

PaleoBios

OFFICIAL PUBLICATION OF THE UNIVERSITY OF CALIFORNIA MUSEUM OF PALEONTOLOGY

11TH NORTH AMERICAN
PALEONTOLOGICAL
CONVENTION

NAPC

2019

PROGRAM WITH ABSTRACTS
JUNE 23 - 27, 2019 RIVERSIDE, CALIFORNIA

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Citation: Droser, M., N. Hughes, N. Bonuso, D. Bottjer, D. Eernisse, R. Gaines, A. Hendy, D. Jacobs, J. Miller-Camp, R. Norris, K. Roy, P. Sadler, M. Springer, X. Wang, and M. Vendrasco (eds.). 2019. 11th North American Paleontological Conference Program with Abstracts. *PaleoBios* 36 (Supplement 1), ucmp_paleobios_44177.

Permalink: <https://escholarship.org/uc/item/6r18f8wn>

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GHOSTS of HELL CREEK. GHOSTS of HELL CREEK (GoHC) is an hour-long performance for proscenium theaters, staging a vast tale spanning 500+ million years, articulated around the Hell Creek ecosystem. The work is presented in four acts, each act featuring a specific vertebrate animal species. Staged like an immersive diorama, the work features multilayered clay body makeup and clay set installation evocative of the Hell Creek Formation's stratigraphy, embellished with complex atmospheric lighting and bass-heavy sound design with Indonesian musical stylings.

PBT won University of Washington's 2017 Bergstrom Award for Art-Science Interface in collaboration with paleontologists Dr. Greg Wilson (Burke Museum curator, Hell Creek Project Director) and Dr. Dave Evans (dinosaur curator, Royal Ontario Museum), to develop the performance's structure and choreographic methodology based on comparative anatomy and locomotion. A.R. engaged in hands-on research as the artist-in-residence at the 2017 Hell Creek Project.

PBT is planning a North American tour of GoHC with an Indonesian ensemble, including a residency at Hell Creek Project for the Indonesian team. The live performance will show on North American stages, and will be accompanied by a suite of companion programming including Round-table Dialogs on Deep-time Identity with the Indonesian ensemble, mentor scientists, and audiences, allowing for a rich and equitable conversation exploring diverse perspectives on human ancestry and origins, giving voice to the Indonesian ensemble's process in relationship to their rich cultural traditions.

NEITHER A RODENT NOR A LAGOMORPH: GOMPHOS AS THE MOST SUCCESSFUL BASAL GLIRES (CLASS:MAMMALIA) IN THE EARLY EOCENE OF CHINA

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The "Mixodontia", a paraphyletic group of early Glires partitioned between Eurymylidae and Mimitonidae, is known from the Paleocene to the earliest Oligocene of China, Kazakhstan, and Kyrgyzstan. This array of ca. 20 species is morphologically closer to lagomorphs than rodents, but overall presents a mosaic of dental and skeletal characters found in both groups.

Most of the taxa are extremely scarce in the fossil

record, with the exception of *Gomphos*. It was a large mimitonid (weight ca. 2 kg) and the most successful representative of early Glires, known from the earliest Eocene "red beds" (the Bumbanian ALMA), otherwise called the "*Gomphos* beds".

We studied the fossil remains of *Gomphos* (maxillary and mandibular fragments, teeth, and postcranial elements) from 11 localities of Bumbanian through early Irindian age in the Erlan Basin (Nei Mongol, China), with the focus on the tarsal elements (mostly, the calcaneus and astragalus). We analyzed 14 calcaneal measurements of *Gomphos elkema*, the most abundant species stratigraphically restricted to Bumbanian, using the Analysis of Variance (ANOVA) and Principle Component analysis (PCA). Samples from the Nuhetingboerhe, Shaerhaolei and Ulanboerhe localities yielded most of the material (over 400 specimens), allowing us for some statistical comparisons within *Gomphos elkema* paleopopulations.

The ANOVA test result of the calcaneus measurements showed great uniformity across the Bumbanian samples from all Nei Mongol localities (including also younger, Arshantan material). The most variable part of the calcaneus appeared to be the calcaneal eminence, which hosts the posterior articular surface for the astragalus and therefore constitutes the main point of the shank support. The dimensions of this structural element showed some differences at a slight ($p < 0.1$) to moderate ($p < 0.05$) level of significance between the samples. Our quantitative results coincide with some qualitative observations on the calcaneus morphology. *Gomphos* displays a rodent type of the calcaneus, with only one (not two, as in lagomorphs) facet on the eminence, the facet for the astragalus. Medially to this facet, there is an area serving as a partial support for the fibula and the attachment for the calcaneofibular tendon. This surface is variable in size and structure; in some specimens it forms a nascent fibular facet, which could be a functional adaptation possibly paralleling the lagomorphs. The results of PCA show that the calcanei of *Gomphos* lie in the morphospace closest to that of a marmot and musk rat, which tentatively indicates adaptations to burrowing and a relatively poor running ability.

The research was supported by National Science Centre (Cracow, Poland) grant No. 2015/18/E/NZ8/00637.

PRESERVATION BIAS IN THE FEZOUATA SHALE

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Exceptionally preserved biotas have been providing crucial paleontological data on the earliest major pulses of animal evolution – the Cambrian Explosion and the Ordovician radiation – for over 100 years. The Fezouata Shale is the only Ordovician formation to yield a diverse exceptionally preserved biota, yet the mechanism behind the preservation of soft parts in this formation and the potential of the Fezouata Shale deposits to reveal accurate snapshots of early animal life remain poorly understood. Here, based on two recently drilled cores, we constrain facies controls over the exceptional preservation of the Fezouata Biota. We find that the mechanisms leading to soft part preservation in some distal facies of this formation are strikingly different from those at play in Cambrian deposits. In addition to that, based on an original database, we compare the preservation potential of this new mechanism to the processes operating for Cambrian soft tissue preservation in the Burgess Shale and the Chengjiang Biota. Using a statistical approach, we show that the spatial distribution and type of soft tissues preserved are significantly different between Cambrian biotas and the Fezouata Shale, which is distorting to a variable extent our knowledge on the original diversity in ancient paleoenvironments. Constraining this bias is essential to correctly reconstruct paleoecological and evolutionary scenarios.

THE RISE AND FALL OF THE 'AGE OF FISHES': VERTEBRATE RESPONSES TO PALEOZOIC EXTINCTIONS

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While vertebrates are both diverse (65000+ species) and ecologically important in modern oceans, they were noticeably marginal during classic early Paleozoic radiations, including the Cambrian Explosion or the Great Ordovician Biodiversification Event. It was unclear whether this absence was due to preservational issues or lack of effort. Newer quantitative analyses have revealed that jawed fishes and their relatives exhibited stepwise diversification centered on two Paleozoic mass extinctions: the end-Ordovician (443 Ma) and the end-Devonian (359 Ma). In this talk,

I will show how mass extinction drove significant vertebrate turnover while also opening opportunities and altering selective regimes. While stem-vertebrates first appeared at classic Cambrian sites such as Chengjiang and Burgess, they were scarce at or absent from equally famous and productive Ordovician Lagerstätten, with the exception of ubiquitous conodonts (currently relatives of jawless lamprey and hagfish). The so-called 'Age of Fishes' only started in second half of the Silurian, following a post-extinction faunal hiatus and long-term losses among conodonts. Hard tissue fossils of jawed fishes and relatives became abundant, and these lineages gained a high level of ecological diversity through the Devonian. However, the familiar modern fauna of sharks, ray-finned fishes, and tetrapods only became dominant during the Carboniferous, once prior incumbents were eliminated by the Hangenberg event. Paleozoic recovery intervals, the Silurian-early Devonian and Mississippian, were marked by dramatic shifts and innovations in vertebrate ecology; their influence on vertebrate evolution was as significant as the turnover events themselves. Thus, Paleozoic mass extinctions and their recoveries had a profound impact on vertebrate biodiversity, which can be observed to this day.

CAPTURING CONVERGENCE AND INNOVATION IN FISH ECOMORPHOLOGY ACROSS TIME AND SPACE

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Biomechanical studies routinely link fish form with functional and ecological demands, including hydrodynamics and feeding mechanics. The reality of this phenomenon is also shown by the numerous cases of convergence in body form among fishes and other vertebrates (e.g. whales, ichthyosaurs), and even invertebrates (e.g. sea slugs), past and present. Anomalous, single-origin forms like seahorses are the exception that proves the rule. However, body form has never been quantified across the 500-million-year fish record and/or their 34000+ living species, let alone the extent and correlates (ecological and structural) of convergence across time and space. Construction of the requisite 'morphospace for all fishes' was limited by a lack of homologous structures for geometric morphometrics, and the apparent complexity of their traits. Here, we show results from a new reductionist approach using discrete coding to capture the form of