MEETING PROGRAM & ABSTRACTS

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clade which has an unstable position near to the base of Neosauropoda; but the basal macronarian *Galveosaurus* does not cluster with other turiasaurs. *Rapetosaurus* is more closely related to saltasaurids than to *Malawisaurus*, contradicting the largest previous analysis of titanosaur relationships.

Reconstruction of ghost ranges and biogeographic analysis provide insights into eusauropod evolutionary history. For example, *Bellusaurus* is found to be the most basal macronarian, indicating that neosauropods were present in East Asia during the Jurassic, contrary to the hypothesis that members of this clade did not invade this area until the Cretaceous. The position of *Bellusaurus* also suggests that Macronaria and Diplodocoidea diverged in, or before, the early Middle Jurassic prior to the break-up of Pangaea.

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

TYRANNOSAURUS MIGHT RUN FASTER THAN HUMAN: A DETAILED STUDY BASED ON AVAILABLE KNOWLEDGE OF EXPERIMENTAL BIOLOGY AND COMPUTER SIMULATION

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A theory of static calculation was previously presented, stating that *Tyrannosaurus* was not a fast runner. The work postulated a certain mid-stance posture, and obtained the result that *Tyrannosaurus* muscle is insufficient to support it. The work and subsequent studies brought insight on the prediction of running ability of *Tyrannosaurus*. However, parameters involved in the evaluation have not been fully analyzed. Moreover, the evaluation methodology is a static one, hence speed estimation is quite limited. We calculated whole running motion of *Tyrannosaurus* based on time-dependent biomechanical calculations with the use of the evolutionary computation method. As a result, we obtained the possible locomotion pattern of *Tyrannosaurus*, and found a possibility that the mid-stance posture is more upright than reported in previous works. This result gives smaller estimation of muscle mass needed to support the posture, and shows that *Tyrannosaurus* could run at a speed of 14 m/s.

Detailed discussion of involved parameters is also presented. Among them the most important parameters is maximum muscle stress, which is the one at which the muscle exerts force best. We have examined 110 references on this issue. As a result, we have found that previous works misunderstood the parameter as isometric tetanic tension. The correct parameter has been stated as specific tension in experimental biology, and the parameter range spans widely as ~11-220 N/cm^2. The previous works assumed this parameter as 30 N/cm^2. Therefore the muscle can generate larger force than previously assumed, which makes *Tyrannosaurus* possibly capable of fast running. The mechanical power of muscle during running is also calculated in our dynamical simulation. This is the first study in this research area. The value of mechanical power also allows for fast running in *Tyrannosaurus*.

We have completed work discussing known biomechanical parameters based on 150 references of experimental biology, and then applied this to the discussion of running ability of large bipedal theropod, *Tyrannosaurus*. The result shows a possibility that *Tyrannosaurus* might run faster than a human. At the presentation, we show all of the data that support the above statements.

Preparators' Symposium (Saturday, November 8, 2014, 3:00 PM)

TRANSFER PREP OF AN EOCENE BIRD FROM THE GREEN RIVER FORMATION, WY.

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The Green River Formation of the Eocene Epoch is famous for its vast array of beautifully preserved taxa. The fine-grained limestone can record the finest details for posterity, including ephemeral specimens of plants, insects, even feathers. While not common, bird fossils have been discovered in the limestone and can range from a single feather to a fully articulated specimen. Usually, bird fossils are found as a single specimen on one slab. When an exquisitely preserved complete 52 million year old bird with feathers was discovered in the 'split-fish layer' from southwestern Wyoming as a slab and counterpart, it presented a challenging opportunity to attempt 'transfer prep' of the specimen's bones onto one slab.

Bird fossils are notoriously delicate. Their bones are small, thin and hollow; and feathers are essentially a carbon stain showing what type of feather it used to be. Regarding this specimen, all features were present: skull, entire skeleton, feathers. The most important feature (the skull) was on the left slab, as well as its feet and claws. Some of the limb bones and half of the furcula were also on the left slab. The feathers and a greater percentage of the bones were better preserved and more intact on the right slab.

After initial dissent on my part, and persistent insistence on the curator's part, it was finally decided that as much bone material as possible on the left slab was to be removed and transferred to the right slab. The goal was to make one complete bird fossil, containing as much original material as possible. If a bone could be removed from the left slab, it would be carefully dissected off and then transferred into place in its negative impression on the right slab. The bone, now glued into place, could then have the excess matrix removed, and it would join the rest of the skeleton and feathers on the right slab. As much of the left slab as possible was to be left intact for 'destructive sampling'.

While a daunting project, the bird's bones proved robust enough to manipulate after careful consolidation of all bones (left and right). Great care was taken to consolidate only bone material. After using extremely fine tools and precise application of glue and consolidants, most of the skeleton was eventually assembled on to the right slab, with minimal destruction to the left side.

This project begged some difficult questions, including ethical ones. "Is this really necessary?" "What is the purpose of this?" At what point does a preparator say, "No!", to drastic alteration of an important specimen? What is the argument for/against a project of this nature?

Technical Session XV (Saturday, November 8, 2014, 9:00 AM)

BODY SIZE EVOLUTION ON PALAEO-ISLANDS: ANTIQUITY OF THE ISLAND RULE AND TEMPORAL FLUCTUATIONS

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We assessed the generality of the island rule in a database comprising 63 species of fossil mammals from islands world-wide, ranging from the late Miocene to the early Holocene, and tested whether observed patterns differed among taxonomical and functional groups. Body mass of each pair (insular mammal and its ancestral taxon) was estimated using the same method. We found that across 7 orders of fossil mammals (Proboscidea, Cetartiodactyla, Rodentia, Lagomorpha, Soricomorpha, Erinaceamorpha, Carnivora), body size evolution exhibited the predicted graded trend from gigantism in small mammals to dwarfism in large mammals. Body size decrease was most dramatic in Elephantidae and Hippopotamidae, notably *Palaeoloxodon falconeri* and *Hippopotamus minor*. Body size increase was most dramatic in species that utilized aquatic prey (*Megalenhydris*, *Nesiotites*). The island rule appears to be a pervasive pattern, exhibited by mammals from a broad range of orders, functional groups, and time periods. Our findings confirm the hypothesis that ecological release in species-poor biotas may result in the convergence of insular mammals on the size of intermediate but absent species. The more pronounced gigantism and dwarfism of palaeo-insular mammals relative to what is found in extant mammals is consistent with a hypothesis that emphasizes the importance of ecological interactions that play out over time: the time in isolation from mammalian predators and competitors was 0.1 to > 1.0 Ma for palaeo-insular mammals, but < 0.01 Ma for most extant populations of insular mammals.

We also assembled data on temporal variation in body size and associated variation in ecological characteristics (colonization or extirpation of mammalian competitors and predators) for 19 species of fossil, non-volant small mammals across 4 large (> 3640 km^2) palaeo-islands ranging between the late Miocene and early Holocene. We found that following first appearance in the insular fossil record, small mammals tended to increase in body size, in accordance to the predictions of the island rule hypothesis. These trends, however, ceased or were reversed following colonization of the focal islands by mammalian predators or competitors. Temporal trends as observed in palaeo-insular mammals indicate that the observed trends for any particular species, island and climatic regime may be strongly influenced by interactions among species.

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Poster Session II (Thursday, November 6, 2014, 4:15 - 6:15 PM)

AN INVESTIGATION OF SEXUAL DIMORPHISM AND POPULATION STRUCTURE OF THE DODO (*RAPHUS CUCULLATUS*) BASED ON THE MARE AUX SONGES FOSSIL REMAINS

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The dodo (*Raphus cucullatus*), a large flightless pigeon once endemic to the island of Mauritius, is an icon of human-induced extinction. Unfortunately, very few fragmentary remains exist from specimens collected before the bird's extinction in the 17th century, and many aspects of dodo anatomy and biology remain poorly known. A large part of our knowledge of the dodo derives from bones collected from the Mare aux Songes (MAS), a mid-Holocene fossil concentration Lagerstätte first discovered in 1865 but considered lost midway through the 20th century. The 2005 rediscovery of the MAS has enabled us to address longstanding questions regarding the remains collected at the locality and to examine sexual dimorphism and population structure.

To this purpose, we performed a biometric study using 10 different linear dimensions on the largest sample of dodo skeletal remains ever analyzed, consisting of more than 750 bones selected for their completeness. We analyzed tarsometatarsi, tibiotarsi and femora from the recent Dodo Research Project (DRP) excavations as well as historically collected materials from multiple museum collections. Kolmogorov-Smirnov Z-tests and Wald-Wolfowitz runs tests were used to examine potential differences between historically collected remains and bones collected by the DRP. Bones from the recent DRP excavations were statistically indistinguishable from the historically collected bones, enabling us to combine these data in further analyses. We performed two-step cluster analyses to search for naturally occurring size fractions in the data, using a log-likelihood distance measure and Schwarz's Bayesian information criterion. Mann-Whitney-Wilcoxon tests were performed to determine the significance of the obtained fractions.

Our results identify two significantly different size classes, with the bones of one morph 5% larger on average, which we interpret as evidence for sexual dimorphism in the dodo. Both size classes contain approximately equal numbers of bones. We interpret the larger bones as being from males and the smaller from females, since males are generally larger in extant columbids. The observed sexual dimorphism is significantly less pronounced than previously hypothesized or observed in the closely related extinct flightless Rodrigues Solitaire, but similar to the degree of skeletal dimorphism observed in closely related living columbids. The skeletal metrics of the MAS dodos provide a new intriguing window on the population structure and dynamics of this iconic and enigmatic extinct bird.