México, Querétaro, Mexico; JIMÉNEZ-HIDALGO, Eduardo, Universidad del Mar, Oaxaca, Mexico

The family Cricetidae is the second largest group of mammals with 792 species in 147 genera. They evolved in the Northern Hemisphere during the Paleogene, and were well adapted to Neartic ecosystems, and during the Great American Biotic Interchange, their Sigmodontinae subfamily diversified in South America into 80 genera and 400 species. Despite its importance, there is no consensus on the taxonomic and biostratigraphic limits of Sigmodontinae in the Hemphillian–Blancan of southern North America, because the fossils are rare, incomplete, and without radiometric ages.

Here we present material of sigmodontines and neotomines from the late Hemphillian, early Blancan, and Irvingtonian faunas in central Mexico, within the San Miguel de Allende Basin, Guanajuato (SMA), and Tecolotlán Basin, Jalisco. This material has been collected by Harley Garbani and Carranza-Castañeda since the 1980s in different projects of the Universidad Nacional Autónoma de México (UNAM), and continues to be collected in recent projects of the Centro de Geociencias, UNAM.

The species of sigmodontine reported are *Prosigmodon* and *Calomys*. These are the most complete known material for both genera, with complete jaws, fragments of maxillaries, and isolated teeth. Using the material attributed to *Prosigmodon* sp. from Tecolotlán and 16 taxa from the Hemphillian–Recent of North America (*Copemys*, *Prosigmodon*, *Sigmodon*, *Neotoma*, and *Reithrodontomys*), we built a systematic phylogenetic model (38 characters) with maximum parsimony in TNT software. The topology of the single most parsimonious tree (consistency index = 0.653, retention index = 0.851) shows *Prosigmodon* radiating at the Clarendonian–Hemphillian boundary, and we suggest the possibility that *Prosigmodon* originated in the Clarendonian faunas of California, in relation to the lineage *Copemys-Prosigmodon*, and later migrated to central Mexico.

In our biostratigraphic study in the SMA Basin, we determined that in the latest Hemphillian (Hh4), radiometric age ~4.7 Ma, species of *Prosigmodon* are common, and species of *Calomys* and *Neotoma* are rare. In the early Blancan (3.6 to 3.3 Ma), the presence of species of *Neotoma* increases, and new morphospecies related to *Sigmodon* appear, which have yet to be formally described. In the Irvingtonian, the rodent faunas are dominated by species of *Neotoma*, *N.* cf. *albigula*, and *N.* cf. *magnodonta* or *N.* cf. *alleni*. We discuss this faunistic succession and the evolutionary trends of hypsodonty, which are events that are likely a response to the diversification of the open and arid ecosystems in the late Neogene of North America.

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

LAUNCH MECHANICS OF *QUETZALCOATLUS* AND OTHER LARGE PTEROSAURS: A TEST OF THREE HYPOTHESES

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Withdrawn

There are three main hypotheses about how large pterodactyloids may have launched themselves from the ground: (1) a running takeoff in bipedal posture, (2) a sta[illegible]ing takeoff in bipedal posture, and (3) a standing takeoff in quadrupedal post[illegible]ed almost entirely by the forelimbs. The viability [illegible] each hypothes[illegible] size and functional mechanics, including bone stre[illegible]th. [illegible]al [illegible]nd models at the Vertebrate Pale[illegible]gy Lab[illegible], enabled measurements [illegible] thrust from the legs durin[illegible] be effective. But at the same time, [illegible] sweep of the wings), which along with wingb[illegible] the wings, is limited by shoulder height, body size, a[illegible]-correlated). Because wing length is positively correlated with b[illegible]ingbeat frequency is negatively correlated at 0.355 for birds, 0.26 for bats), l[illegible]e p[illegible]erosaurs could not have achieved a stroke reaching 40° below the horizontal (considered minimally effective for thrust) without leaping. So a running takeoff is unlikely. (2) The femur + tibiae + metatarsals of most large pterosaurs were nearly as long as the humerus + forearm + carpometacarpus, and each set of bones was three times the gleno-acetabular length, which is approximately proportional to the cube root of the body mass. The erect parasagittal hindlimbs, proportionally longer relative to body length than those of herons and egrets, needed to effect a wing-assisted jump to bring the animal to approximately three hip heights above the ground to enable a wingstroke to reach 40° below the horizontal. If this was possible, as it seems, then (2) is plausible. (3) When the humerus is laterally extended, rotation effecting retraction of the forelimb is prevented by a bony stop at the deltopectoral crest. To retract the forelimb for a quadrupedal launch, it must be supinated (rotated outward) at least 135°, and thrust must be provided by a sudden and massive extension of the elbow and wrist joints, for which no adequate musculature is known. Failure of the limb bones is predicted because the long bone walls are only 1-2 mm thick and are not built to withstand compression. Hypothesis (2) appears to be the only plausible one.

Grant Information
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Poster Session III (Friday, October 19, 2018, 4:15–6:15 PM)

DINOSAUR FOOTPRINTS FROM THE CONIACIAN FRONTIER FORMATION DEPOSITS OF SOUTHWESTERN MONTANA

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The dinosaur fossil record for the early Late Cretaceous of northwestern America is sparse. In Montana, the dinosaur fauna consists solely of the neornithopod *Oryctodromeus cubicularis* and fragmentary material ascribed to ankylosaurian dinosaurs from the early Cenomanian-aged Blackleaf Formation. Subsequent dinosaur records are concentrated in Campanian and younger deposits, resulting in a temporal gap of approximately 10 Ma. Here we present the first dinosaur footprints from the Coniacian-aged Frontier Formation deposits of southwestern Montana. Recent paleontological expeditions in the Centennial Mountains, near the Idaho state border, recovered tracks ascribed to, in decreasing order of abundance, ornithopod, ankylosaurian, and theropod dinosaurs. The Frontier Formation in this area mostly consists of sandstone, siltstones, and silty mudstones locally displaying root traces and limestone nodules, and interpreted as alluvial plain deposits. Tracks are primarily preserved as hyporelief on fine sandstones strata or weathered out natural sandstone casts in mudstone or fine sandstone isolated blocks. This is the first record of dinosaurs for Coniacian deposits of Montana, and suggests that a considerable diversity of dinosaurs inhabited these terrestrial habitats. Their description will be fundamental to understand dinosaur evolution and biogeographic trends across the early part of the Upper Cretaceous. The Frontier Formation represents an important burgeoning paleontological source and provides a new target for future studies.

Poster Session III (Friday, October 19, 2018, 4:15–6:15 PM)

NEO-TAPHONOMIC COMPARISON OF THE MASS DEATHS OF CETACEANS THAT OCCURRED IN THE CHILEAN PATAGONIA IN MARCH 2015 AND JULY 2016

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In general, long term neo-taphonomic studies of cetaceans and marine vertebrates are rare in the literature, and most existing studies are based on small temporal-scale observations and small sample. The largest mass mortality of baleen whales (sei whales) ever recorded occurred in the Chilean Patagonia in 2015, and an additional mass mortality of pilot whales occurred in 2016. These two mass mortality events have given us a great opportunity to analyze the neo-taphonomic states of decomposition and disarticulation for these two species and to make neo-taphonomic comparisons between two differently sized cetaceans: the large baleen whale (Balaenoptera borealis*)* and the smaller toothed whale (Globicephala melas*)*. The initial states of both cetaceans were compared, along with their orientation, and the substrate where they were deposited. For the mass mortality event of *Balaenoptera borealis*, 68.8% (n = 205) of the carcasses were Class 1 (carcasses with low or medium decomposition status), and most were in a ventrolateral position with the mouth wide open (n = 97; 55.7%), reflecting the inflation process of the tongue once the animal was dead. Its position with respect to the sea was generally parallel to the coastline (n = 337; 73.3%) and on a sand beach substrate (n = 295; 66.1%). Meanwhile, the mass mortality event of *G. melas* (n = 124) was characterized by two predominant taphonomic states (over 90%: Class 1 and 2), and most of the carcasses were lying on their right side (n = 79; 93.7%), probably due to the adverse weather conditions registered in the area and its fusiform body. Its position with respect to the sea shows a tendency to be parallel to the coastline (n = 124; 62.9%) and on a sand beach substrate (n = 124; 83.9%).

The speed at which the decomposition process began suggests different taphonomic criteria for both species and determined their body position once they were deposited on the coast (swelling of the tongue in mysticetes, for example). The direction of the carcasses with respect to the coastline, reflects the action of the tidal movements (parallel to the coastline), and their deposition on sandy beaches could suggest possible fossilization pathways.

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

CLIMATE AND CULTURALLY MEDIATED CHANGES TO THE HUMAN NICHE ALTERED INTERSPECIFIC INTERACTIONS WITH ENDEMIC CANIDS IN NORTH AMERICA

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Today, humans are found in virtually all habitats on Earth: from high elevation settlements in Tibet, to below sea level in Death Valley, and from harsh and inhospitable deserts such as the Sahara, to the subarctic city of Oymyakon, Russia. However, humans are animals with physiological limitations, and earlier in their evolutionary history as hunter gatherers, their distributions were constrained by abiotic conditions. Understanding the abiotic constraints on humans as they expanded their global range may provide important insights into their own evolutionary history, as well as their impacts on landscapes and biota.

There has been growing interest in describing the prehistorical distribution and ecological niche of humans (e.g., Neanderthals during the last interglacial). In our present study, we characterized the climatic niche of modern humans in North America using species distribution models (SDM, in Maxent) throughout the Holocene. Records of this time period are important in their recording of the geographic expansion and adaptation of anatomically modern humans on a new continent. Models were trained using occurrences from the Canadian Archaeological Radiocarbon Database and spatially downscaled CCSM3 paleoclimate simulations for North America. Likelihood of occurrence of humans across the North American landscape was reconstructed at 1,000-year intervals, from 10,000–1,000 yr BP. We then compare the distribution of humans with canids, a predatory guild that was very successful in North America throughout the late Quaternary. Interactions between humans and canids may be especially intriguing due to potential overlap in dietary resources, and the fact that early humans utilized domesticated dogs.

We find Holocene human distributions were well described with climatic niche models; however, the climatic variables important in defining the human niche changed over the Holocene. The timing of these changes correspond to cultural and technological adaptations. In turn, these changes are reflected in the differing associations between humans and canids during the Holocene. Early–middle Holocene wolves and coyotes appear to be positively associated with humans, but become negatively associated in the late Holocene. Humans also develop a positive association with foxes during the late Holocene. Our results suggest that the human niche is variable, yet predictable, and has shaped our interactions with endemic species for thousands of years.

Technical Session XIV (Saturday, October 20, 2018, 10:30 AM)

PALEOZOIC CROWN LUNGFISHES FROM GONDWANA FORESHADOW THE EARLY TRIASSIC RECOVERY FAUNA

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ANGIELCZYK, Kenneth D., Chicago, IL, United States of America; FRÖBISCH, Jörg, Museum für Naturkunde, Berlin, Germany; SMITH, Roger M., University of the Witwatersrand, Cape Town, South Africa; CISNEROS, Juan C., Universidade Federal do Piauí, Teresina, Brazil; RICHTER, Martha, The Natural History Museum, London, United Kingdom

Modern lungfishes are renowned for tolerance of extreme environmental variation, which is thought to contribute to their abundance during the recovery from the Permo–Triassic Mass Extinction (PTME). However, the Paleozoic origins of this clade and its biogeographic context remains unclear, with a 60 Ma ghost lineage at the base of the crown lungfish diversification. This gap is perplexing given the exceptional record of archaic lungfishes within this interval, particularly within paleoequatorial Euramerica, but also within eastern Europe. One possibility is that the assembly of the crown lungfish bauplan from known Carboniferous and Permian archaic lungfish groups occurred rapidly in the recovery from the PTME. However, an alternative explanation is that the crown lungfish bauplan evolved earlier in geographic regions outside the well-sampled Carboniferous and Permian basins of Euramerica, Russia, and South Africa. The sudden appearance of a diverse crown lungfish fauna in the earliest Triassic would then represent a biogeographic release in response to climate or diversity trends associated with the PTME. New lungfish faunas from outside these basins provide an opportunity to test these hypotheses.

Here we report a diverse lungfish fauna from the Early Permian Pedra de Fogo Formation (Parnaíba Basin, northeastern Brazil) comprised of abundant lungfish toothplates and rarer associated or articulated skeletal remains. This fauna lacks archaic lungfish taxa characteristic of contemporary localities in equatorial Euramerica. Instead, the Parnaíba fauna preserves a diverse assemblage of derived lungfishes, including a gnathorhizid and several crown lungfishes (ceratodontiforms). The gnathorhizid is represented by abundant toothplates and several partial skulls and shows similarities to the North American gnathorhizid genera. The ceratodontiform, which is represented by toothplates as well as several partial skeletons, shows affinities with Triassic taxa currently considered early members of the lepidosireniform stem group. Comparison with lungfish toothplate assemblages from the Paraná Basin of southern Brazil shows that the lungfish assemblage from the Parnaíba basin is also present in the Middle Permian of Brazil, likely representing a persistent biogeographic province in western Gondwana. We hypothesize that the lungfish crown group originated early in western Gondwana but remained biogeographically restricted until the PTME eliminated incumbent competition in better-known biogeographical provinces.

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

CORRELATED BODY SIZE CHANGES IN CENOZOIC TURTLES, CROCODILIANS, AND MAMMALS

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Environmental factors regulate maximum body size in living poikilotherms: increases in temperature can facilitate evolution of larger sizes, whereas competitive exclusion or predation by endothermic taxa impose upper limits on size. The relative influence of these factors over evolutionary timescales is poorly understood for Cenozoic reptiles, despite pronounced changes in Earth's climate regime and changes in endothermic vertebrate diversity during this interval. To examine the history of body size change in reptiles over the Cenozoic, we compiled maximum sizes for turtles and crocodilians for each sub-epoch from specimen examinations and literature searches. We correlated size trends over time with global temperature proxies derived from benthic foraminifera $\delta^{18}O$ values and with maximum mammal body sizes, representing potential competition and predation pressures. Our results show a significant positive correlation between body size in reptiles and mammals from the Paleogene through the Neogene. During that period, reptile body size increased as global temperatures dropped, in contradiction to predictions based on modern environmental drivers. Hypotheses that the rise of mammals limited the niches available to large reptiles are complicated by our data showing that reptiles' size increased alongside mammals'. This shared increase in size suggests that ecological release after the K-Pg extinction allowing evolution into niches previously filled by dinosaurs is an unsatisfactory explanation for mammal body size increase in the Cenozoic; instead, a common mechanism may have driven maximum body size to increase across classes of terrestrial vertebrates.

Podium Symposium (Wednesday, October 17, 2018, 3:00 PM)

THE PURPORTED LATE TRIASSIC CROCODYLOMORPH *PARRISHIA MCCREAI* IS A JUVENILE PHYTOSAUR

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Parrishia mccreai was originally described solely from vertebrae as an early non-crocodylian crocodylomorph archosaur from the Upper Triassic Chinle Formation of Arizona. Subsequent reviews have questioned the validity of the taxon, but few have questioned its crocodylomorph affinities despite the lack of diagnosable vertebral apomorphies for Crocodylomorpha. New specimens from Petrified Forest National Park suggest that *Parrishia mccreai* is not a crocodylomorph, but instead represents a less skeletally mature ontogenetic stage of a phytosaurian archosauriform, verifying its taxonomic status as a nomen dubium. These new specimens include partial skeletons comprising skull fragments diagnostic for Phytosauria (including a quadrate and partial dentaries), sub-triangular osteoderms, and vertebrae that would otherwise be referred to *Parrishia mccreai* based on centrum length and the development of ventral keels. The cervical vertebrae of phytosaurs at early ontogenetic stages are anteroposteriorly elongate, have closely-situated diapophyses and parapophyses, and have well-developed ventral keels, which are all features that are also present in crocodylomorphs, but also represents the plesiomorphic condition for Archosauromorpha. Through ontogeny, the cervical vertebrae of phytosaurs become anteroposteriorly shortened with respect to the rest of the presacral vertebral column, and the ventral keel is reduced or completely lost. These new specimens help to estimate the taxonomic affinities of *Parrishia mccreai*, in effect restricting the crocodylomorph diversity in the Chinle Formation to *Hesperosuchus agilis* (a problematic taxon in itself) and an unnamed long-limbed form. Furthermore, these new specimens provide a better understanding of the skeletal changes that occur throughout the ontogeny of Phytosauria and provide a hypothesis for the apparent lack of juvenile phytosaur axial material in Upper Triassic deposits.

Grant Information
The Petrified Forest Museum Association supported a portion of this work.

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

GROWTH OF THE DROMAEOSAURID THEROPOD DINOSAUR *DEINONYCHUS ANTIRRHOPUS*

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The dromaeosaurid theropod *Deinonychus antirrhopus* has played a large role in shaping debates about the origin of birds, the evolution of flight, and dinosaur metabolism. *Deinonychus* is also one of the largest known dromaeosaurids. Despite its iconic status, *Deinonychus* is definitively known from relatively few specimens from just two horizons, the Cloverly and Antlers formations of Wyoming/Montana and Oklahoma, respectively. Within a few years of its initial description, a significant degree of anatomical variation was recognized in *Deinonychus*, but competing hypotheses to explain this variation—individual, ontogenetic, sexual, or hidden taxonomic differences—have received little scrutiny. Specimens substantially smaller than the largest known individual have been suggested to be histologically mature, signifying extensive variation in growth that mirrors the osteological variation in the current hypodigm. We use new histological data to test hypotheses that explain sources of variation in *Deinonychus* and investigate the growth strategy underlying its unusually large size. We provide the first mass-based growth rates for the genus based on histological and CT-derived data. We fit growth models to our new dataset and weighed competing models against one another using information criteria. Mass-based growth curves are congruent with one another and all histologically sampled individuals of *Deinonychus* yield similar asymptotic age estimates (ca. 13 years). This is similar to the asymptotic age of much smaller dromaeosaurids, suggesting acceleration of growth rate was responsible for the large body mass of *Deinonychus*.

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

A SERIES OF HIGHLY DIVERSE HERPETOFAUNAS FROM THE EOCENE–OLIGOCENE OF NEBRASKA

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Description of a series of four new microfaunas from the Eocene–Oligocene White River Group of Toadstool Geologic Park, Nebraska has revealed a previously undescribed diversity of small reptiles and amphibians, and has provided important new insight into White River environments and organismal responses to climate change during the Eocene–Oligocene Climate Transition (EOCT, ~33.7 Ma). The EOCT represents a drop in global mean annual temperature of approximately 7–9 degrees Celsius and a shift from "greenhouse world" to "icehouse world" conditions. This rapid cooling event was accompanied by the formation of permanent Antarctic polar ice caps, as well as changes in both marine and terrestrial faunas. Marine faunas at this time have been well studied, but information on the terrestrial reptilian record is deficient, and the ecological implications that a global climate shift of this magnitude presents for mid-continent reptiles are unclear. We collected over 5,000 specimens representing a range of vertebrate taxa from four different microsites spanning the Eocene–Oligocene boundary in Toadstool Geologic Park. From this collection, >160 reptile and amphibian specimens (primarily vertebrae) were isolated and identified, and represent the most diverse herpetofauna from this time and region. Our newly described White River reptile fauna contains at least two previously undescribed taxa, including a new species of potentially fossorial booid snake and the first record of salamanders from the White River Group, as well as several specimens that represent significant range extensions for known taxa. Preliminary analyses indicate a decrease in body size in the younger Oligocene deposits that may be associated with EOCT cooling. Analyses of herpetofaunal composition and abundance shows little change in the abundances of the common reptile taxa across the four study sites, but the loss of salamanders and the addition of a new fossorial snake taxon in younger sediments suggests an upwards aridification, and possibly cooling, of the White River Group at thislocality.

Technical Session XIX (Saturday, October 20, 2018, 3:45 PM)

VERTEBRAL OSTEOLOGY OF *HIPPOSAURUS BOONSTRAI* (THERAPSIDA, BIARMOSUCHIA) FROM THE MIDDLE PERMIAN OF SOUTH AFRICA, WITH IMPLICATIONS FOR THE EVOLUTION OF ARCHOSAUROMORPHA

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Biarmosuchia is an enigmatic clade of early therapsids from the middle and late Permian of southern and eastern Africa and European Russia. Biarmosuchian taxonomy and phylogenetic relationships are based on cranial characters; most taxa completely lack known postcrania. The holotype of *Hipposaurus boonstrai* from South Africa is a rare exception and includes a nearly complete skeleton described over 80 years ago, despite remaining largely unprepared. We micro-CT scanned the vertebral column of *H. boonstrai* and are now able to fully describe its unexpected morphology, which is strikingly different from other early synapsids.