene megafaunal extinctions.

COMPARING THE PALEOECOLOGY OF THREE SUBTROPICAL TO TROPICAL EARLY MIOCENE FAUNAS IN THE NORTH AMERICAN CONTINENT

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The early to middle Miocene had a relatively warm and equable climate and the paleoecology of this time in mid-latitude North America is well-documented. However, there have been few studies on the paleoecology of low-latitude terrestrial Neotropical faunas. The paleoecology from three early Miocene faunas were analyzed using bulk carbon and oxygen stable isotope values calculated from the dental enamel of herbivorous land mammals (Camelidae, Equidae, and Rhinocerotidae). The Thomas Farm Local Fauna (Hemingfordian, ~18 Ma) is from north-central Florida and is tropical to subtropical. The two other faunas are tropical and are from separate stratigraphic horizons within the Gaillard Cut located along the Panama Canal in Panama, Central America. The Las Cascadas Fauna is the older of the two (older than 23 Ma; Arikareean). An unconformity and the marine Culebra section separates it from the overlying Centenario Fauna (Hemingfordian?). The values for $\delta^{13}C$ were not significantly different between the three faunas and they imply a C3 dominated diet for all of the mammals that were sampled. The $\delta^{13}C$ values in the *Parahippus leonensis* (Equidae) samples from Thomas Farm had a large range, -11.39‰ to -5.23‰, suggesting a varied diet within the species that may have included water-stressed plants or possibly even some C4 grasses. The $\delta^{18}O$ values were not significantly different between the Las Cascadas and Centenario faunas, but they were significantly different when comparing Thomas Farm to each Panamanian fauna. This implies that Panama was most likely getting more rain annually in the Miocene than north-central Florida. It also suggests that the evaporation sources of precipitation for Florida and Panama in the Miocene were different than they are today. Today, precipitation is supplied to both Florida and Panama from a warm Atlantic source and has a similar isotopic signature. In the Miocene, the evaporation source for Panama was significantly more negative than the source for Florida, which suggests that the closing of the Panamanian land bridge in the late Miocene may have created a change in precipitation sources on the southern North American continent.

URANIUM SERIES DATING: APPLICATIONS TO PLEISTOCENE CHRONOLOGY

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Uranium series dating or more appropriately Uranium Series Disequilibrium Dating (USDD) has been successfully applied to corals, travertine, eggshell, tooth enamel, and wood, but less successfully to oyster shell, peat, cementum, dentine, and bone. In Florida the abundance of carbonates, flora, and fauna in close association provides opportunities for studies on uranium uptake and comparative dating with Electron Spin Resonance (ESR), Optically Stimulated Luminescence (OSL), and Radiocarbon techniques.

Applications of USDD to any material require certain conditions to be fulfilled for a closed system. They are: 1. Uranium must enter the system during the formation, growth, or the short time during burial of the material and not be gained or lost after burial except for radioactive decay. 2. Thorium-230 must be not be gained or lost except by radioactive decay. Certain open systems can be modeled when multiple samples are analyzed to remove the effects of thorium contamination and uranium gain or loss. In general, successful dating is accomplished by analyzing multiple samples of differing materials and getting a consistent age. Under conditions of burial in impermeable matrix almost every type of sample can dated using closed system assumptions. The Dade-Collier Training and Transition Airport (TNT) vertebrate locality is an example of this condition.

During the late 1960s and early 1970s, work began on a new Dade Collier Jetport in the Everglades that was to be the largest airport in the USA and one suited for supersonic aircraft. That this environmental disaster was averted is one of the early successes of the new Environmental Protection Agency (EPA) inaugurated under President Nixon. During construction of the first runway (still in use today for training flights), a barrow pit (the most eastern on the south side) was excavated to provide fill for the runway. This fill contained fossil bones and teeth of horses, camels, and proboscideans. The limestone containing the bones was set aside as it was not suitable as runway fill and other pits were dug where the rock was more suitable. Today the area may be reopened to excavate rock for making cement. Samples of bone, tooth dentine and enamel, and marl were analyzed by USDD, and produced an average age of 300,000 years BP and greater.

The age of other South Florida localities has been determined by the USDD method using tooth enamel. These include the Monkey Jungle sinkhole fill containing horse teeth which dated to about 150,000 years BP; the Cutler Hammock Sinkhole also horse teeth were dated to about 17,000 years BP; and the Bonita Springs Mastodon to greater than 300,000 years BP.

HELODERMATID LIZARD FROM A MIO-PLIOCENE OAK-HICKORY FOREST FROM EASTERN TENNESSEE, USA, AND A REVIEW OF MONSTERSAURIA OSTEODERMS

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The extant venomous Gila monster and beaded lizards, species of *Heloderma* live today in the southwestern USA and south along the Pacific coastal region into Central America, but their fossil history is poorly understood. Here we report helodermatid osteoderms (dermal ossicles) from the late Miocene-early Pliocene Gray Fossil Site (GFS), eastern Tennessee, USA. Twenty-three species of mammals are known from the fauna including abundant *Tapirus polkensis*, as well as fish, anurans, salamanders, turtles, *Alligator*, birds, and snakes. Beaded lizards belong to the Monstersauria, a clade that includes *Primaderma* + *Paraderma* + *Gobiderma* + Helodermatidae (*Estesia, Eurheloderma, Lowesaurus*, and *Heloderma*). Osteoderms of lizards in this clade are unique within Squamata; they typically are circular to polygonal in outline, domed to flat-domed in cross-section, have a vermiculate surface texture, are not compound structures, and do not have imbricate surfaces as in many scincomorph and anguid lizards. We review and characterize the osteoderms of all members of Monstersauria. Osteoderms from the cranium, body, and limbs of *Heloderma* characteristically have a ring-extension (bony flange) at least partly surrounding the dome. Its presence appears to be a key character distinct to all species of *Heloderma*, consequently, we propose the presence of a ring-extension to be an apomorphy. Three osteoderms from the GFS range from 1.5 to 3.0 mm in diameter, have the circular shape of helodermatid osteoderms with a domed apical surface, and have the ring-extensions permiting the generic identification. Macrobotanical remains from the Gray Fossil Site indicate an oak-hickory subtropical forest dominated by *Quercus* (oak) and *Carya* (hickory) with some conifer species, an understory including the climbing vines *Sinomenium*, *Sargentodoxa*, and *Vitis*. The Gray Fossil Site biota has a strong Asian influence.

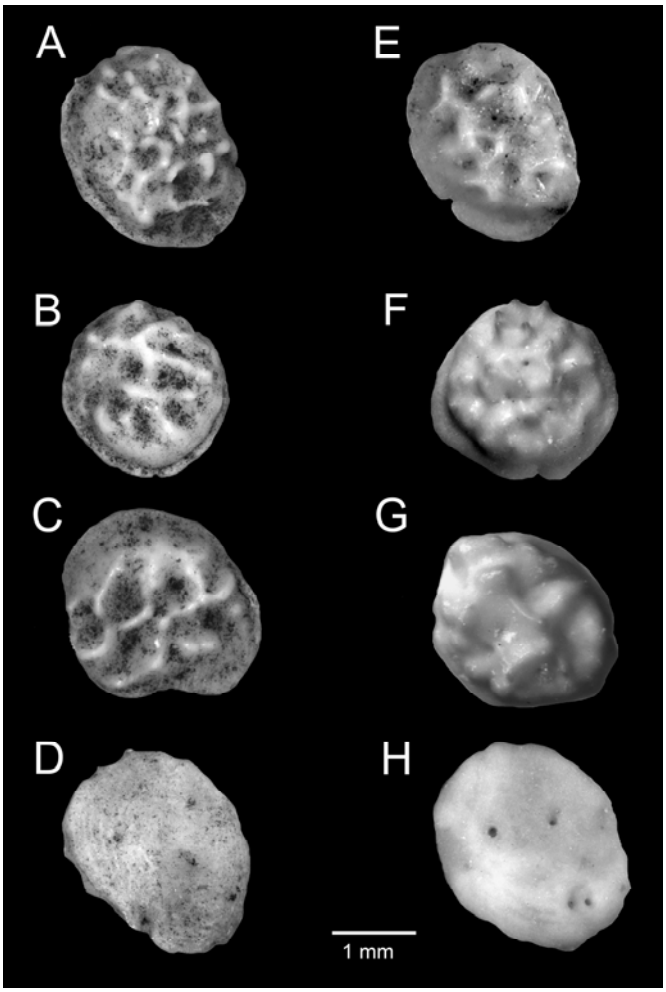

Figure 1. A-C, apical view and (D) basal view (of C) of three *Heloderma* osteoderms (ETMNH 8746) recovered from the Gray Fossil Site. E-G,apical view and (H) basal view of three extant *H. horridum* (ETVP 7083) isolated osteoderms showing varying degrees of a bone ring-extension around the tubercle.

ACCOUNTING FOR AND MINIMIZING OBSERVER BIAS IN PALEODIETARY PREDICTIONS DERIVED FROM DENTAL MICROWEAR ANALYSIS

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Many previously published dental microwear (DM) studies that utilize light microscopy are problematic because observer error has not been investigated, despite some claims that observer bias is a significant source of error. DM features are often categorized without explicitly defined size or shape criteria, the data are often collected by multiple observers, and we have found that published descriptions of commonly adopted methods are incomplete, rendering them irreproducible. For these reasons, the results of many published microwear studies may be suspect. A new method of DM analysis, using light microscopy, is described and observer error, using this newer methodology, is measured. Five observers with varying degrees of prior experience with dental microwear analysis examined identical sets of images of molar wear surfaces from a variety of extant browsing and grazing ungulates. The digital images were taken through a light microscope with a resulting resolution of 33,846 dpi. DM features were partitioned into standardized scratch-width and pit-diameter categories. The images included in each analysis were randomly ordered and none of the observers were aware of the species identity or diets of the specimens. Correlation coefficients were initially low, but improved iteratively as all five observers gained experience until correlation coefficients became highly significant. However, significant differences in the mean numbers of microwear features persisted and there was no trend for iterative improvement in interobserver comparisons of means. The number of DM features recognized per image is heavily influenced by the observer although observers very easily found the same relative differences. Plotting the data show that each observer produced nearly identical clusters of specimens even though the positions of these clusters in bivariate space differ from observer to observer. The widely adopted practice of comparing mean numbers of pits and scratches when the data are collected by multiple observers or compiled from multiple publications may produce dubious results. We suggest that researchers interested in comparing the microwear of extinct species with those of extant species with known diets collect their own data from randomly ordered images rather than combine their data with pre-published extant microwear databases collected by other observers.

A NEW GLYPTOSAURINE LIZARD FROM THE EOCENE OF SAN DIEGO COUNTY, CALIFORNIA

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The glyptosaurine lizards represent an extinct subfamily of anguid lizards, mostly from the Paleogene. They were at their peak during the Eocene, with fossil forms widespread across Europe and North America, and rare in Asia. In North America, the majority of glyptosaurines are found in the Rocky Mountain region, from which several recognized genera are known. Given their wide distribution, the glyptosaurines were likely an important part of Paleogene ecosystems in Europe and western North America.

A previously undescribed specimen from the Santiago Formation in San Diego County, California, of late Uintan age, is notable for its geographic location, being one of very few glyptosaurines known from Southern California, and by far the most complete from this formation. This specimen also appears to have a distinct morphology from previously described glyptosaurine taxa, and may represent a new species or genus. The specimen includes several cranial elements and many osteoderms, both of which have been used commonly in past studies for differentiating glyptosaurine taxa. Thus, this specimen is complete enough to allow for detailed comparison with known forms. Determining the taxonomic position of this specimen will allow for further clarification of the systematics of the subfamily, a topic which has been the subject of much deliberation and revision in the past, as well as shedding light on the distribution and ecology of the glyptosaurine lizards during their peak of diversity in North America.

NICHE PARTITIONING IN FOSSIL SHARKS? A COMPARISON OF TOOTH BREAKAGE RATES IN MIOCENE CARCHARHINIFORM SHARKS FROM THE CARMEL CHURCH QUARRY, CAROLINE COUNTY, VIRGINIA.

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Excavation of marine sediments of the middle Miocene Calvert Formation at the Carmel Church Quarry has resulted in the collection of thousands of shark and ray teeth. Commonly found shark teeth include four genera of charcharhiniforms, *Hemipristis*, *Carcharhinus*, *Physogaleus* and *Galeocerdo*, among others. Unlike most large collections of shark teeth, the Carmel Church specimens were all collected in situ from a single bed with a maximum thickness of less than 1 m. While the majority of teeth from Carmel Church represent clearly reworked specimens, a substantial portion show no evidence of reworking and provide a sample that may represent the local population of sharks over a relatively short period of time. Multiple shark taxa with similar tooth morphologies and body sizes may have coexisted through niche partitioning. This could have been achieved through behavioral variations such as temporal segregation (diurnal or nocturnal habits, or seasonal movements) or through variations in dietary preferences. In order to test for evidence of variation in dietary preferences, tooth breakage frequency and height-thickness ratios were examined in four shark genera that are broadly similar to each other in size and tooth morphology – *Hemipristis*, *Galeocerdo*, *Physogaleus* and *Carcharhinus*. Preliminary results show *Carcharhinus* with a higher frequency of breakage at the apex of the tooth than that of *Hemipristis*.

NEW EARLY MIOCENE CAMELIDS (FLORIDATRAGULINAE) FROM PANAMA: FILLING THE TROPICAL UNGULATE FOSSIL GAP

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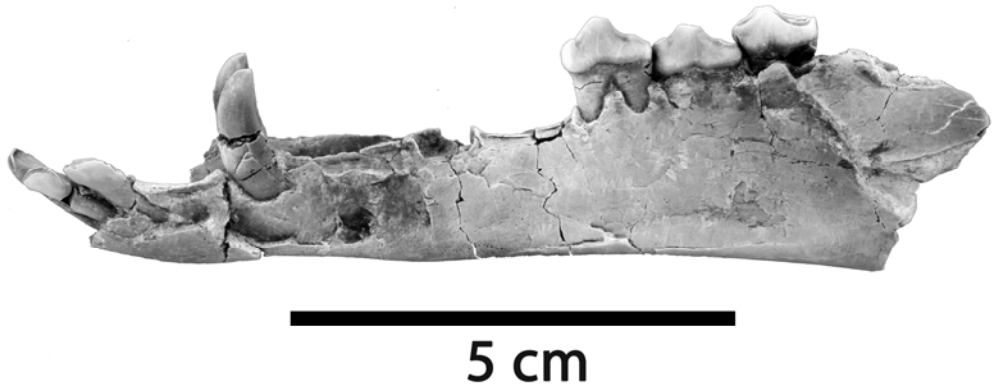
Early to middle Miocene floridatragulines are a bizarre group of camels characterized by extremely elongated snouts, shallow and narrow mandibular symphyses, and relatively primitive dentitions. The fossil record for this clade is currently restricted to subtropical localities such as the Barstovian Burkeville and Cold Spring faunas of coastal Texas, the Hemingfordian Thomas Farm Local Fauna (L.F.) in Florida and the Zoyotal L.F. in Mexico, and the Arikareean Castolon L.F. in western Texas. Here we report two new species of the floridatraguline camel *Aguascalientia* well represented by partial jaws and isolated teeth from the early Miocene Las Cascadas Formation in the Panama Canal Area, Central America. The specimens can be attributed to the genus *Aguascalientia* based on the following characters: 1) a complete lower dental formula; 2) brachydont teeth; 3) an unusual elongated jaw with 2 caniniform teeth (c and p1) well separated by a diastema; 4) a long and narrow mandibular symphysis; 5) reduced lower premolars; 6) variably present small intercolumnar pillars present in the molars; 7) an m3 hypoconulid divided by lingual and labial selenes; and 8) the lack of a presumably more derived p2-p3 diastema (present in *Floridatragulus*). Preliminary biochronological interpretations indicate that the Las Cascadas Fauna constitutes a distinctive early Miocene faunal province characterized by the arrival of immigrants into a small continental basin directly connected with more northerly North American continental terrains. The new material also supports a paleobiographical relationship between small camelids from the earliest Miocene Buda Local Fauna in Florida and early to middle Miocene floridatragulines from Central America, Texas, and Florida.



Left lateral view of UF 254129, a partial mandible of *Aguascalientia* n. sp. from the Las Cascadas Formation, Panama. Visible teeth from the left side are i1-i3, c, p2-p4. Note absence of p2-p3 diastema.

UPDATE ON VERTEBRATE PALEONTOLOGY RESEARCH AND OUTREACH AT THE GRAY FOSSIL SITE AND NATURAL HISTORY MUSEUM

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The Gray Fossil Site (GFS) of northeastern Tennessee is an extensive Mio-Pliocene fossil deposit that continues to reveal exciting discoveries. Unique aspects of the site include that: 1) it is the only known late Miocene to early Pliocene fossil locality in the Appalachians, 2) it preserves both fauna and flora, which allows the reconstruction of a relatively complete biological system, 3) it represents one of the only Mio-Pliocene forested ecosystems in the Americas, and therefore preserves species and biological communities new to science, 4) it is exceedingly large, with less than one percent sampled so far, 5) a natural history museum and education annex are located on site, allowing the integration of fieldwork, fossil preparation, collections management, classroom lectures, research, and outreach to the public all in one place, and 6), the site and museum are part of ETSU, which now has a strong foundation in paleontological research and undergraduate/graduate training.

Here we provide an update and overview of activities and research at the GSF over the past year. During this time, the paleontology program made new discoveries, acquired additional fossil bearing property, and built an education annex. Moreover, a three year NSF grant began in 2010 that supports excavation and research at the GFS. This funding allowed us to explore new areas of the site and hire a crew for excavation, screenwashing, preparation, and sorting. Three new test pits were opened, and as expected, these proved to be highly fossiliferous. Like much of the site, the most prominent vertebrates encountered during excavation were tapirs (*Tapirus polkensis*) and various water turtle taxa. Among the turtles, the most significant discovery was a relatively complete snapping turtle (*Chelydra* sp.) skeleton. Prior to the recovery of this taxon at the GFS, *Chelydra* had not been reported from a Mio-Pliocene context. Other significant reptile material includes osteoderms of a helodermatid lizard and additional *Alligato*r remains that will be important for describing the GFS species. Notable mammal discoveries include additional badger (*Arctomeles dimolodontus*), panda (*Pristinailurus bristoli*) and camel material, our first potential record of a borophagine dog, and the first peccary skull from the site.

New additions to the site/museum complex include property and an education building. The acquired property encompasses the entire northern section of the deposit, which was privately owned and not accessible. Previous excavations in this area (by the former owners) revealed taphonomic and perhaps depositional differences that preserve other types of fossils (e.g., fossil leaves and insects). In addition, a large amount of fossil bearing sediment was dumped on this property as spoil during the original TDOT road construction in 2000. We will begin excavating this area in May of 2011, and will also start using the new education building. This museum annex will serve as a staging area for a number of our growing programs, including the paleontology field school, paleo-camp, teacher workshops, Governor's School, Upward Bound, public lectures, and conferences.

REVIEW OF THE HORSES OF THE BLANCO FORMATION, TEXAS

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The Blanco Formation in Crosby County, Texas is the type formation for the Blancan Land Mammal Age. Several taxa cross the Pliocene-Pleistocene boundary (e.g., *Equus*, *Nannippus peninsulatus*, and *Megalonyx leptostomus*). A review of the large mammals found in the Blanco Formation was made. An ash bed, the Blanco Ash, in the upper beds of the Blanco Formation, has been dated to 2.8 Ma in Chron 2An.1n. However, reversed polarity data places the Blanco Formation in Chron C2r.2r. Additional, detailed stratigraphic work should clarify the temporal span of the Blanco Formation.

Horse evolution is frequently considered good example of evolution. However, poorly described or fragmentary type specimens have led to several taxonomic revisions. The horse species found in the Blanco Formation were reviewed. Computed tomography (CT) scanning was utilized to look at the dentition of fossil horses from the Blanco Formation. While a larger dataset is needed, CT scanning provided a novel methodology to study horse cusps and enamel changes without destructive analysis. A high-resolution CT scan of the holotype of *Equus simplicidens* showed changes in the enamel patterns, such as changes in the fossettes, from the occlusal surface to the base of the crown. A medical CT scan of a mandible of *Nannippus peninsulatus* was insufficient in resolution to analyze tooth cusp patterns, but it provided a clear view of the relationship of molars without destructive analysis. The CT scans of the Blancan horse material indicate that this is a very useful, non-destructive technique for analyzing fossil dentitions.

REVISED PHYLOGENY OF RED PANDAS (AILURINAE)

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Though fossil red pandas (Carnivora: Ailuridae: Ailurinae) are widely distributed throughout the northern hemisphere, most are only known from teeth. Consequently, few researchers have attempted to interpret their interrelationships. Moreover, of the few phylogenetic trees that have been constructed, all have used only the upper first molar (mainly because it was common to most of the taxa). Because of this, the recovery of two skulls of *Pristinailurus bristoli* from eastern Tennessee (Gray Fossil Site) and the description of additional material of the new Russian taxon (*Parailurus baikalicus*) warrant a reevaluation of this unique group of carnivorans.

Skull and mandible of *Pristinailurus bristoli* from the Gray Fossil Site. Adapted from Wallace (2011). Scale bar = 2 cm.

Seventy character states representing mostly dental features (on all upper and lower teeth) were scored for one basal ailurid (*Simocyon*) and six ailurines (*Pristinailurus bristoli*, *Parailurus* spp., and *Ailurus fulgens*). *Simocyon* was chosen as the outgroup because of its basal status within the family, and its lack of many typical derived ailurine characters. The resulting matrix was analyzed using PAUP 4.0 beta 10, which yielded a single most parsimonious tree (TL = 123, CI = 0.80, RI = 0.56). Topology differs significantly from previous trees and will be discussed. Of interest are the 1) generic reassignment of one taxon, 2) justification of two new species, and 3) description and justification of several tribes.

ARCTIC DINOSAUR HISTOLOGY: OSTEOLOGICAL GROWTH IN AN ARCTOMETATARSALIAN THEROPOD FROM THE LATE CRETACEOUS PRINCE CREEK FORMATION IN ALASKA

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The bone microstructure of an endochondral element from an arctic theropod is described for the first time. The metatarsal II (or IV) is from the Late Cretaceous Prince Creek Formation in Alaska and is arctometatarsalian, indicated by the flat medial surface for articulation with metatarsal III. The element resembles that of tyrannosaurids and ornithomimosaurs, with a flat dorsal surface, posteriorly extended lateral condyle, triangular shaped lateral collateral fossa, distinct diaphyseal angle, and a larger lateral condyle relative to the medial condyle. Histological analysis reveals that its microstructure is more similar to that of ornithomimosaurs than tyrannosaurids. The diaphysis of the metatarsal is composed of fibro-lamellar bone tissue and shows both lamellar and reticular vascularization patterns as observed in long bones of other ornithomimosaurs. The composition of long bones in tyrannosaurids, however, is generally restricted to the lamellar pattern. Moreover, the growth lines in the Alaskan specimen, as in other ornithomimosaurs, are predominantly annuli and discontinuous unlike the complete lines of arrested growth (LAGs) that occur in tyrannosaurids. We estimate the individual to have been approximately 5 years old and comparable in size to *Gallimimus* at similar age. A previous description of the long bone histology in the ornithomimosaur *Timimus* from southern high latitudes made reference to pronounced LAGs. These were interpreted as adaptations for polar climate survival. Our results suggest that variance in ornithomimosaur is greater than previously appreciated and their relevance to environmental adaptation needs more rigorous examination. This study also illustrates the utility of osteohistology as a method to determine the taxonomic affinity of elements that are morphological similar and indistinguishable between taxa.