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October 9 – 12, 2019

Brisbane Convention & Exhibition Centre

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SOCIETY OF VERTEBRATE PALEONTOLOGY
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EDITORS
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Regular Poster Session IV (Saturday, October 12, 2019, 4:15 - 6:15 PM)

RESOLVING THE TAXONOMIC VALIDITY OF THE GIANT EXTINCT MARSUPIAL *NOTOTHERIUM* (DIPROTODONTIDAE) AND ITS RELATIONSHIP TO *ZYGOMATURUS*

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The megafaunal herbivores of the family Diprotodontidae were integral members of terrestrial ecosystems in Australia and New Guinea until the last-surviving and largest-ever diprotodontid, *Diprotodon optatum*, became extinct c. 40,000 years ago. Despite their iconic status as the largest-ever marsupials and the frequency with which their remains are encountered, key aspects of their systematics and evolutionary history remain poorly resolved. There is no clearer example of this than the taxonomic confusion surrounding the late Cenozoic genera *Nototherium* Owen, 1845 and *Zygomaturus* Macleay, 1858, which has persisted for more than 160 years. This is attributable to: 1) the highly fragmentary fossil material upon which the original two species of *Nototherium* were founded; 2) the destruction of the lectotype of *N. inerme* during World War II; and 3) marked similarities in the size and shape of the jaws and teeth of species referred to *Nototherium* and *Zygomaturus*. Most recently, this has led to *Nototherium* and its original two species, *N. inerme* and *N. mitchelli*, being relegated to *nomina dubia*. However, re-appraisal of the type material plus new material recently uncovered, including two crania, has shed light on the taxonomy and distinctiveness of *Nototherium* and provided evidence for its validity. Here I reassess the systematics and distribution of *Nototherium* and *Zygomaturus* and provide a preliminary diagnosis of the two most convergent and oft-confused species, *Nototherium inerme/mitchelli* and *Zygomaturus trilobus*.

Grant Information:
Royal Society of South Australia
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Regular Poster Session IV (Saturday, October 12, 2019, 4:15 - 6:15 PM)

THE RICH ICHNOLOGIC RECORD OF EGG MOUNTAIN FROM THE TWO MEDICINE FORMATION (UPPER CRETACEOUS) OF MONTANA, U.S.A., PROVIDES INSIGHT INTO THE ENVIRONMENT, SEDIMENTOLOGY AND ECOLOGY OF A DINOSAUR NESTING SITE

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The Upper Cretaceous Egg Mountain locality is a rich dinosaur nesting site that famously produced the first dinosaur eggs from North America and multiple clutches for the theropod *Troodon formosus*. Recently, the site has produced several well-preserved mammals and lizards. In addition to abundant skeletal and egg remains, several kinds of trace fossils indicate abundant biological activity, representing nesting, dwelling, and feeding behaviors. We report the first comprehensive overview of trace fossils from the site. Reproductive traces of both vertebrates and invertebrates are pervasive. Eggs and eggshell represent five different oviparous vertebrates that bury or partially bury their eggs within the substrate. These include eggs for the dinosaurs *Troodon, Maiasaura*, and the ootaxon *Continuoolithus,* as well two thin, un-ornamented varieties of eggs of unknown identity. Insect pupation structures are abundant throughout the less than 3 m section and suggest workable, well-drained soil conditions persisted with relatively low sedimentation rates throughout the time of deposition. Their abundance corroborates semi-arid, seasonally dry conditions of the Two Medicine Formation and may indicate relatively sparse vegetation. Furthermore, enigmatic hemispherical structures may represent invertebrate dwelling and feeding traces and add to the diversity of burrowing soil organisms at the locality. Vertebrate feeding traces are represented by three morphologies of coprolites and multi-individual, crania-skewed assemblages of small vertebrates (mammals and lizards) that may represent regurgitated gastric pellets and/or prey-processing locales. Though the specific producers of these feeding traces are difficult to determine, they offer unique insight into trophic interactions at the locality. Overall, the striking abundance of trace fossils suggests a suitable environment for both soil-dwelling organisms and nesting vertebrates. Large, well-preserved bones are notably absent from the site. The trace fossil assemblage is dominated by *in situ*terrestrial activity with the majority of the invertebrate (insect pupation) and vertebrate (nesting activity) traces representing subsurface activity. The record of biotic activity is a unique window into the ecology and environment of a Cretaceous dinosaur nesting locality.

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Technical Session I (Wednesday, October 9, 2019, 11:00 AM)

NEW DATA ON THE NEOGENE MARINE MAMMAL FAUNAS OF THE EASTERN NORTH PACIFIC

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Marine sedimentary deposits from the eastern North Pacific region provide us with a nearly continuous record spanning the last 30+ million years. Some of the major transition in the evolutionary history of marine mammals are recorded within these deposits and allow us to look at the timing of these events at different scales. Herein we reviewed published observations and add new data of Miocene-Pliocene marine mammals based mainly on the NHMLA and OCPC collections. Our data includes specimens from formations spanning from Washington to Baja California Sur. Occurrences are vetted on a site-by-site basis, with updated chronostratigraphic and taxonomic information, allowing for more precise first and last appearance dates.
Preliminarily, some of the patterns observed hint at major changes around the mid Tortonian (~9-8 Ma) as follows. Platanistoids, present in the region since the Oligocene, disappeared ~9 Ma, roughly coinciding with the first appearance of lipotids in the late Tortonian (~8 Ma). Kentriodontids are restricted to Aquitanian to early Tortonian deposits, contrasting with Western Atlantic faunas where they persist until the Pliocene. Crown group delphinoids appear by the late Tortonian and are still present, with some (e.g., monodontids) now restricted to the Arctic. Pinniped assemblages shift from those comprised of desmatophocids, stem otariids, and basal odobenids during the Burdigalian through Langhian to those dominated by large odobenids, including the appearance of neodobenians. Herbivorous marine mammals are present in Burdigalian-Langhian deposits, including multi-species communities of desmostylians and dugongids. However, by the late Serravalian through early Tortonian, herbivore diversity declines with the local extinction of dugongines and desmostylians, after which only hydrodamalines remain.
Our data hints at major faunal changes around the mid-late Tortonian (~9-8 Ma), including the local extinction of some odontocetes, desmatophocids, and desmostylians, and the evolution and diversification of several modern groups such as delphinoids and neodobenians. The appearance and predominance of benthic-feeding taxa, and kelp-eating sirenians by the late Miocene can be correlated with increasing upwelling along the eastern North Pacific which led to changes in benthic productivity and the evolution of large, fast growing algae. Ongoing work aimed at narrowing the chronostratigraphic range of poorly constrained formations in California and Mexico will allow us to improve upon these observations.

Regular Poster Session III (Friday, October 11, 2019, 4:15 - 6:15 PM)

EVOLUTIONARY TRENDS OF *PROTYPOTHERIUM* LINEAGE THROUGHOUT THE MIOCENE-PLIOCENE OF SOUTH AMERICA

VERA, Bárbara, Centro de Investigación Esquel de Montaña y Estepa Patagónica (CIEMEP), CONICET-UNPSJB, Esquel, Chubut, Argentina; SCARANO, Alejo C., Museo de La Plata, La Plata, Argentina

Protypotherium (Interatheriinae, Notoungulata, Mammalia) is a well-known and very diverse genus of extinct native ungulates of South America, widely distributed from southern to middle latitudes of Argentina, Chile, and Bolivia. This genus exhibits distinctive species throughout the different biozones from the Miocene to Pliocene that display an interesting size pattern. Three species from the late Early Miocene, *P. attenuatum* (small), *P. praerutilum* (medium), and *P. australe* (large); two species from the Middle to early Late Miocene, *P. endiadys* (small) and *P. colloncurensis* (large); two species from the Late Miocene, *P. minutum* (small) and *P. distinctum* (large); and only one species from Late Miocene-Pliocene, *P. antiquum* (large). The large sample of specimens studied during several years of research allow to us to analyze the shape and size of upper and lower molars for all the species of *Protypotherium*, in order to test the hypothesis of reduction of size ranges preserving a general tooth morphology as a response to climate deterioration. Elliptic Fourier analyses (EFA) were used to capture the shape of the occlusal

morphology and the centroid size (CS) was also retained for subsequent analyses. Our results demonstrate that: 1) in general, a similar morphological tooth pattern is observed among all species from Miocene to Pliocene; 2) there is a tendency to increase the size from the smallest species of the late Early Miocene (e.g., *P. australe*) to the largest one in the Late Miocene-Pliocene (*P. antiquum*); 3) tooth shape variation is not associated with a change in size (CS), both in upper and lower molars and between small and large species; 4) a decrease in the number of species is recorded from three in the early Miocene to one in the Late Miocene-Pliocene. This striking pattern could be correlated with a global trend to lower temperatures, which indicates a deterioration of paleoenvironmental conditions. In South America, a markedly descend of temperature occurred during Miocene times that is also testified by paleoflora and the marine environmental. Given this paleoenvironmental context, a successful conservative tooth pattern, together with an increase of size and a reduction in number of species were the main evolutionary and ecological tendencies accounted in *Protypotherium* from the Miocene to Pliocene.

Technical Session XIII (Friday, October 11, 2019, 3:00 PM)

PATTERNS OF OSSIFICATION IN THE VERTEBRAL COLUMN OF AMNIOTES AND THEIR ANCESTRAL CONDITION

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Ossification in the axial skeleton of amniotes displays a great diversity with regards to relative timing and overall patterns. Unfortunately, due to the infrequent preservation of ontogenetic sequences in the fossil record and limited research interest, the evolutionary history of these patterns remains poorly understood. Thanks to several exceptionally well-preserved specimens of the early Permian mesosaurid sauropsid *Stereosternum tumidum,* we were able to observe mineralization gradients along the spine and retrace the ossification sequences of several vertebral elements. In this study, we focused our attention on four major traits for which we reviewed the state of knowledge in amniotes and performed ancestral state reconstructions: (1) the number of loci from which neural arches ossify, (2) the number of loci from which centra ossify, (3) the number of loci and direction of neural arch fusion, and (4) the spreading direction of neurocentral suture fusion. For all examined traits, it appears that the condition in *Stereosternum* represents the plesiomorphic state not only for sauropsids but for amniotes in general. Neural arch and centra ossification first occur in one locus in the anterior cervical region and progress posteriorly along the spine. Similarly, fusion of initially paired neural arch elements first occurs in the anteriormost cervicals and then follows a “zipper-like” cranio-caudal gradient. Conversely, closure of the neurocentral sutures begins in the last caudal vertebrae and then proceeds anteriorly from that point. These patterns seem to constitute a major difference between the sauropsid and the synapsid lineages, the latter being more diverse with regards to the number of loci and direction of ossifications. Modes of neurocentral suture closure appear to vary substantially within the sauropsid lineage, with marked differences between major clades, suggesting that these characters may bear more phylogenetic signal than previously realised. However, further research is necessary to refine our more detailed and deep-time understanding of the evolutionary history of these traits.

Grant Information:
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Technical Session VIII (Thursday, October 10, 2019, 3:00 PM)

A 3D GEOMETRIC MORPHOMETRIC ASSESSMENT OF INTERPOPULATIONAL CRANIAL DIVERSITY OF THE MARSUPIAL DASYURUS HALLUCATUS

VIACAVA, Pietro F., The University of Queensland, St Lucia, Australia; BLOMBERG, Simone P., The University of Queensland, St Lucia, Australia; PHILLIPS, Matthew, Queensland University of Technology, Brisbane, Australia; WEISBECKER, Vera, The University of Queensland, St Lucia, Australia

The morphological identification of mammalian species can be challenging when there is substantial intraspecific diversity in the paleontological record. Finding the morphological patterns that lead to intraspecific differentiation can be a useful tool to address this issue. Here, we use the extant Northern quoll as an ideal species for testing if, and how, local adaptation to ecologically distinct environments can lead to divergence in cranial shape between genetically close relatives. The Northern quoll used to be distributed throughout a large part of northern Australia. However, its distribution is now fragmented into genetically distinct, isolated populations separated by major biogeographic breaks, which may have begun to partition their range well before the first records from the European settlement. Despite this relatively short time of isolation, fast phenotypic adaptation is expected due to the short life span of this species. Here, we use 3D geometric morphometrics to quantify the full 3D cranial shape variation of 181 Northern quoll individuals belonging to four mainland populations and several island populations. 900 landmarks were used in this study, including 101 fixed landmarks, 93 curves and 18 patches. Procrustes ANOVA suggests significant interpopulational shape differences. Cluster analysis also reveals that these correspond to genetics-based phylogenies. Pairwise comparisons between the mean shapes of each population showed longer skulls with shorter muzzles for Queensland and Northern Territory populations, a more prominent braincase and wider muzzles for Kimberley and Pilbara populations, and smaller skulls and shorter muzzles for island populations. However, potential confounding factors include allometry, sexual dimorphism, a geographical continuum and precipitation ranges. We demonstrated a possible link to precipitation data and a longitudinal continuum, Pilbara desert individuals present acoustic-adapted basicranium shape relative to rainforest individuals with larger skulls possibly adapted to interspecific competition and a high-resource diet. For paleontological studies concerned with closely related species, our results indicate that interpopulational variation is confounded by ecological drivers and can be masked at the species differentiation level. Furthermore, the template used in this study has the potential to be applied to several mammalian taxa, allowing investigations of how these processes occur across the micro and macroevolutionary level divide.

Grant Information:
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Technical Session XI (Friday, October 11, 2019, 8:00 AM)

DO RAPTOR PELLETS RECORD SMALL MAMMAL COMMUNITY COMPOSITION OR RAPTOR DIETARY PREFERENCE? A CASE STUDY IN YELLOWSTONE NATIONAL PARK

VITERI, Maria, Stanford University, Stanford, CA, United States of America; STEGNER, Mary Allison, Stanford University, Stanford, CA, United States of America; HADLY, Elizabeth A., Stanford University, Stanford, CA, United States of America

Skeletal remains from raptor pellets have long been used to reconstruct small mammal communities, yet pellets are also commonly cited as proxies for raptor dietary preferences. While past research has shown that certain species of raptors, such as barn owls, sample local small mammal communities in proportion to their true local abundances, few studies have been conducted across multiple raptor species. This is important for understanding taphonomic biases both in modern pellet assemblages and in deeper-time accumulations of bone where raptors served as the sampling vector, as in many cave deposits.
We examined nearly 1000 pellets from seven species of avian predators including ravens and both nocturnal and diurnal raptors that were collected in the late 1990s from four localities in Yellowstone National Park, Wyoming, U.S.A. The localities differ in habitat type, vegetation structure, and climate, and therefore exhibit differences in their small mammal communities. We ask: Across these sites, do raptors differ from one another in their prey preference, or do they eat what is locally abundant? If raptor species have strong dietary preferences, we expect to find similar diets within species, across localities. If instead they eat what is locally abundant, we expect that different raptor species at the same site will have more similar diets, but their diets will differ significantly between sites.
We morphologically identified craniodental material from pellets and quantified relative abundance from the number of individual specimens. We visualized differences in small mammal prey among sites and among predator species using principal components analysis and tested for differences. Preliminary analyses show that while each raptor species does tend to eat similar subsamples of the small mammal community, most variation in raptor diet is explained by *locality*. These results suggest that raptors faithfully sample their local small mammal communities and exhibit optimal foraging instead of dietary specialization. Analysis of raptor pellets remains a promising method for accurately and non-invasively sampling past and modern small mammal communities.

Grant Information:
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