KEY INNOVATIONS AND EVOLUTIONARY CONSTRAINTS DURING THE EVOLUTION OF AVIAN TAKE-OFF

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Andy Farke; Amber MacKenzie; Jess Miller-Camp

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(Article begins on next page)
Key innovations and evolutionary constraints during the evolution of avian flight

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mammalianiform fossils are the consequence of the labile chondrogenesis of the otic capsule relative to the cochlear nerve(s) and its cochlear ganglion, which also contributed to the varying degrees of the cochlear canal curving and coiling among different mammalianiforms. Both Otodectes and Ichthyolestes have the labial and buccal osteological structures are deeply rooted in the complex cascade of genetic networks for cochlear development. However, the homoplasic patterns of the cochleas in Mesozoic mammalianiforms provide the historical evidence of how and where along the phylogeny the conserved morphogenetic mechanisms, although highly canalized in normal development of extant mammals, had occurred in much broader variation in the deep evolutionary history of mammalianiforms.

Poster Session I (Wednesday, October 26, 2016, 4:15–6:15 PM)

MARTES AMERICANA IS SELECTIVE IN FOLLOWING THE RULES: A TEST OF BERGMANN’S AND ALLEN’S RULE

LYNCH, Leigha M., Oklahoma State University Center for Health Sciences, Tulsa, OK

United States of America

Martes americana is widely distributed across North America and is successful in many different climates. Wide geographic spread can often result in morphological variation between populations, including differences consistent with Bergmann’s or Allen’s rule. I tested for both rules in M. americana using skeletal measurements from 22 individuals from Alaska (n = 11), Maine (n = 5), Idaho (n = 2), and New York (n = 4).

Bergmann’s rule states that individuals living in colder climates will be proportionally shorter limbs than those living in warmer climates. I tested for Bergmann’s rule using a Wilcoxon signed-rank analysis on the skull length, as a proxy for body size, of individuals from two groups: 1) Alaska and 2) Maine, Idaho, and New York. These groups are based on the minimum annual temperature of each region, of which Alaska is about 15°F colder. There was a significant difference in skull length between the two groups (Z = -2.101, p = 0.035), with Alaskan specimens averaging 5 mm larger (δ = 0.478cm) or about 5% of the skull length. This is consistent with Bergmann’s rule.

Allen’s rule states that individuals living in colder climates will have proportionally shorter limbs than their warm climate counterparts. Because M. americana follows Bergmann’s rule, I tested whether skull length and limb length were changing in conjunction using a Pearson’s correlation. I measured forelimb length by combining the length of the humerus and ulna and hindlimb length by combining the femur and tibia. Both forelim (r = 0.704, p = 0.001) and hind limb (r = 0.746, p = 0.0001) length had a strong and significant positive correlation to skull length. I then tested if this correlation differed between the two regions using a Wilcoxon signed-rank analysis for forelimb/hind length and finding there was a significant difference between groups in the forelimb (Z = 2.445, p = 0.014, δ = 0.122) and hind limb (Z = 2.781, p = 0.005, δ = 0.104). However, this difference is a result of individuals in Alaska having proportionally longer limbs than similarly sized individuals in warmer regions. For example, an individual from Alaska with a skull length of 8.74 cm has a forelimb length of 0.478 cm or about 5% of the skull length. This is consistent with Bergmann’s rule.

The presence of size and limb proportional differences in populations of M. americana suggests it is selectively adapted to a wide climatic range. Future geometric morphometric studies of M. rufa must take allometric effects of shape into account.

Poster Session IV (Friday, October 28, 2016, 4:15–6:15 PM)

ANATOMIC COMPARISON OF THE POSTCRANIAL SKELTONAL OF THE EXTANT RED PANDA, AIILURUS FULGENS, TO THE EXTINCT LATE MIOCENE AIILURIID SIMOCYON BATALLERI AND PRISTINAILURUS BRISTOLI (CARNIVORA, AIILUROIDEA)

LYON, Lauren M., East Tennessee State University, Johnson City, TN, United States of America; WALLACE, Steven C., East Tennessee State Univ, Johnson City, TN, United States of America; SALESA, Manuel J., Faculdade de Ciências da Universidade de Lisboa, Lisbon, Portugal; SILICEO, Gema, Universidad de Alcalá, Madrid, Spain; ANTON, Mauricio, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

Pristinailurus bristolii is only known from the late Hemiphillean Gray Fossil Site (Washington County, TN). Since its description in 2004 based on an isolated M1, several specimens have been found, bringing the MNI up to seven. Among the new material are two nearly complete specimens: ETMNH 3596 (~98% complete) and ETMNH 15000 (~75% complete). Though being among the most complete known fossil ailiurs, both skeletons have yet to be described in detail. Once a widespread and successful group across the northern hemisphere, ailiurs are restricted to a single extant taxon (Ailurus fulgens) that inhabits the remote regions of the Himalayas. What adaptations did this family exhibit in the past that allowed it to be so successful compared to today? Postcranial adaptations of ailiurs are rare, so the new material from P. bristolii is considered a unique upland faunal assemblage in which numerous small to medium-sized taxa are represented. The new material reveals several features that are similar to those of S. batalleri, but with differences that are significant. Some of these include the long manus and pes, the presence of a prehensile tail, and the presence of a prominent tail. P. bristolii was thought to have a plantigrade gait, but the new material reveals the presence of a retroverted tail, which is similar to that of S. batalleri. This suggests that P. bristolii was adapted for explosive climbing, as is predicted for a species with a prehensile tail.

The presence of size and limb proportional differences in populations of M. americana suggests it is selectively adapted to a wide climatic range. Future geometric morphometric studies of M. rufa must take allometric effects of shape into account.

Poster Session II (Thursday, October 27, 2016, 4:15–6:15 PM)

KEY INNOVATIONS AND EVOLUTIONARY CONSTRAINTS DURING THE EVOLUTION OF AVIAN FLIGHT

MACALUSO, Loredana, Universita` di Torino, Torino, Italy; TSCHOPP, Emanuel, Universita` di Torino, Torino, Italy

The evolution of powered flight happened three times independently in vertebrates (bats, pterosaurs, and birds). Among these, avian flight is unique in the inclusion of the tail into the forelimb locomotor module. In birds, the shortened tail is connected to a retroverted pubis through the internal and external puboischial muscles. These muscles control movements of the pubis and help maintain the orientation of the tail during flight. Pubis retroversion was thus a crucial innovation during the evolution of avian flight, but it remains unclear how and why this change in orientation occurred at the first three occasions. I performed five times with the first avialans: four times in Maniraptora and once in Ornithorhynchia. Here, we perform Fisher’s and Barnard’s test exacts to check for statistically significant correlations with traits that possibly influenced the orientation of the pubis: accessory ventillation system, gait, feeding strategy. These tests showed a strong correlation between anteriorly projecting pubes and the pubis retroversion, the so-called aero-ventillation system is considered a plesiomorphic feature within Dinosauria. Cuirassal ventillation helped inflating the lungs through the expansion of the gastral basket by the ischiuritans muscle, which connected the gastralia to the anteriorly projecting pubis.

Poster Session II (Thursday, October 27, 2016, 4:15–6:15 PM)

THE EARLY PERMIAN (CISURALIAN) RICHARDS SPUR LOCALITY, OKLAHOMA, USA, AND THE EARLY EVOLUTION AND DIVERSITY OF PARAREPTILIA

MACDOUGALL, Mark J., University of Toronto Mississauga, Mississauga, ON, Canada; REIZS, Robert R., University of Toronto Mississauga, Mississauga, ON, Canada

Parareptiles first appear in the fossil record in the Late Carboniferous, and the clade continued to diversify into the Permain, eventually obtaining a cosmopolitan distribution and becoming a common component of Middle and Late Permain terrestrial vertebrate faunas. In contrast to their diversity during the Middle and Late Permain, Early Permain parareptiles are historically the least studied, exhibiting weak taxonomic diversity, with eureptiles and synapsids being the more common amniote carnivores and herbivores. As a result of extensive studies of the vertebrate assemblage at the Early Permain (289 ma) Richards Spur locality of Oklahoma, several new parareptile species have been described from the locality. While the description of new parareptile species is important, the locality is also important as it is one of the few parareptile localities that have been found in the region. These new discoveries have drastically increased our knowledge of parareptile evolution during the Early Permain. Nearly a century of work at this locality has yielded an exceptionally diverse fauna of terrestrial amniotes. The locality represents a key unique upland faunal assemblage in which numerous small to medium sized taxa are exceptional preserved and in abundance.

Here we discuss the importance of the Richards Spur parareptile fauna and how it grants us previously unavailable knowledge of the Early Permain. Currently, eight of the 19 species of parareptiles described from the Early Permian Richards Spur. Furthermore, the species present at Richards Spur represent some of the earliest members of most major Early Permain parareptile clades, the sole exception being the aquatic, Gondwanan-restricted Mesosaurus. These factors indicate that Richards Spur was clearly an important locality, understanding which can provide a new perspective on the diversification of parareptile species. The species-level/taxonomic diversity of Early Permain parareptiles is now coming close to matching that of contemporaneous eureptiles, which is not surprising, given their relationship as sister taxa. The Richards Spur assemblage provides a rare glimpse into the initial diversification of an advanced clade, which highlights the importance of this region of Laurasia as the potential center for the radiation of small, predatory parareptiles, as exemplified by the lanthanohsauroids.

Technical Session I (Wednesday, October 26, 2016, 10:30 AM)

HORSES IN THE CLOUD: BIG DATA EXPLORATION, MINING, AND INTEGRATION FOR EQUUS (MAMMALIA, EQUIDAE)

MACFADDEN, Bruce J., University of Florida, Gainesville, FL, United States of America; GURALNICK, Robert J., University of Florida, Gainesville, FL, United States of America

Large cloud-based specimen and related natural history databases are becoming more important to analyze biodiversity distributions. Here we report the results of a meta-research study using Equus. Extinct species of Equus are widely distributed and have an abundant fossil record. Likewise, extinct species of the genus Equus have a widespread distribution on all continents except Antarctica. In order to test the efficacy of six relevant big databases for (paleo)biogeographic analyses, location data records (latitude, longitude) for the genus Equus were explored and mined from DigBio, the Paleobiology Database, VertNet, BISON, Neotoma, and GBIF. These were chosen from prior knowledge of where relevant data might be aggregated, and also because these databases have different objectives and data sources and, therefore, would provide a useful comparative study of a widespread taxon. Although they vary based on their objectives, each of the six big databases contain paleontological location data, whereas five contain modern location data as well. The mining of data records for Equus from these six sources yielded 105 thousand location records, ranging from 32.3 thousand (GBIF) to 0.2 thousand (Neotoma). These data include individual points that are unique, in other words, only occurring in one of