Raleigh Convention Center
Meeting Facilities Map

Concurrent Sessions

Concurrent Sessions

Friday, 1:45 p.m. – 4:15 p.m. ONLY

306 A-C Concurrent Sessions

Poster Session/Exhibits

Exhibit Hall A
Registration
Merchandise Sales
Lounge
Education & Outreach, Colbert and General Poster Sessions

Auction Event/ Awards Banquet

305A Speaker Ready Room

October 2012

72nd Annual Meeting
Society of Vertebrate Paleontology
Raleigh Convention Center
Raleigh, NC, USA
October 17 – 20, 2012

Program and Abstracts
SOCIETY OF VERTEBRATE PALEONTOLOGY
OCTOBER, 2012
ABSTRACTS OF PAPERS
SEVENTY-SECOND ANNUAL MEETING

Raleigh Convention Center
Raleigh, NC, USA
October 17-20, 2012

HOST COMMITTEE
Vincent Schneider, Co-Chair; Mary Schweitzer, Co-Chair; Alton Dooley; Terry Gates; Gregg Gunnell;
Andrew Heckert; Kristin Lamm; Adam Smith; Lindsay Zanno

EXECUTIVE COMMITTEE
Philip Currie, President; Catherine Forster, Vice President; Blaire Van Valkenburgh, Past-President;
Christopher Bell, Secretary; Ted Vlamis, Treasurer; Kristina Curry Rogers, Member-at-Large;
Christian Sidor, Member-at-Large; Lars Werdelin, Member-at-Large

SYMPOSIUM CONVENORS
Kerin Claeson; Robert Denton, Jr.; Jason Head; Tobin Hieronymus; Patrick O’Connor; Robert O’Neill;
Marcelo Sánchez-Villagra; Lars Schmitz; Graham Slater

PROGRAM COMMITTEE
Jonathan Bloch, Co-Chair; Anjali Goswami, Co-Chair; Jason Anderson; Paul Barrett; Brian Beatty; Kerin Claeson;
Kristi Curry-Rogers; Ted Daeschler; David Evans; David Fox; Nadia Fröbisch; Christian Kammerer; Matthew Lamanna;
Johannes Müller; William Sanders; Bruce Shockey; Mary Silcox; Michelle Stocker; Rebecca Terry; Paul Upchurch
SAVE
THE DATE

SVP 73rd Annual Meeting
October 30 – November 2, 2013
Westin Bonaventure Hotel & Suites, Los Angeles, CA, USA
Esteemed Friends and Colleagues of the Society of Vertebrate Paleontology,

The Host Committee of the 72nd Annual Meeting welcomes members and student members of the Society of Vertebrate Paleontology to Raleigh, North Carolina, where you can experience first-hand a bit of southern hospitality. Your Host Committee consists of individuals representing a number of institutions and whose research interests encompass many facets of the discipline of vertebrate paleontology.

The principal institutions hosting this year’s meeting are the North Carolina Museum of Natural Sciences and North Carolina State University. The theme for this year’s meeting emphasizes the Triassic roots of North Carolina paleontology, and we hope that you take advantage of the chance to learn about some of our spectacular specimens. Our rich Cenozoic deposits have yielded marine faunas including large cetaceans and sharks, and our scheduled field trips focus on these fantastic deposits. For those whose interests lie towards more human-oriented questions, another field excursion offers a rare opportunity to visit the Duke Lemur Center, the world’s largest sanctuary for rare and endangered prosimian (strepzirhine) primates, and includes a visit to collections at the Division of Fossil Primates.

Raleigh is a small city, by most standards, but is very cosmopolitan, and easily accessible from any airport on the East coast, usually with direct flights. Raleigh is a premier travel destination, and presents visitors with a surprising diversity of ethnic cuisines and cultural opportunities, as well as more traditional southern cooking and hospitality. Our beautiful downtown area, within walking distance from the museum, offers many restaurants with a wide selection of food and drink, and many featuring outdoor seating, a real treat for socializing with colleagues on warm October evenings.

We warmly welcome you with a reception at the North Carolina Museum of Natural Sciences, where we will highlight our new Nature Research Center. While most traditional museums present a public face to the question “What do we know?,” our new research facility is committed to bringing to the public a deeper awareness of the process of science, by emphasizing in all exhibits "HOW do we know what we know.” To this end we have developed many ‘citizen science’ activities, and encourage public participation in research through more accessible, continually updated exhibits. We hope that you enjoy all the highlights of our museum, our city and our state as you take part in the 72nd Annual Meeting of the Society of Vertebrate Paleontology. Welcome to the City of Oaks!

72nd Annual Meeting Host Committee

PRESENTATION POLICIES

SVP Abstracts are reviewed by the Program Committee and occasionally by outside reviewers. Authors are responsible for the technical content of their articles.

Unless specified otherwise, coverage of abstracts presented orally at the Annual Meeting is strictly prohibited until the start time of the presentation, and coverage of poster presentations is prohibited until the relevant poster session opens for viewing. As defined here, “coverage” includes all types of electronic and print media; this includes blogging, tweeting, advanced online publication and other intent to communicate or disseminate results or discussion presented at the SVP Annual Meeting.

Still photography, video and/or audio taping or any other electronic recording at the SVP annual meeting is strictly prohibited, with the exception of the designated SVP press event. (The SVP reserves the right to engage professional photographers or audio/videotape professionals to archive sections of the meeting for the Society’s use.)

Editorial policies of Science and Nature magazines: If you are planning to submit, or have submitted, your publication to Science or Nature, be sure you are familiar with their embargo policies.

Please address any questions about program practices to the Program Committee or to the Executive Committee.
# 2012 SVP Schedule of Events

All events are held at the Raleigh Convention Center unless otherwise noted with a **

<table>
<thead>
<tr>
<th>Event/Function</th>
<th>Tuesday, October 16</th>
<th>Wednesday, October 17</th>
<th>Thursday, October 18</th>
<th>Friday, October 19</th>
<th>Saturday, October 20</th>
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<tbody>
<tr>
<td>Registration Desk</td>
<td>1 pm – 6 pm</td>
<td>7 am – 5 pm</td>
<td>7 am – 5 pm</td>
<td>7:30 am – 5 pm</td>
<td>8:00 am – 5 pm</td>
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<tr>
<td></td>
<td>Exhibit Hall A, Level 1</td>
<td>Exhibit Hall A, Level 1</td>
<td>Exhibit Hall A, Level 1</td>
<td>Exhibit Hall A, Level 1</td>
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<tr>
<td>Symposium</td>
<td>8 am – 12:15 pm</td>
<td>Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution <strong>BALLROOM A, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Technical Session IX <strong>BALLROOM B, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Technical Session XIV <strong>BALLROOM A, LEVEL 4</strong></td>
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<tr>
<td>Technical Session</td>
<td>8 am – 12:15 pm</td>
<td>Technical Session I <strong>BALLROOM B, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Preparers’ Session <strong>BALLROOM C, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Technical Session X <strong>BALLROOM B, LEVEL 4</strong></td>
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<tr>
<td>Technical Session</td>
<td>8 am – 12:15 pm</td>
<td>Technical Session II <strong>BALLROOM C, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Technical Session X <strong>BALLROOM C, LEVEL 4</strong></td>
<td>8 am – 12:15 pm Technical Session XV <strong>BALLROOM B, LEVEL 4</strong></td>
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<tr>
<td>Plenary Session/WELCOME</td>
<td>8 am – 12:15 pm</td>
<td>Technical Session III <strong>BALLROOM A, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session VI <strong>BALLROOM A, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session XVII <strong>BALLROOM A, LEVEL 4</strong></td>
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<tr>
<td>Technical Session</td>
<td>8 am – 12:15 pm</td>
<td>Technical Session IV <strong>BALLROOM B, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session VII <strong>BALLROOM C, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session XVIII <strong>BALLROOM B, LEVEL 4</strong></td>
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<tr>
<td>Technical Session</td>
<td>8 am – 12:15 pm</td>
<td>Technical Session V <strong>BALLROOM C, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session VIII <strong>BALLROOM C, LEVEL 4</strong></td>
<td>1:45 pm – 4:15 pm Technical Session XIX <strong>BALLROOM C, LEVEL 4</strong></td>
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<tr>
<td>Workshops/Educational Events</td>
<td>9 am – Noon Archival Materials Workshop For Pre-Registered Attendees <strong>NORTH CAROLINA MUSEUM OF NATURAL SCIENCES – NATURE RESEARCH CENTER</strong></td>
<td>National Fossil Day Lectures <strong>NORTH CAROLINA MUSEUM OF NATURAL SCIENCES</strong></td>
<td>12:30 pm – 1:30 pm Palaeontology and the Media – Communicating Your Research to the Popular Press Workshop For Pre-Registered Attendees <strong>ROOM 306 A, LEVEL 3</strong></td>
<td>12:30 pm – 1:30 pm Effective Poster Design Workshop For Pre-Registered Attendees <strong>ROOM 306 A, LEVEL 3</strong></td>
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<td></td>
<td>9 am – 4 pm Phylogenetic Comparative Methods Workshop For Pre-Registered Attendees <strong>ROOM 306 A, LEVEL 3</strong></td>
<td><strong>NORTH CAROLINA MUSEUM OF NATURAL HISTORY – NATURE RESEARCH CENTER</strong></td>
<td>2:00 pm – 5:00 pm Archival Materials Workshop For Pre-Registered Attendees <strong>NORTH CAROLINA MUSEUM OF NATURAL SCIENCES</strong></td>
<td>12:30 pm – 1:30 pm Effective Poster Design Workshop For Pre-Registered Attendees <strong>ROOM 306 B, LEVEL 3</strong></td>
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<tr>
<td>Special Event</td>
<td>7:00 pm</td>
<td>Fleshing Out the Past...in 3D! Integrating Science, Technology and Outreach with the Virtual Dinosaur Project – A Special Public Presentation by Lawrence Witmer <strong>NORTH CAROLINA MUSEUM OF NATURAL SCIENCES</strong></td>
<td>12:30 pm – 1:30 pm Effective Poster Design Workshop For Pre-Registered Attendees <strong>ROOM 306 B, LEVEL 3</strong></td>
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</table>
### 2012 SVP SCHEDULE OF EVENTS (subject to change)
All events are held at the Raleigh Convention Center unless otherwise noted with an **

<table>
<thead>
<tr>
<th>Event/Function</th>
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<tr>
<td><strong>Poster Sessions</strong></td>
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<td>Set-up: 7:30 am – 9:30 am</td>
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<tr>
<td><strong>Exhibit Viewing</strong></td>
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<td><strong>SVP Business Meeting and Open Forum</strong></td>
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<td><strong>Press Event</strong></td>
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<td><strong>Social Events</strong></td>
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<tr>
<td><strong>7 pm – 10 pm Welcome Reception</strong></td>
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<td><strong>7 pm – 10 pm Student Roundtable Forum &amp; Reprint Exchange</strong></td>
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<td><strong>MARRIOTT – STATE BALLROOM C/D</strong></td>
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<tr>
<td><strong>6:30 pm – 10:30 pm Auction</strong></td>
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<td><strong>7 pm – 8:30 pm Awards Banquet Dinner (Open to all Meeting Attendees)</strong></td>
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<td><strong>10 pm – 2 am After-Hours Party</strong></td>
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<td><strong>MARRIOTT – STATE, UNIVERSITY AND CHANCELLOR BALLROOMS</strong></td>
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<td><strong>Beverage Service</strong></td>
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<td><strong>Poster Session IV: 9:30 am – 4:15 pm</strong></td>
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<td><strong>Reception: 4:15 pm – 6:15 pm</strong></td>
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<td><strong>Meeting Rooms</strong></td>
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<td><strong>All Committee Meeting Rooms are Located at the Marriott Raleigh City Center 500 Fayetteville Street Raleigh, NC, USA</strong></td>
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<td>**8 am – 7 pm <strong>at the MARRIOTT UNIVERSITY BALLROOM A</strong></td>
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## PROGRAM AT A GLANCE

<table>
<thead>
<tr>
<th>Ballroom A</th>
<th>Ballroom B</th>
<th>Ballroom C</th>
<th>Ballroom A</th>
<th>Ballroom B</th>
<th>Ballroom C</th>
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</thead>
<tbody>
<tr>
<td>Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time</td>
<td>Technical Session I</td>
<td>Technical Session II</td>
<td>Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Dr. Donald Baird</td>
<td>Romer Prize Session</td>
<td>Preparators’ Session</td>
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<td>8:00 am</td>
<td>Barrett</td>
<td>Zanno</td>
<td>Gai</td>
<td>Grandstaff</td>
<td>Bamforth</td>
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<td>8:15 am</td>
<td>Larsson</td>
<td>Snively</td>
<td>Criswell</td>
<td>Campaglio</td>
<td>Boehmer</td>
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<tr>
<td>8:30 am</td>
<td>Cadena</td>
<td>Steigler</td>
<td>Giles</td>
<td>Garcia</td>
<td>Campione</td>
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<tr>
<td>8:45 am</td>
<td>Bloch</td>
<td>Gold</td>
<td>Mickle</td>
<td>Schwimmer</td>
<td>Christensen</td>
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<tr>
<td>9:00 am</td>
<td>Head</td>
<td>Loewen</td>
<td>Standen</td>
<td>Brochu</td>
<td>Cleland</td>
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<td>9:15 am</td>
<td>Antoine</td>
<td>Carr</td>
<td>Long</td>
<td>Parris</td>
<td>Deccechi</td>
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<td>9:30 am</td>
<td>MacPhee</td>
<td>Burch</td>
<td>Daeschler</td>
<td>Weishampel</td>
<td>Gould</td>
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<tr>
<td>9:45 am</td>
<td>Velez-Juarbe</td>
<td>Sullivan</td>
<td>Janis</td>
<td>Fix</td>
<td>Hammond</td>
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<td>10:00 am</td>
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<tr>
<td>10:15 am</td>
<td>K. Hunt</td>
<td>Cullen</td>
<td>Presentation Withdrawn</td>
<td>Brasatte</td>
<td>Hastings</td>
</tr>
<tr>
<td>10:30 am</td>
<td>MacFadden</td>
<td>Kobayashi</td>
<td>Presentation Withdrawn</td>
<td>Vavrek</td>
<td>Heers</td>
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<tr>
<td>10:45 am</td>
<td>Rincon</td>
<td>Lautenschlager</td>
<td>Pardo</td>
<td>Lamb, Jr.</td>
<td>Lyson</td>
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<tr>
<td>11:00 am</td>
<td>Scheyer</td>
<td>Wang</td>
<td>Liston</td>
<td>Crane</td>
<td>McHugh</td>
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<tr>
<td>11:15 am</td>
<td>Moreno-Bernal</td>
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<td>Gottfried</td>
<td>Main</td>
<td>Montanari</td>
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<tr>
<td>11:30 am</td>
<td>Madden</td>
<td>Goswami</td>
<td>Stearley</td>
<td>Hippensteel</td>
<td>Tseng</td>
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<tr>
<td>11:45 am</td>
<td>Croft</td>
<td>Parsons</td>
<td>Friedman</td>
<td>Gallagher</td>
<td>Uno</td>
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<tr>
<td>12:00 pm</td>
<td>Jaramillo</td>
<td>Presentation Withdrawn</td>
<td>Case</td>
<td>Denton</td>
<td>Wilberg</td>
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<td>12:15 pm</td>
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## Ballroom A

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<th>Ballroom A</th>
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<th>Ballroom A</th>
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<td>Technical Session III</td>
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<td>1:45 pm</td>
<td>Theodor</td>
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<td>A. Boyd</td>
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<td>Sanders</td>
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<td>Plavcan</td>
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<td>Zijkstra</td>
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<td>Granotosky</td>
<td>Morhardt</td>
<td>Bebej</td>
<td>Upchurch</td>
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<td>C. Miller</td>
<td>Porter</td>
<td>Fordyce</td>
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<td>Wood</td>
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<td>4:00 pm</td>
<td>Samuels</td>
<td>C. Brown</td>
<td>Pyenson</td>
<td>D’Emic</td>
<td>Sánchez-Villagra</td>
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EXHIBIT HALL A, LEVEL 1
## PROGRAM AT A GLANCE

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<tr>
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<tr>
<td>8:00 am</td>
<td>Clarke</td>
<td>Bever</td>
<td>Angielczyk</td>
<td>LeBlanc</td>
<td>Pei</td>
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<tr>
<td>8:15 am</td>
<td>J. Brown</td>
<td>Rabi</td>
<td>Castanhinha</td>
<td>J. Chen</td>
<td>Prieto-Marquez</td>
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<td>8:30 am</td>
<td>Mounce</td>
<td>Vitek</td>
<td>Beck</td>
<td>Marjanović</td>
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<td>8:45 am</td>
<td>Bapti</td>
<td>Lively</td>
<td>Abdala</td>
<td>Anderson</td>
<td>C. Boyd</td>
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<td>9:00 am</td>
<td>Lloyd</td>
<td>Gignac</td>
<td>Blob</td>
<td>Tsuji</td>
<td>Osi</td>
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<tr>
<td>9:15 am</td>
<td>Simpson</td>
<td>Butler</td>
<td>Huttenlocker</td>
<td>Reisz</td>
<td>Druckenmiller</td>
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<td>9:30 am</td>
<td>Slater</td>
<td>Nesbitt</td>
<td>Kammerer</td>
<td>Müller</td>
<td>Erickson</td>
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<tr>
<td>9:45 am</td>
<td>Marcot</td>
<td>Irnis</td>
<td>Sidor</td>
<td>Schoch</td>
<td>Woodward</td>
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| 10:00 am | COFFEE | |

| 10:15 am | G. Hunt | Molnar | O’Meara | Pritchard | Forster | Friscia |
| 10:30 am | Organ | Young | Schultz | N. Fraser | Dalla Vecchia | Werdelin |
| 10:45 am | Schmitz | Stocker | Krause | Peecook | Morschhauser | Bibi |
| 11:00 am | Price | Conrad | T. Smith | Sookias | Levtit | Cherney |
| 11:15 am | Hieronymus | Watanabe | M. Chen | Morris | Maiorino | Wicks |
| 11:30 am | O’Connor | Schachner | Grossnickle | Kelley | Makovicky | Kimura |
| 11:45 am | Claeson | Hutchinson | G. Wilson | Motani | Bykowski | Flynn |
| 12:00 pm | Wainwright | Nestler | R. Beck | Maxwell | Arbou | Smikey |

| 1:30 pm | LUNCH | |

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<th>Ballroom A</th>
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<td>Technical Session XVIII</td>
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<td>Jiang</td>
<td>De Bast</td>
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<td>2:00 pm</td>
<td>Leary</td>
<td>O’Keefe</td>
<td>Clemens</td>
<td>Habib</td>
<td>Yapuncich</td>
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<td>2:15 pm</td>
<td>Noto</td>
<td>Stigman</td>
<td>Chester</td>
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<td>Ezcurra</td>
<td>Konishi</td>
<td>Williamson</td>
<td>Balanoff</td>
<td>Manz</td>
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<td>2:45 pm</td>
<td>Rauhut</td>
<td>Lindgren</td>
<td>Atwater</td>
<td>L. Wilson</td>
<td>Ruf</td>
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<td>3:00 pm</td>
<td>Arajo</td>
<td>Gauthier</td>
<td>Ramdeshan</td>
<td>Mitchell</td>
<td>Ahrens</td>
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<td>Simoes</td>
<td>Gingerich</td>
<td>Kcepka</td>
<td>Hooker</td>
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<td>3:30 pm</td>
<td>Simon</td>
<td>DeMar, Jr.</td>
<td>Koemigwald</td>
<td>N.A. Smith</td>
<td>Sparkling</td>
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<td>Lamanna</td>
<td>McCartney</td>
<td>Kirk</td>
<td>Ando</td>
<td>Sole</td>
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<td>J. Wilson</td>
<td>Larson</td>
<td>Beard</td>
<td>Meijer</td>
<td>Stucky</td>
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| 4:15 pm | Poster Session III | EXHIBIT HALL A, LEVEL 1 | Poster Session IV | EXHIBIT HALL A, LEVEL 1 |
**WEDNESDAY MORNING, OCTOBER 17, 2012**  
**SYMPOSIUM 1: VERTEBRATE PALEONTOLOGY IN THE NORTHERN NEOTROPICS:** CRADLE AND MUSEUM OF EVOLUTION ACROSS GEOLOGICAL TIME  
**RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4**  
**MODERATORS: Jason Head and Marcelo Sánchez-Villagra**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Title</th>
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<tbody>
<tr>
<td>8:00</td>
<td>Barrett, P., Butler, R., Irmis, R., Scheyer, T., Sánchez-Villagra, M.</td>
<td>A NEW ORNITHISCHIAN DINOSAUR FROM THE VENEZUELAN ANDES</td>
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<tr>
<td>8:15</td>
<td>Larsson, H.</td>
<td>THE CRETACEOUS NEOTROPICS: COLOMBIAN VERTEBRATES AT THE BOUNDARY OF SHIFTING ENVIRONMENTS AND THE MESozoIC MARINE INTERCHANGE</td>
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<tr>
<td>8:30</td>
<td>Cadena, E., Ksepka, D., Bloch, J.</td>
<td>FOUR NEW PElOMEDUSOIDES TURTLES FROM THE MIDDLE-LATE PALEOCENE OF COLOMBIA: THE FIRST CENOZOIC GIANT FRESHWATER TURTLE AND AN UNUSUALLY CIRCULAR TURTLE SHELL</td>
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<tr>
<td>8:45</td>
<td>Bloch, J., Rincon, A., Head, J., Herrera, E., Jaramillo, C.</td>
<td>EARLY EOCENE MAMMALS FROM THE HOT TROPICS OF NORTHERN SOUTH AMERICA</td>
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<td>9:00</td>
<td>Head, J., Bloch, J., Rincon, A., Moreno-Bernal, J., Jaramillo, C.</td>
<td>PALEOGENE SQUAMATES FROM THE NORTHERN NEOTROPICS: ECOLOGICAL IMPLICATIONS AND BIOGEOGRAPHIC HISTORIES</td>
</tr>
<tr>
<td>9:15</td>
<td>Antoine, P.</td>
<td>CENOZOIC MAMMALS FROM AMAZONIA: DIVERSITY, ENVIRONMENT AND BIOGEOGRAPHY</td>
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<tr>
<td>9:30</td>
<td>MacPhee, R., Iturralde-Vinent, M.</td>
<td>WHEN AND HOW DID LAND VERTEBRATES REACH THE GREATER ANTILLES?</td>
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<td>9:45</td>
<td>Velez-Juarbe, J., Domning, D.</td>
<td>PALEOGENE VERTEBRATE FAUNAS FROM THE GREATER ANTILLES</td>
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<td>10:00</td>
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<td>10:15</td>
<td>Hunt, K., Kay, R.</td>
<td>ORIGIN OF THE GREATER ANTILLEAN PRIMATE FAUNA</td>
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<td>10:30</td>
<td>MacFadden, B., Foster, D., Rincon, A., Morgan, G., Jaramillo, C.</td>
<td>THE NEW WORLD TROPICS AS A CRADLE OF BIODIVERSITY DURING THE EARLY MIOCENE: CALIBRATION OF THE CENTENARIO FAUNA FROM PANAMA</td>
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<tr>
<td>11:00</td>
<td>Scheyer, T., Aguiler, O., Fortier, D., Sánchez, R., Sánchez-Villagra, M.</td>
<td>NEOGENE CROCODYLIAN MEGADIVERSITY PEAK AND FAUNAL SUCCESSION IN VENEZUELA</td>
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<tr>
<td>11:30</td>
<td>Madden, R., Dunn, R., Strömberg, C., Kohn, M.</td>
<td>THE MIOCENE OF EQUATORIAL SOUTH AMERICA AND THE BIOTIC CONSEQUENCES OF ANDEAN UPLIFT</td>
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<td>11:45</td>
<td>Croft, D.</td>
<td>A SYNTHESIS OF CENOZOIC NEOTROPICAL MAMMAL EVOLUTION IN SOUTH AMERICA: BIOGEOGRAPHY AND INFLUENCES FROM HIGHER LATITUDES</td>
</tr>
<tr>
<td>12:00</td>
<td>Jaramillo, C.</td>
<td>FOSSIL VERTEBRATES FROM NEOTROPICAL LATITUDES: A VAST RECORD WAITING TO BE DISCOVERED</td>
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WEDNESDAY MORNING, OCTOBER 17, 2012
TECHNICAL SESSION I
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4
MODERATORS: Lindsay Zanno and Mark Loewen

8:00  Zanno, L., Makovicky, P., Gates, T. A NEW GIANT CARCHARODONTOSAURIAN ALLOSAUROID FROM THE LOWER CRETACEOUS CEDAR MOUNTAIN FORMATION OF CENTRAL UTAH

8:15  Snively, E., Cotton, J., Ridgely, R., Witmer, L. FEEDING MOTIONS IN ALLOSAURUS (DINOSAURIA: THEROPODA): MULTIBODY DYNAMICS OF THE CERVICOCEPHALIC APPARATUS SUGGESTS RAPID LATERAL STRIKES BUT SAGITTAL PREY DISMEMBERMENT


8:45  Gold, E., Brusatte, S., Norell, M. PNEUMATICITY PATTERNS IN THE SKULL OF ALIORAMUS ALTAI, A LONG-SNOUTED TYRANNOSAURID (DINOSAURIA: THEROPODA), FROM THE LATE CRETACEOUS OF MONGOLIA

9:00  Loewen, M., Sertich, J., Irmis, R. THE EARLY EVOLUTION OF TYRANNOSAURID DINOSAURS: NEW ANATOMICAL, PHYLOGENETIC AND BIOGEOGRAPHIC EVIDENCE

9:15  Carr, T. ONTOGENY AND PHYLOGENY OF CEPHALIC ORNAMENTATION IN TYRANNOSAURIOIDEA (DINOSAURIA, COELUROSAURIA)

9:30  Burch, S. EVOLUTION OF THE FORELIMB MUSCULATURE IN TYRANNOSAURIOIDEA (DINOSAURIA: THEROPODA)


10:00 BREAK

10:15  Cullen, T., Ryan, M., Evans, D., Currie, P., Kobayashi, Y. MULTI-ELEMENT HISTOLOGICAL ANALYSIS OF AN ORNITHOMIMID (DINOSAURIA) BONE BED FROM THE HORSESHOE CANYON FORMATION, ALBERTA


10:45  Lautenschlager, S., Rayfield, E., Witmer, L., Altangerel, P. A BIOMECHANICAL MODEL OF ERLIKOSAURUS ANDREWSI (DINOSAURIA: THERIZINOSAURIA) WITH IMPLICATIONS FOR CRANIAL FUNCTION AND DIETARY PREFERENCES

11:00  Wang, S., Xu, X. A NEW OVIRAPTORID SPECIMEN FROM THE UPPER CRETACEOUS OF SOUTHERN CHINA

11:15  He, T., Varricchio, D., Jackson, F., Jin, X., Poust, A. AN OVIRAPTORID ADULT-EGG ASSOCIATION AND THE ORIGIN OF AVIALAN REPRODUCTIVE STRATEGIES

11:30  Goswami, A., Prasad, G., Benson, R., Verma, O., Flynn, J. NEW VERTEBRATES FROM THE LATE CRETACEOUS KALLAMEDU FORMATION, CAUVERY BASIN, SOUTH INDIA, INCLUDING A TROODONTID DINOSAUR, A GONDWANATHERIAN MAMMAL, AND A SIMOSUCHUS-LIKE NOTOSUCHIAN CROCODYLIFORM

11:45  Parsons, W., Parsons, K. THE FIRST INTACT SCAPULAR GLENOID REGION OF DEINONYCHUS ANTIRRHOPUS AND THE CONSEQUENT RE-INTERPRETATION OF DROMAEOSAURID FEATURES THAT ENHANCED THE EVOLUTION OF AVIAN FLIGHT

12:00 Presentation Withdrawn
WEDNESDAY MORNING, OCTOBER 17, 2012
TECHNICAL SESSION II
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: John Long and Matt Friedman

8:00  Gai, Z., Zhu, M. THE ORIGIN OF THE VERTEBRATE JAW: INTERSECTION BETWEEN DEVELOPMENTAL BIOLOGY-BASED MODEL AND FOSSIL EVIDENCE

8:15  Criswell, K., Finarelli, J., Friedman, M., Garwood, R., Coates, M. DELTOPTYCHIUS: CRANIAL CHARACTERS AND RETHINKING EARLY HOLOCEPHALAN PHYLOGENY

8:30  Giles, S., Brazeau, M., Atwood, R., Friedman, M. ENDOSKELETAL ANATOMY OF THE STEM ACTINOPTERYGIAN CHEIROLEPIS REVEALED BY HIGH-RESOLUTION COMPUTED TOMOGRAPHY

8:45  Mickle, K. IDENTIFICATION OF THE BONES OF THE SNOUT IN LOWER ACTINOPTERYGIANS – A NEW NOMENCLATURE SCHEME BASED ON CHARACTERS

9:00  Standen, E., Larsson, H. A LIVING ANALOGUE TO THE FIN-LIMB TRANSITION: LOCOMOTION AND FIN USE OF AN AIR BREATHING FISH ON LAND

9:15  Long, J., Holland, T., Young, G. A PECULIAR TETRAPODOMORPH FISH FROM THE MIDDLE DEVONIAN OF AUSTRALIA SUPPORTS GONDWANA ENDEMISM IN THE STEM TETRAPOD RADIATION

9:30  Daeschler, E., Shubin, N., Jenkins, Jr., F. TRANSFORMATION OF THE PECTORAL GIRDLE DURING THE FIN-TO-LIMB TRANSITION

9:45  Janis, C., Devlin, K., Warren, D., Witzmann, F. DERMAL BONE IN EARLY TETRAPODS: A PALEOPHYSIOLOGICAL HYPOTHESIS OF ADAPTATION FOR TERRESTRIAL ACIDOSIS

10:00  BREAK

10:15  Presentation Withdrawn

10:30  Presentation Withdrawn

10:45  Pardo, J., Anderson, J. A MICRO-CT INVESTIGATION OF MODES OF TOOTH IMPLANTATION AND REPLACEMENT IN EARLY TETRAPODS

11:00  Liston, J. GROWTH, AGE AND SIZE OF LEEDSICHTHYS, THE LARGEST BONY FISH


11:30  Stearley, R., Cavender, T. A NEW FOSSIL CHAR (SALVELINUS) FROM MIOCENE LAKE SEDIMENTS IN STEWART VALLEY, NEVADA

11:45  Friedman, M. THE GEOLOGICAL AGE AND BIOGEOGRAPHY OF CICHLID FISHES: SETTING THE (FOSSIL) RECORD STRAIGHT

12:00  Case, J. DIVERSITY, ABUNDANCE AND TURNOVER IN THE ANTARCTIC MARINE FAUNA DURING THE EOCENE IN RESPONSE TO CLIMATE CHANGE
WEDNESDAY AFTERNOON, OCTOBER 17, 2012  
TECHNICAL SESSION III  
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4  
MODERATORS: Aaron Wood and William Sanders

1:45  **Theodor, J., Dreger, S., Wigg, J., Ruf, I.** EAR MORPHOLOGY OF *CAENOMERYX* AND RELATIONSHIPS OF CAINOTHERIIDS

2:00  **Noret, J., Tabor, N., Jacobs, B., Sanders, W., Kappelman, J.** STABLE ISOTOPE DATA FROM THE CHILGA BASIN, ETHIOPIA, AND THEIR IMPLICATIONS FOR RESOURCE PARTITIONING AMONG LATE PALEOGENE AFRICAN ENDEMIC MAMMALS

2:15  **Sanders, W., Gunnell, G.** ONTOGENETIC, BEHAVIORAL AND EVOLUTIONARY CONSIDERATIONS OF CRANIAL POLYMORPHISM IN EARLY OLIGOCENE *AEGYPTOPITHECUS ZEUXIS* (CATARRHINI, PRIMATES)

2:30  **Plavcan, J., Ward, C., Manthi, F.** NEW DIMINUTIVE CERCOPITHECINE TEETH FROM KANAPOI, KENYA, AND IMPLICATIONS FOR THE EVOLUTION OF DIVERSITY IN GUENONS


3:00  **Granatosky, M., Miller, C., Lemelin, P., Schmitt, D.** PHALangeAL MORPHOLOGY OF SUSPENSORY MAMMALS: IMPLICATIONS FOR THE LOCOMOTION OF MALAGASY SUBFOSSIL SLOTH LEMURS (PRIMATES: PALAEOPROPITHECIDAE)

3:15  **Miller, C., Granatosky, M., Chester, S., Boyer, D., Schmitt, D.** LUMBAR MORPHOLOGY OF SUSPENSORY, GLIDING AND FLYING MAMMALS: IMPLICATIONS FOR THE LOCOMOTOR BEHAVIOR OF SELECT FOSSIL PRIMATES

3:30  **Grass, A.** INFERRING LEVELS OF ARBOREALITY OF EXTINCT SLOTHS THROUGH A GEOMETRIC MORPHOMETRIC ASSESSMENT OF SCAPULA MORPHOLOGY

3:45  **Wood, A., Rincon, A., Moreno Rodriguez, F., Bloch, J., Jaramillo, C.** HABITAT STRUCTURE AND HINDLIMB FUNCTIONAL MORPHOLOGY IN AN EARLY MIOCENE EQUID FROM PANAMA

4:00  **Samuels, J.** SKULL SHAPE REFLECTS LOCOMOTOR ECOLOGY IN RODENTS AND CARNIVORANS

WEDNESDAY AFTERNOON, OCTOBER 17, 2012  
TECHNICAL SESSION IV  
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4  
MODERATORS: Ashley Morhardt and Alexander Kellner

1:45  **Holliday, C., Nesbitt, S.** MORPHOLOGY AND DIVERSITY OF THE MANDIBULAR SYMPHYSIS OF ARCHOSAUROMORPHS

2:00  **Tsai, H., Holliday, C.** ANATOMY OF ARCHOSAUR PELVIC SOFT TISSUES AND ITS SIGNIFICANCE FOR INTERPRETING HINDLIMB FUNCTION

2:15  **Kellner, A., Costa, F., Rodrigues, T.** NEW EVIDENCE ON THE PTEROID ARTICULATION AND ORIENTATION IN PTEROSAURS

2:30  **Padian, K., Fallon, B.** META-ANALYSIS OF REPORTED PTEROSAUR TRACKWAYS: TESTING THE CORRESPONDENCE BETWEEN SKELETAL AND FOOTPRINT RECORDS

2:45  **Button, D., Unwin, D., Purnell, M.** CONTINUOUS CHARACTER STATES AND THEIR IMPACT ON THE PHYLOGENY OF THE PTEROSAURIA

3:00  **Morhardt, A., Ridgely, R., Witmer, L.** FROM ENDOCAST TO BRAIN: ASSESSING BRAIN SIZE AND STRUCTURE IN EXTINCT ARCHOSAURS USING GROSS ANATOMICAL BRAIN REGION APPROXIMATION (GABRA)

3:15  **Porter, W., Witmer, L.** DINOSAUR CEPHALIC VASCULAR ANATOMY AND ITS PHYSIOLOGICAL IMPLICATIONS: EVIDENCE FROM THE FOSSILS
WEDNESDAY AFTERNOON, OCTOBER 17, 2012
TECHNICAL SESSION IV (CONTINUED)

3:30 Schweitzer, M., Cleland, T., Zheng, W., Bern, M. MOLECULAR EVIDENCE FOR ENDOGENEITY OF DINOSAUR OSTEOCYTES

3:45 Barta, D., Varricchio, D., Jackson, F. A CLADISTIC APPROACH TO UNDERSTANDING DINOSAUR EGG DIVERSITY AND THE EVOLUTION OF REPRODUCTIVE TRAITS WITHIN DINOSAURIA: PRELIMINARY RESULTS

4:00 Brown, C., Evans, D., Campione, N., O’Brien, L., Eberth, D. EVIDENCE FOR TAPHONOMIC SIZE BIAS IN A MODEL MESOZOIC TERRESTRIAL ALLUVIAL-PARALIC SYSTEM

WEDNESDAY AFTERNOON, OCTOBER 17, 2012
TECHNICAL SESSION V
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Mark Clementz and Nicholas Pyenson

1:45 Boyd, A. A RELATIONSHIP BETWEEN CERVICAL VERTEBRAL MORPHOLOGY AND TERRESTRIAL AND AQUATIC HABITATION

2:00 Rivin, M., Velez-Juarbe, J., Rhue, V. A NEW HALITHERIINE DUGONGID FROM THE EARLY MIOCENE OF ORANGE COUNTY, CALIFORNIA


2:30 Fahlke, J., Voss, M., Gingerich, P., Antar, M., Zalmout, I. PREDATION OF BASILOSARUS ISIS ON DORUDON ATROX (CETACEA, BASILOSARIIDAE): A CASE STUDY FROM THE EOCENE OF EGYPT

2:45 Clementz, M., Uhen, M. ONTOGENETIC VARIATION IN DENTAL STABLE ISOTOPE VALUES OF TWO SPECIES OF BASILOSARIDS (ZYGORHIZA KOCHII AND DURUDON ATROX)

3:00 Bebej, R., Zalmout, I., Abed El-Aziz, A., Antar, M., Gingerich, P. FIRST EVIDENCE OF REMINGTONOCETIDAE (MAMMALIA, CETACEA) OUTSIDE INDO-PAKISTAN: NEW GENUS FROM THE EARLY MIDDLE EOCENE OF EGYPT

3:15 Fordyce, R., Fitzgerald, E., González Barba, G. LONG-TUSKED ARCHAIC OLIGOCENE ODONTOCETES FROM OREGON AND BAJA CALIFORNIA SUR, EASTERN PACIFIC MARGIN

3:30 Lambert, O., Biannuci, G., De Muizon, C. THE ARCHAIC BEEKED WHALE NINOZIPHIUS PLATYROSTRIS: CLUES ON THE EVOLUTIONARY HISTORY OF THE FAMILY ZIPHIIDAE (CETACEA, ODONTOCETI)

3:45 Ekdale, E. PHYSIOLOGICAL AND EVOLUTIONARY IMPLICATIONS OF THE COCHLEAR MORPHOLOGY OF MIOCENE MYSTICETI (CETACEA)

4:00 Pyenson, N., Gutstein, C., Parham, J., Rubilar-Rogers, D., Suárez, M. ROADSIDE WHALES IN THE ATACAMA: A MASS DEATH ASSEMBLAGE OF MARINE MAMMALS FROM CERRO BALLENA, A NEW LOCALITY OF THE BAHIA INGLESA FORMATION, ATACAMA REGION, CHILE
WEDNESDAY AFTERNOON, OCTOBER 17, 2012
POSTER SESSION I
RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Miyata, K., Demere, T. NEW INFORMATION ON BASICRANIA OF TROGOSUS (TILLODONTIA, MAMMALIA) WITH AN EXQUISITELY PRESERVED PETROSAL

2 Bastl, K., Nagel, D. SCAPHOLUNATUM, OR SCAPHOID AND LUNATUM, THAT IS THE QUESTION. THE CASE OF HYAENODON

3 Morse, P., Bloch, J., Secord, R., Chester, S., Boyer, D. ARCTOCYONID DIVERSITY DURING THE PALEOCENE-EOCENE THERMAL MAXIMUM OF NORTH AMERICA

4 Rankin, B., Ludtke, J., Barrón-Ortiz, C., Yang, X., Fox, J. USING THE EXTENDED PRICE EQUATION TO ANALYZE PATTERNS OF BODY SIZE CHANGE IN MAMMALS ACROSS THE PALEOCENE-EOCENE THERMAL MAXIMUM IN NORTH AMERICA

5 Missiaen, P., Quesnel, F., Dupuis, C., Storme, J., Smith, T. SMALL IS BEAUTIFUL: THE ERQUELINNES MAMMAL FAUNA FROM THE EARLIEST EOCENE OF THE SOUTHERN MONS BASIN, BELGIUM

6 Tsubamoto, T. ESTIMATING BODY MASS OF FOSSIL LAND MAMMALS USING THE ASTRAGALUS

7 Tabrum, A. ADDITIONAL MATERIAL OF THE TYPE SPECIMEN OF THE TAPIROID COLODON KAYI (HOUGH) FROM THE SAGE CREEK BASIN, MONTANA

8 Schwermann, L., Von Koenigswald, W. DENTAL MORPHOLOGY AND FUNCTION OF DIACODEXIS IN COMPARISON WITH PRIMITIVE ARTIODACTYLA

9 Rook, D. THE IMPORTANCE OF SEDIMENT IN THE GRAZER/GRASSLAND STORY OF NORTH AMERICA

10 Boardman, G., Secord, R. A MULTI-PROXY REAPPRaisal OF DIET AND MICROHABitat IN CHADRONIAN AND OrellAN UNGULATES FROM NEBRASKA BASEd ON STABLE ISOTOPES, MesoWEAR AND HYPSODONTY INDEX

11 Wilson, P., Moore, J. QUANTITATIVE ANALYSIS OF THE TAPHONOMIC PATTERNS OF VERTEBRATE ASSEMBLAGES FROM THE OLGOCENE POLESIDE MEMBER OF THE BRULE FORMATION, BADLANDS NATIONAL PARK, SOUTH DAKOTA

12 Lubar, C., Prothero, D. FOSSIL CAMELS FROM THE LATE OLGOCENE EASTLAKE LOCAL FAUNA, OTAY FORMATION, SAN DIEGO COUNTY, CALIFORNIA


14 Prothero, D., Beatty, B., Stucky, R. SIMOJOVELHYUS, THE OLDEST MAMMAL FOSSIL FROM CENTRAL AMERICA, IS A PECCARY, NOT A HELOHYID

15 Barrón-Ortiz, C., Rankin, B., Theodor, J. CHARACTERIZATION OF UNGULATE BUCCAL CUSP SHAPE USING OUTLINE-BASED GEOMETRIC MORPHOMETRICS AND ITS IMPLICATION FOR MESOWEAR ANALYSES

16 Gelnaw, W. MORPHOMETRY.ORG, A NEW WEBSITE FOR SHARING MORPHOMETRIC DATA

17 Burk, D. USING GIS SLOPE AND ASPECT DATA AS PREDICTORS OF SURFACE FOSSIL ABUNDANCE IN THE UINTA BASIN, UTAH

18 Moran, S. INTRA-INDIVIDUAL VARIATION OF CARBON AND OXYGEN ISOTOPES WITHIN THE MIOCENE HORSE PARAIHIPPUS LEONENSIS AND IMPLICATIONS FOR DIET

19 Feranec, R., Pagnac, D. EARLY EVIDENCE FOR THE ABUNDANCE OF C4 GRASSES FROM THE MIDDLE MIOCENE BARSTOW FORMATION, SAN BERNARDINO COUNTY, CALIFORNIA
20 Maguire, K. USING PALEOSOLS TO IDENTIFY NICHE PARTITIONING IN MIOCENE EQUIDS OF CENTRAL OREGON

21 WITHDRAWN

22 Martínez-Maza, C., Alberdi, M., Prado, J. PALEOHISTOLOGICAL ANALYSIS OF METAPODIAL BONES OF MIOCENE HIPPARIAN CONCUDENS FROM SPAIN

23 Scott, E., Springer, K., Manker, C. LATE PLEISTOCENE EQUUS AND Bison FROM THE TULE SPRINGS LOCAL FAUNA, UPPER LAS VEGAS WASH, CLARK COUNTY, NEVADA

24 Hulbert Jr., R. EQUUS SPECIES RICHNESS IN THE RANCHOLABREAN OF THE SOUTHEASTERN U.S. COASTAL PLAIN: A QUANTITATIVE ANALYSIS OF ISOLATED CHEEK TEETH

25 Loffredo, L., DeSantis, L. HIGH OBSERVER VARIABILITY IN DENTAL MESOWEAR ANALYSIS OF AN EXTREME GENERALIST CORMOHIPPARIAN EMSLIEI FROM FLORIDA: CAUTIONARY LESSONS LEARNED FROM INTEGRATING GEOCHEMICAL AND DENTAL MESOWEAR DATA

26 McHorse, B., Davis, E., Hopkins, S. FUNCTIONAL MORPHOLOGY IN MODERN HORSES: NATURAL VS. ARTIFICIAL SELECTION

27 Gilmore, L., Bredehoeft, K. PALEOPATHOLOGICAL ANALYSIS OF TAPIRUS SPP. FROM FLORIDA AND TENNESSEE

28 Ayoub, M., Mihlbachler, M. DENTAL WEAR AND FEEDING ECOLOGY IN NORTH AMERICAN LATE MIOCENE RHINOCEROTIDAE, APHELOPS AND TELEOCERAS

29 Handa, N., Nakaya, H., Nakatsukasa, M., Kunimatsu, Y. NEW SPECIMENS OF ELASMOTHERIINI (RHINOCEROTIDAE, PERISSODACTYLA) FROM THE NAMURUNGULE AND NAKALI FORMATIONS (EARLY LATE MIOCENE) OF NORTHERN KENYA

30 Stilson, K., Hopkins, S., Davis, E. THE EVOLUTION OF RHINO ARTHRITIS IN THE CENOZOIC

31 Mihlbachler, M., Beatty, B., Ayoub, M. EXTRACTION AND ANALYSIS OF INGESTA IMPACTED IN THE DENTITIONS OF MODERN UNGULATES: NEW EVIDENCE FOR LINKING DENTAL WEAR AND FEEDING ECOLOGY

32 Karme, A., Kallonen, A., Galambosi, S., Engström, P., Fortelius, M. ARTIFICIAL CHEWING WITH REAL TEETH

33 Prado, J., Alberdi, M., Domingo, L. MEGAFANA EXTINCTION AND CLIMATIC CHANGE IN THE PAMPEAN REGION, ARGENTINA

34 Davis, M. WHAT IS THE APPROPRIATE SPATIAL AND TEMPORAL SCALE OF FAUNMAP DATA?

35 Damuth, J., Janis, C., Travouillon, K., Archer, M., Hand, S. MOLAR WEAR GRADIENT ANALYSIS IN EXTANT AND FOSSIL KANGAROOS (MARSUPIALIA, MACROPODOIDEA)

36 Vietti, L. QUANTIFYING BONE WEATHERING STAGES USING RA, A SURFACE ROUGHNESS PARAMETER MEASURED FROM 3D DATA

37 Louys, J. A DIVERSE WOMBAT FAUNA FROM THE PLIOCENE CHINCHILLA SAND FORMATION, SOUTHEASTERN QUEENSLAND, AUSTRALIA

38 Gunnell, G., Simmons, N., Rosenberger, A., O’Neill, H., Rimoli, R. FIRST RECORDS OF FOSSIL BATS FROM THE DOMINICAN REPUBLIC

39 Salles, L., Carlos, M., Lanzelotti, W., Perini, F., Simmons, N. QUATERNARY BATS FROM SERRA DA MESA (BRAZIL): HUMERAL REMAINS AND TAXONOMIC ASSESSMENTS

40 Schwermann, A. NEW INFORMATION OF THE EVOLUTION OF THE SHOULDER GIRDLE AND FORELIMBS OF FOSSORIAL MOLES
WEDNESDAY AFTERNOON, OCTOBER 17, 2012
POSTER SESSION I (CONTINUED)

41 Pujos, F., Antoine, P., Mamani Quispe, B., Abello, A., Andrade Flores, R. THE MIOCENE VERTEBRATE FAUNAS OF ACHIRI, BOLIVIA

42 Gaudin, T. PREMAXILLAE OF EXTINCT ANTILLEAN MEGALONYCHID SLOTHS ACRATOCNUS AND NEOCNUS AND A POTENTIAL NEW SYNAPOMORPHY FOR MEGALONYCHIDAE (XENARTHRA, MAMMALIA)

43 Resar, N., Green, J. USING SCANNING ELECTRON MICROSCOPY TO RECONSTRUCT FEEDING ECOLOGY IN GROUND SLOTHS

44 Green, J., Resar, N. ANALYSIS OF DENTAL MICROWEAR IN THE XENARTHRA: DOES SCANNING ELECTRON MICROSCOPY REVEAL A LINK BETWEEN FEEDING ECOLOGY AND TOOTH SCARRING?

45 Jasinski, S., Wallace, S. AN ARMADILLO AND A LEG: INFERRING BEHAVIORAL DIFFERENCES OF DASYPUS BELLUS AND DASYPUS NOVEMCINCTUS FROM MORPHOLOGY OF THE CALCANEUS

46 Gillette, D., Carranza-Castañeda, O., White, R., McCord, R., Thrasher, L. EVOLUTIONARY STASIS OF NORTH AMERICAN GLYPTODONTS DURING THE GREAT AMERICAN BIOTIC INTERCHANGE

47 Reizner, J. AN ONTOGENETIC STUDY AND POPULATION HISTOLOGY OF THE CERATOPSID DINOSAUR EINIOSAURUS PROCURVICORNIS

48 Brandau, D., Irmis, R. COMPARATIVE TAPHONOMY OF CERATOPSID BONEBEDS: IMPLICATIONS OF NEW DATA FROM SOUTHERN LARAMIDIA

49 Varriale, F. THE NEOCERATOPSIAN HORIZONTAL SHELFW IS NOT HORIZONTAL, AND OTHER NEW INFORMATION ABOUT THIS STRUCTURE

50 Campbell, J., Ryan, M., Currie, P., Langston, W. NEW RECONSTRUCTION OF THE PARIETAL MORPHOLOGY OF PACHYRHINOSAURUS CANADENSIS, A CENTROSAURINE CERATOPSID FROM THE CAMPANIAN OF ALBERTA

51 Scannella, J., Fowler, D., Goodwin, M., Horner, J. TRANSITIONAL TRICERATOPS: DETAILS OF AN ONTOGENETIC SEQUENCE FROM THE UPPER MIDDLE UNIT OF THE HELL CREEK FORMATION, MONTANA

52 Tokaryk, T., Ryan, M., Evans, D. NO ENVIRONMENTAL PARTITIONING OF CERATOPSIDAE WITHIN THE LOWER DINOSAUR PARK FORMATION (CAMPANIAN) FAUNAL ZONE OF WESTERN CANADA

53 Lund, E., O’Connor, P., Loewen, M., Jinnah, Z. NEW CENTROSAURINE CERATOPSID MATERIAL FROM THE MIDDLE CAMPANIAN WAHWEAP FORMATION OF SOUTHERN UTAH

54 Frederickson, J. CRANIAL DEVELOPMENT OF CENTROSAURUS APERTUS: UNDERSTANDING HORN VARIATION AND EVOLUTION THROUGH AN ONTOGENETIC APPROACH

55 Wiersma, J., Loewen, M., Irmis, R. A RE-EVALUATION OF TOROSAURUS UTAHENSIS: IMPLICATIONS FOR MAASTRICHTIAN CERATOPSIAN DIVERSITY IN WESTERN NORTH AMERICA

56 Hedrick, B., Dodson, P. MYOLOGICAL RECONSTRUCTION OF THE BASAL CERATOPSIANS, PSITTACOSAURUS AND PROTOCERATOPS: UNDERSTANDING MUSCLE RELOCATION RELEVANT TO POSTURE

57 Peterson, J., Dischler, C. DISTRIBUTIONS OF INJURIES IN PACHYCEPHALOSAURIDS USING FRONTOPARIETAL LANDMARKS

58 Gunn, J., Nazikian, T., Farke, A. DENTAL MICROWEAR IN HADROSAURID DINOSAURS FROM THE KAIPAROWITS FORMATION, UTAH

Mori, H., Druckenmiller, P., Prieto-Márquez, A., Joshi, S. RECONSTRUCTION AND MORPHOMETRIC ANALYSIS OF JUVENILE EDMONTOSAURUS SP. FROM THE LOWER MAASTRICHTIAN (CRETACEOUS) PRINCE CREEK FORMATION OF NORTHERN ALASKA

Freedman, E., Tanke, D., Wolff, E. OSTEOPATHY IN HADROSAURINES (DINOSAURIA: ORNITHISCHIA) OF THE JUDITH RIVER FORMATION (CAMPANIAN) OF NORTH CENTRAL MONTANA

Guenther, M., Wosik, M., McCarthy, S. REFINING HADROSAURID DIVERSITY IN THE SAN JUAN BASIN THROUGH THE REEXAMINATION OF HISTORIC SPECIMENS

Farke, A., Chok, D., Herrero, A., Scolieri, B. ONTOGENY IN THE HADROSAURID DINOSAUR PARASAUROLOPHUS REVEALED BY AN ARTICULATED SKELETON FROM THE KAIPAROWITS FORMATION OF SOUTHERN UTAH

MacDougall, M., Reisz, R. RECONSTRUCTION OF INACCESSIBLE ANATOMY FROM AN EARLY PERMIAN LANTHANOSUCHOID (AMNIOTA: PARAREPTILIA), AND A NEW PHYLOGENETIC ANALYSIS OF THE PARAREPTILIA

Jones, M., Zikmund, T. A FUNCTIONAL INTERPRETATION OF THE CRANIAL SUTURE MORPHOLOGY IN CAPTORHINUS AGUTI (REPTILIA)

Drymala, S., Bader, K. ASSESSING PREDATOR-PREY INTERACTIONS THROUGH THE IDENTIFICATION OF BITE MARKS ON AN AETOSAUR (PSEUDOSUCHIA) OSTEODERM FROM THE UPPER TRIASSIC (NORIAN) CHINLE FORMATION IN PETRIFIED FOREST NATIONAL PARK (ARIZONA, USA)

Suzuki, D., Chiba, K. MECHANISM OF THE CRUROTASAL JOINT

Ji, C., Shang, W., Diao, G., Motani, R., Tintori, A. BIODIVERSITY AND STRATIGRAPHIC DISTRIBUTION OF THE FIRST LATE LADINIAN (MIDDLE TRIASSIC) MARINE VERTEBRATE FAUNA – XINGYI FAUNA FROM SOUTH CHINA

Beardmore, S., Orr, P., Manzocchi, T., Furrer, H. CAN THE PALAEOECOLOGY OF REPTILE FOSSILS BE INFERRED FROM TAPHONOMY?

Mueller, B., Chatterjee, S. NEW DREPANOSAURID (ARCHOSAUROMORPHA: DREPANOSAURIDAE) MATERIAL FROM THE LATE TRIASSIC DOCKUM GROUP OF WEST TEXAS

Spielmann, J., Lucas, S., Heckert, A. A NEW ARMORED ARCHOSAUROMORPH FROM THE LATE TRIASSIC (OTISCHALKIAN) COLORADO CITY FORMATION OF THE CHINLE GROUP, WEST TEXAS

Sobral, G., Müller, J. X-RAY MICRO-COMPUTED TOMOGRAPHY REANALYSIS OF THE UPPER TRIASSIC DIAPSID ELACHISTOSUCHUS HUENEI

Lucas, S., Heckert, A., Spielmann, J. NEW SPECIES OF THE ENIGMATIC ARCHOSAUROMORPH DOSWELILLA FROM THE UPPER TRIASSIC BLUEWATER CREEK FORMATION, NEW MEXICO, USA

Domingo, L., Barroso-Barcenilla, F., Cambra-Moo, Ó. FIRST STABLE ISOTOPE ANALYSES ON CROCODILES AND DINOSAURS FROM THE LATE CRETACEOUS “LO HUECO” FOSSIL SITE (CUENCA, SPAIN)

Dufeau, D., Morhardt, A., Witmer, L. ONTOGENETIC CHANGE IN THE CRANIAL ENDOCAST AND ENDOSEOUS LABYRINTH OF AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS): IMPLICATIONS FOR THE INTERPRETATION OF EXTINCT ARCHOSAURS

Imai, T., Evans, T., Cahoon, J., Varricchio, D. EGGSHELLS AS SEDIMENT: A FLUME STUDY TO DETERMINE THE APPLICABILITY OF SEDIMENT-TRANSPORT EQUATIONS TO EGGSHELLS

Kruk, B., Susorney, H., Jackson, F., Shaw, C., Varricchio, D. APPLICATIONS OF ELECTRON BACKSCATTER DIFFRACTION ON FOSSILIZED AND MODERN EGGSHELL
WEDNESDAY AFTERNOON, OCTOBER 17, 2012
POSTER SESSION I (CONTINUED)

78 WITHDRAWN

79 Lomax, D., Massare, J. A NEW SPECIES OF ICHTHYOSAURUS FROM THE LOWER JURASSIC (PLIENSBACHIAN) OF WEST DORSET, ENGLAND

80 Yang, P., Ji, C., Jiang, D., Motani, R., Sun, Z. A NEW SPECIES OF QIANICHTHYOSAURUS (REPTILIA: ICHTHYOSAURIA) FROM XINGYI FAUNA (LADINIAN, MIDDLE TRAASSIC) OF GUIZHOU, SOUTHWESTERN CHINA

81 Burnham, D., Martin, L., Rothschild, B. PLESIOSAURS HAD A TASTE FOR BIRDS

82 Schumacher, B., Carpenter, K., Everhart, M. A NEW PLIOSAUR (PLESIOSAURIA, PLIOSAURIDAE) FROM THE CARLILE SHALE (CRETACEOUS: MIDDLE TURONIAN) OF RUSSELL COUNTY, KANSAS

83 Wilhelm, B., Tokaryk, T. FURTHER CONSIDERATIONS OF THE OSTEOREGNOLOGY OF TERMINONATATOR PONTEIXENSIS

84 Byrd, C. ONTOGENETIC STATE OF A JUVENILE POLYCOTYLID PLESIOSAUR (SAUROPTERYGIA: PLESIOSAURIA) AND ITS IMPLICATIONS FOR PLESIOSAUR GROWTH AND REPRODUCTION

85 Smith, A., Araújo, R. A NEW RHOMALEOSAURID PLIOSAUR FROM THE SINEMURIAN (LOWER JURASSIC) OF LYM REGIS, ENGLAND

86 Xue, Y., Jiang, D., Sun, Z., Yang, P., Ji, C. NEW INFORMATION ON SEXUAL DIMORPHISM AND ALLOMETRIC GROWTH IN THE PACHYPLEUROSAUR KEICHOUSAURUS HUI FROM THE MIDDLE TRIASSIC OF GUIZHOU, SOUTH CHINA

THURSDAY MORNING, OCTOBER 18, 2012
SYMPOSIUM: CRETACEOUS FAUNAS OF APPALACHIA: SYSTEMATICS, PALEOEOLOGY AND TAPHONOMY: A SYMPOSIUM DEDICATED TO THE MEMORY OF DR. DONALD BAIRD
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Robert Denton, Jr. and Robert O’Neill

8:00 Grandstaff, B., Parris, D. SKELETONS IN THE CRETACEOUS CLOSET - AN OVERVIEW OF THE HISTORY OF PALEONTOLOGY IN APPALACHIA

8:15 Ciampaglio, C., Cicimurri, D. ELASMOBRANCH AND OSTEICHTHYAN DIVERSITY FROM TWO LATE CRETACEOUS (LATE CAMPANIAN) TRANSGRESSIVE LAG DEPOSITS ALONG THE NEUSE RIVER, LENOIR COUNTY, NORTH CAROLINA

8:30 Garcia, W., Hippensteel, S. CHONDRICTHYAN AND OSTEICHTHYAN MATERIAL FROM ELIZABETHTOWN, NC, AND BOWIE, MD, AND THE FISH FAUNA OF THE CAMPANIAN-MAASTRICHTIAN OF EASTERN NORTH AMERICA

8:45 Schwimmer, D. LATE CRETACEOUS (MID-CAMPANIAN) VERTEBRATES OF THE HANNAHATCHEE CREEK SITE, WESTERN GEORGIA, A NEARSHORE MARINE BONE BED AT THE ATLANTIC/GULF TRANSITION

9:00 Brochu, C., Denton, R., Grandstaff, B., Parris, D., Schein, J. SOUTHERN NORTHERN CROCODILES: BOREALOSUCHUS FROM THE CAMPANIAN OF ALABAMA AND THE EARLY BIOGEOGRAPHIC HISTORY OF CROCODILYANS IN NORTH AMERICA

9:15 Parris, D., Clements, D., Lauginiger, E., Hope, S. A FIELD GUIDE TO THE BIRDS (VOLANT VERTEBRATES) OF THE CRETACEOUS OF APPALACHIA

9:30 Weishampel, D., Sartin, C., Nabavizadeh, A. HADROSAURIDS FROM THE ‘LOST CONTINENT’ OF APPALACHIA
WESTERN APPALACHIA DINOSAURIAN AND ASSOCIATED VERTEBRATES OF THE LATE CRETACEOUS OF SOUTHEAST MISSOURI

THEROPOD DINOSAURS FROM THE LATE CRETACEOUS OF EASTERN NORTH AMERICA: ANATOMY, SYSTEMATICS, BIOGEOGRAPHY, AND NEW INFORMATION FROM HISTORIC SPECIMENS

LATE CRETACEOUS (SANTONIAN-MAASTRICHTIAN) VERTEBRATE FAUNAS FROM THE ARCTIC OF APPALACHIA

VEGETATION AND CLIMATE RECONSTRUCTION OF DINOSAUR-BEARING LATE MIDDLE CAMPAIGN UNITS IN ALABAMA AND MISSISSIPPI

BRIDGING THE GAP: NORTH CAROLINA’S ROLE IN LATE CRETACEOUS (CAMPAIGN) RESEARCH AND ITS IMPLICATIONS FOR REGIONAL PALEOBIOGEOGRAPHY AND FAUNAL CORRELATIONS

WILDFIRE PALEOEKOLOGY FROM THE CRETACEOUS COAST OF SOUTHAPPALACHIA AT THE ARLINGTON ARCHOSAUR SITE, TEXAS

DEPOSITIONAL ENVIRONMENT AND REWORKING HISTORY OF THE SEVERN (BOWIE, MD) AND BLADEN (ELIZABETHTOWN, NC) FORMATIONS: TAPHONOMIC AND SEDIMENTOLOGICAL CHARACTERISTICS OF TWO LATE CRETACEOUS LAG DEPOSITS

COMPARATIVE TAPHONOMY OF LATE CRETACEOUS VERTEBRATE FOSSIL OCCURRENCES IN THE ATLANTIC COASTAL PLAIN DEPOSITS OF APPALACHIA: TESTING THE HYPOTHESIS OF MASS MORTALITY AT THE K/PG BOUNDARY

EXPLORING THE “LOST CONTINENT” OF APPALACHIA - THE ELLISDALEAN LAND FAUNA AND ITS IMPLICATIONS FOR LATE CRETACEOUS BIOGEOGRAPHY

LOCAL ENVIRONMENTAL CONDITIONS DROVE VERTEBRATE DIVERSITY IMMEDIATELY PRIOR TO THE K/PG EXTINCTION: EVIDENCE FROM CENTRAL CANADA

FOSSILS, GENES AND THE EVOLUTION OF THE VERTEBRAL COLUMN IN ARCHOSAURS

A UNIVERSAL LIMB SCALING RELATIONSHIP FOR ESTIMATING BODY MASS IN EXTINCT TERRESTRIAL TETRAPODS

CHANGING DIETARY NICHES IN MAMMALIAN COMMUNITIES ACROSS THE CRETACEOUS/PALEOGENE BOUNDARY

CHEMICAL AND MOLECULAR CHARACTERIZATION OF ENDOGENOUS PROTEINS FROM THE BLOOD VESSELS OF BRACHYLOPHOSAURUS CANADENSIS AND TYRANNOSAURUS REX CORTICAL BONE

PATTERNS AND PROCESSES AT ORIGIN OF BIRDS: MACROEVOLUTIONARY TEMPO AND MODE
THURSDAY MORNING, OCTOBER 18, 2012
ROMER PRIZE SESSION (CONTINUED)

9:30  Gould, F. ARTICULAR SURFACE MORPHOLOGY AND THE EVOLUTION OF CURSORIALITY IN PALEOGENE UNGULATES: THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC ANALYSIS OF COMPLEX TOPOLOGIES

9:45  Hammond, A. EVIDENCE FOR SUSPENSORY LOCOMOTOR ADAPTATIONS IN A LATE MIOCENE FOSSIL APE BASED ON IN VIVO-VALIDATED MODELS OF HIP JOINT ABDUCTION

10:00  BREAK

10:15  Hastings, A. DYROSAURID CROCODYLIFORMS ATTAIN PEAK TAXONOMIC DIVERSITY AND CRANIAL MORPHospace DISPARITY IN FRESHWATER FOLLOWING LATE CRETACEOUS LARGE MARINE TETRAPOD EXTINCTION

10:30  Heers, A. FROM EXTANT TO EXTINCT: LOCOMOTOR ONTOGENY AND THE EVOLUTION OF AVIAN FLIGHT

10:45  Lyson, T. EVOLUTIONARY DEVELOPMENTAL MODEL FOR THE ORIGIN OF THE TURTLE SHELL AND A NOVEL FUNCTIONAL HYPOTHESIS FOR THE ORIGIN OF THE CHELONIAN LUNG VENTILATION MECHANISM

11:00  McHugh, J. ONTOGENY AND PHYLOGENY OF TEMNOSPONDYL AMPHIBIANS, A WINDOW INTO TERRESTRIAL ECOSYSTEMS DURING THE PERMO-TRIASSIC MASS EXTINCTION

11:15  Montanari, S. STABLE ISOTOPE ECOLOGY OF VERTEBRATES IN ARID ENVIRONMENTS: ARCHIVES OF ENVIRONMENT AND CLIMATE IN THE FOSSIL RECORD

11:30  Tseng, Z. CONVERGENT EVOLUTION AND ITS FUNCTIONAL MECHANISMS: A CASE STUDY OF BONE-CRACKERS

11:45  Uno, K. ENAMEL MATURATION AND INTRATOOTH STABLE ISOTOPE PROFILES IN ELEPHANT (LOXODONTA AFRicana) MOLARS: A NEW TOOL FOR EVALUATING SEASONALITY IN TERRESTRIAL PALEOENVIRONMENTS FROM PROBOSCIDEAN TEETH

12:00  Wilberg, E. A SOLUTION TO THE “LONGIROSTRINE PROBLEM”? A PHYLOGenetIC REAPPRAISAL OF THALATTOSUCHIAN RELATIONSHIPS AND ISSUES SURROUNDING THEIR LABILITY

THURSDAY MORNING, OCTOBER 18, 2012
PREPARATORS’ SESSION
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Kyle Davies and William Simpson

8:00  Keillor, T. FEATHERING DINOSAURS

8:15  Starck, E., Benton, R., Householder, M., Boyd, C., Pagnac, D. FROM DISCOVERY TO PUBLIC OUTREACH: A NEW VISITOR ORIENTATED FOSSIL QUARRY AND FOSSIL PREPARATION LAB OPENS AT THE BEN REIFEL VISITOR CENTER AT BADLANDS NATIONAL PARK


8:45  Sagebiel, J., Brown, M. IMPROVING CURATION AND CONSERVATION STANDARDS AT THE VERTEBRATE PALEONTOLOGY LABORATORY THROUGH INTERDISCIPLINARY COLLABORATIONS

9:00  Storch, P., Wilkins, W., Potapova, O., Agenbroad, L. METHODOLOGY AND RESULTS OF A COMPREHENSIVE SPECIMEN CONSERVATION CONDITION SURVEY OF AN ACTIVE BONE BED AND STORAGE COLLECTION AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.

9:15  May, P., Fair, M., Crawford, B., May, A., MacLeod, M. DIGITAL DEVELOPMENT AND MOUNTING OF AN ALAMOSAURUS SKELETON FOR THE PEROT MUSEUM OF NATURE AND SCIENCE
THURSDAY MORNING, OCTOBER 18, 2012
PREPARATORS’ SESSION (CONTINUED)

9:30 Marsh, A., Brown, M., Colbert, M., Rowe, T. COMBINING MECHANICAL PREPARATION AND X-RAY COMPUTED TOMOGRAPHY TECHNIQUES TO VISUALIZE OBSCURED MORPHOLOGY IN A BASAL SAUROPODOMORPH DINOSAUR

9:45 Colbert, M., Brown, M. THE USE OF HIGH-RESOLUTION XRAY CT TO INTERPRET MATRIX VARIABILITY AND GUIDE FOSSIL PREPARATION

10:00 BREAK

10:15 Supplee, J., Compton, B. USING A GLYCEROL-WATER SOLUTION TO CONTROL RELATIVE HUMIDITY IN A CLOSED ENVIRONMENT

10:30 Sadowska, V., Morrison, I., Silcox, M. COMPARING IMPRESSION MATERIALS FOR DENTAL MICROWEAR ANALYSIS IN A SMALL FOSSIL MAMMAL

10:45 Brown, G. TECHNIQUES AND MATERIALS FOR MICROFOSSIL PREPARATION: MAXIMIZING SUCCESS AND MINIMIZING STRESS

11:00 Kline, P., Kline, M., Main, D. MAPPING AND LAB PREPARATION OF A CRETACEOUS (CENOMANIAN) TURTLE FROM THE WOODBINE FORMATION OF NORTH TEXAS: THE UNUSUAL CHALLENGES OF THE FLYING TURTLE PROJECT


11:30 McCullough, G., Walters, T., Gillette, D., White, R., Thrasher, L. THE COLLABORATION OF INSTITUTIONS, AGENCIES, AND VOLUNTEERS FOR A “PAINLESS” EXCAVATION OF A LARGE GLYPTOTHERIUM FROM THE LATE BLANCAH OF THE SAN SIMON VALLEY IN SOUTHEASTERN ARIZONA


12:00 Brown, M., Davidson, A., Fox, M., Jabo, S., Smith, M. VERTEBRATE PALEONTOLOGICAL PREPARATION CORE COMPETENCIES AND TRAINING CURRICULUM: RESULTS FROM THE 2012 AUSTIN WORKSHOP

THURSDAY AFTERNOON, OCTOBER 18, 2012
TECHNICAL SESSION VI
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Martin Sander and Nathan Smith

1:45 Bourke, J., Porter, W., Witmer, L. DORSAL OR ROSTRAL NOSTRILS? TESTING FLESHY NOSTRIL POSITION AND AIRFLOW IN SAUROPODS USING COMPUTATIONAL FLUID DYNAMICS

2:00 Schmitt, A., Sander, P., Ruf, I. SEMICIRCULAR CANAL DIMENSIONS IN SAUROPODOMORPHA: PALEOBIOLOGICAL IMPLICATIONS


2:30 Holtz, Jr., T. LIASSIC DAWN: PHYLETIC DIVERGENCE ANALYSIS SUPPORTS EARLY TO MIDDLE JURASSIC ESTABLISHMENT OF PRIMARY DINOSAURIAN DIVERSITY

2:45 Smith, N., Hellert, S., Mathews, J., Hammer, W., Makovicky, P. NEW DINOSAURS FROM THE EARLY JURASSIC HANSON FORMATION OF ANTARCTICA, AND PATTERNS OF PHYLOGENETIC DIVERSITY IN EARLY JURASSIC SAUROPODOMORPHS
3:00 Upchurch, P., D’Emic, M., Mannion, P., Benson, R., Pang, Q. NEW INFORMATION ON THE ANATOMY AND RELATIONSHIPS OF TITANOSAURIFORM SAUROPODS FROM THE CRETACEOUS OF EAST ASIA

3:15 Mannion, P., Upchurch, P., Barnes, R. THE EVOLUTIONARY HISTORY OF TITANOSAURIFORM SAUROPODS

3:30 Sander, P., Klein, N. CERVICAL RIB HISTOLOGY OF SAUROPOD DINOSAURS SUGGESTS FUNCTION IN THE MUSCULAR CONTROL OF THE NECK

3:45 Stein, K., Prondvai, E. NO FIBROUS (WOVEN) BONE IN SAUROPOD FIBROLAMELLAR BONE?

4:00 D’Emic, M., Wilson, J. BONE HISTOLOGY OF A DWARF SAUROPOD DINOSAUR FROM THE LATEST CRETACEOUS OF JORDAN AND A POSSIBLE BIOMECHANICAL EXPLANATION FOR “TITANOSAUR-TYPE” BONE HISTOLOGY

THURSDAY AFTERNOON, OCTOBER 18, 2012
TECHNICAL SESSION VII
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4
MODERATORS: Sarah Werning and Robert Burroughs


2:00 Lamm, K. TOWARD A QUANTITATIVE WAY TO IDENTIFY ANCESTORS IN THE FOSSIL RECORD: A BAYESIAN APPROACH

2:15 Ferrer, E. USING PHYLOGENY AS A FRAMEWORK FOR DIVERSITY STUDIES

2:30 Burroughs, R. EXPLORING AND EVALUATING THE IMPACT OF ANATOMICAL PARTITIONS ON MORPHOLOGY-BASED PHYLOGENETIC ANALYSES

2:45 Alroy, J. SIMPLE EQUATIONS FOR ESTIMATING BODY MASS IN MAMMALS (AND DINOSAURS)

3:00 Werning, S. HOW DOES A “TYPICAL” MAMMAL GROW? SAMPLING AND THE INTERPRETATION OF FOSSIL BONE TISSUE

3:15 Koyabu, D., Maier, W., Sánchez-Villagra, M. RESOLVING THE HOMOLOGY AND MIXED EMBRYONIC ORIGIN OF A MAMMALIAN SKULL BONE: THE IDENTITY OF THE INTERPARIETAL BASED ON PALEONTOLOGICAL AND DEVELOPMENTAL DATA

3:30 Halliday, T., MacKenzie, P., Goswami, A. TESTING THE INHIBITORY CASCADE MODEL IN MESOZOIC AND CENOZOIC MAMMALIAFORMS

3:45 Asher, R., Pattinson, D., Tabuce, R., Gheerbrant, E., Hautier, L. PATTERNS OF DENTAL ERUPTION AND VARIABILITY IN MAMMALS

4:00 Sánchez-Villagra, M. THE MARSUPIAL-PLACENTAL DICHOTOMY REVISITED: THE RELEVANCE OF GEOGRAPHY AND PHYSIOLOGY ON EVOLUTIONARY PATTERNS OF DIVERSITY AND DISPARITY

THURSDAY AFTERNOON, OCTOBER 18, 2012
TECHNICAL SESSION VIII
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Catherine Badgley and Samantha Hopkins

1:45 Tomiya, S. GENERIC DURATIONS OF TERRESTRIAL MAMMALS IN THE OLIGO-HOLOCENE OF NORTH AMERICA AND IMPLICATIONS FOR THE UTILITY OF BODY SIZE AS A PREDICTOR OF SUPRASPECIFIC EXTINCTION RISK
THURSDAY AFTERNOON, OCTOBER 18, 2012
TECHNICAL SESSION VIII (CONTINUED)

2:00 Hopkins, S., Maguire, K., McLaughlin, W. FAUNAL HETEROGENEITY IN BARSTOVIAN MAMMALS OF THE NORTHWEST: WHAT DOES FAUNAL DIVERSITY TELL US ABOUT TECTONICS AND HABITAT DIVERSITY?

2:15 Badgley, C., Finarelli, J. DIVERSITY DYNAMICS OF MAMMALS IN RELATION TO LANDSCAPE HISTORY FOR THREE NEOGENE RECORDS FROM NORTH AMERICA

2:30 McLaughlin, W., Hopkins, S. RECONCILING FAUNAL AND FLORAL CLIMATIC INTERPRETATIONS ACROSS THE EARLY BARSTOVIAN OF THE NORTHWEST U.S.A.

2:45 Campbell, K., Prothero, D., Beatty, B., Frailey, C. NEW LATE MIOCENE NORTH AMERICAN ARTIODACTYL FROM THE AMAZON BASIN: IMPLICATIONS FOR INTERCHANGE DYNAMICS

3:00 Kay, R., Vizcaíno, S., Bargo, M. THE PALEOENVIRONMENT AND PALEOECOLOGY OF THE COASTAL MIOCENE SANTA CRUZ FORMATION (LATE EARLY MIOCENE, ARGENTINA)

3:15 Domingo, M., Badgley, C., Azanza, B., Alberdi, M. NEW INSIGHTS ON MAMMALIAN FAUNAL DYNAMICS FROM THE MIOCENE OF SPAIN


3:45 Fraser, D., Hassall, C., Gorelick, R., Rybczynski, N. WARMER CLIMATES WEAKEN BIOTIC LATITUDINAL GRADIENTS

4:00 Moore, J. WHITE RIVER GROUP MAMMALS EXHIBIT ECOLOGICAL RESPONSE TO THE EARLIEST OLIGOCENE CLIMATE TRANSITION

THURSDAY AFTERNOON, OCTOBER 18, 2012
POSTER SESSION II

RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Lesser, S., Santucci, V., Jorstad, T. NATIONAL PARK SERVICE VERTEBRATE COLLECTIONS AT THE SMITHSONIAN: COLLABORATION TO SUPPORT SCIENCE AND STEWARDSHIP

2 De La Garza, R., Lewis, P., Primm, T. THE BACTERIAL FLORA OF REPOSITORY FOSSILS: SOURCES, SURVIVAL AND REMOVAL

3 Jabo, S., Kroehler, P., Makos, K., Peters, D. CONTROL OF HAZARDOUS PARTICULATE EXPOSURE DURING FOSSIL PREPARATION THROUGH THE USE OF LOCAL EXHAUST SYSTEMS

4 Kazumi, W., Ikeda, T., Saegusa, H., Shinya, A. STYLCUS SHARPENING INSTRUMENT FOR FOSSIL PREPARATION

5 Patterson, D., Du, A., Bobe, R., Behrensmeier, A., Reed, D. TAPHONOMIC COMPARISON OF MODERN EAST AFRICAN OWL PELLETS AND THE KANAPI FOSSIL MICROMAMMAL ASSEMBLAGE

6 Higgins, P., Potapova, O., Agenbroad, L. MINERALIZATION OF MAMMOTH MOLARS

7 Bravo-Cuevas, V., Cabral-Perdomo, M. PROBOSCIDEAN DIVERSITY FROM THE PLIO-PLEISTOCENE OF HIDALGO, CENTRAL MEXICO

8 Meade-Hunter, D., Stucky, R., Holen, S., Hunter, M. A NEW PLIO-PLEISTOCENE VERTEBRATE SITE IN PHILLIPS COUNTY, COLORADO, PRESERVING EXCEPTIONAL REMAINS OF STEGOMASTODON

9 Smith, G., Graham, R. DENTAL WEAR AND LAMELLAR FREQUENCY ANALYSIS TO CONSTRAIN THE IDENTITY OF THE NORTH AMERICAN MAMMOTH SPECIES

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Smith, K., Stynder, D. PROBLEMATIC IDENTIFICATION OF PROBOSCIDEANS AT THE MIDDLE PLEISTOCENE PALEONTOLOGICAL/ARCHAEOLOGICAL LOCALITY OF ELANDSFONTEIN (WESTERN CAPE PROVINCE, SOUTH AFRICA)

Maschenko, E., Potapova, O., Boeskorov, G., Plotnikov, V., Agenbroad, L. PRELIMINARY DATA ON THE NEW PARTIAL CARCASS OF THE WOOLLY MAMMOTH, MAMMUTHUS PRIMIGENIUS, FROM YAKUTIA, RUSSIA

Nabavizadeh, A. JAW MECHANICS OVER PROBOSCIDEAN EVOLUTION

Cavin, J., Samuels, J. THE FIRST RECORD OF AN APATEMYID FROM OREGON: SINCLAIRELLA DAKOTENSIS FROM THE TURTLE COVE MEMBER OF THE JOHN DAY FORMATION

Silcox, M., Bloch, J., Gunnell, G. CRANIAL ANATOMY OF PALEogene MICROSYOPIDAE (MAMMALIA, EUARCHONTA) AND ITS RELEVANCE TO UNDERSTANDING EUARCHONTAN RELATIONSHIPS

Kristjanson, H., Prufrock, K., Silcox, M. BODY MASS AND SHEARING QUOTIENTS OF MICROSYOPIDAE (MAMMALLIA, PRIMATES) FROM THE EARLY EOCENE, BIGHORN BASIN, WY (WASATCHIAN, NALMA): PALEOECOLOGICAL IMPLICATIONS FOR DIET

Lopez-Torres, S., Silcox, M., Bloch, J. PATTERNS OF ENCEPHALIZATION IN THE EARLY EVOLUTION OF PRIMATES

Allen, K., Kay, R. ENDOCAST SHAPE AND BRAIN PROPORTIONS IN PRIMATES

Gebo, D., Smith, T., Dagosto, M. NEW POSTCRANIAL ELEMENTS FOR TEILHARDINA BELGICA, AN EARLY EOCENE FOSSIL PRIMATE

Coster, P., Ni, X., Beard, K. THE MIDDLE EOCENE ADAPIFORM PRIMATES FROM THE SHANHUAUANG FISSURE FILLINGS, JIANGSU PROVINCE, PEOPLE’S REPUBLIC OF CHINA

Perry, J., MacNeill, K., Heckler, A., Hartstone-Rose, A. METHODS FOR ESTIMATING CHEWING MUSCLE SIZE, BITE FORCE AND GAPE IN FOSSIL PRIMATES

Roig, I., Moyà-Solà, S. FIRST DESCRIPTION OF THE TALAR MORPHOLOGY OF PSEUDOLORIS PYRENAICUS (OMOMYIDAE, PRIMATES) AND IMPLICATIONS FOR ITS LOCOMOTOR BEHAVIOUR

Minwer-Barakat, R., Marigó, J., Moyà-Solà, S. NEW MATERIAL OF A LARGE-SIZED MICROCHOERINAE (OMOMYIDAE, PRIMATES) FROM THE LATE EOCENE SITE OF SOSSÍS (NE SPAIN)

Kato, T. LATE Oligocene Beaver (Castoridae, Rodentia) FROM WESTERN JAPAN

Stevens, N., O’Connor, P., Roberts, E. A NEW TAXON OF DIAMANTOMYS FROM THE LATE OLIGOCENE NSUNGWE FORMATION, RUKWA RIFT BASIN, SOUTHERN TANZANIA

Petermann, H. IMPLICATIONS FOR MUSCLE RECONSTRUCTION IN FOSSILS FROM HISTOLOGICAL EVIDENCE FOR MUSCLE INSERTION IN EXTANT AMNIOTE FEMORA

Hawthorn, J., Reisz, R. TESTING EVOLUTIONARY SIZE TRENDS IN THE OPHIACODONTID (SYNAPSIDA, EUPELYCOSAURIA) SKULL

Brink, K., Leblanc, A., Sander, M., Reisz, R. DENTAL HISTOLOGY AND TOOTH IMPLANTATION IN EARLY PERMIAN NON-MAMMALIAN SYNAPSIDS

Dentzien-Dias, P., Paes, V., Schultz, C. FIRST RECORD OF TRACKS IN THE PERMIAN (LOPINGIAN) OF THE PARANÁ BASIN, SOUTHERN BRAZIL

Newham, E., Goswami, A., Benson, R., Upchurch, P. MAMMALIAFORM TAXONOMIC DIVERSITY AND TURNOVER THROUGH THE MESOZOIC

Simon, R. REPRESENTATION OF EXTANT MONOTREME DIVERSITY EFFECTS PHYLOGENETIC RESULTS OF EXTINCT AND CROWN-GROUP MAMMALS
Sartin, C., Rose, K. INTRASPECIFIC VARIATION IN THE STYLAR CUSPS OF DIDELPHIS VIRGINIANA

Heckert, A., Schneider, V., Mitchell, J., Sload, E., Olsen, P. THE CURRENT KNOWLEDGE OF TRIASSIC VERTEBRATE ASSEMBLAGES OF THE DEEP RIVER BASIN (NEWARK SUPERGROUP: CHATHAM GROUP), NORTH CAROLINA, BASED ON RECENT DISCOVERIES


Santucci, V., Milner, A., Birthisel, T., Clites, E., Kirkland, J. LIFE AMONG THE DUNES, A LOWER JURASSIC “MEGATRACK BLOCK” FROM THE NAVAJO SANDSTONE, GLEN CANYON NATIONAL RECREATION AREA, UTAH

King, L., Foster, J., Heckert, A. A COMPARISON OF THE MICROVERTEBRATE FOSSILS FROM THE GARDEN PARK FOSSIL AREA IN COLORADO AND THE LITTLE HOUSTON QUARRY NEAR SUNDANCE, WYOMING (BOTH LATE JURASSIC, MORRISON FORMATION)

Yamamura, D., Schmitt, J. SANDSTONE DIAGENESIS AS AN INDICATOR OF DIAGENETIC PATHWAYS IN VERTEBRATE SKELETAL REMAINS AND HEMATITE CONCRETIONS FROM A CREVASSE SPLAY SANDSTONE, HELL CREEK FORMATION (UPPER CRETACEOUS), EASTERN MONTANA

Callapez, P., Barroso-Barcenilla, F., Cambra-Moo, Ó., Pérez-García, A., Torices, A. NEW DATA ON THE CENOMANIAN VERTEBRATE SITE OF NAZARÉ (WEST CENTRAL PORTUGAL)

Bennett, III, G., Main, D., Noto, C., Anderson, B., Vranken, N. MICROVERTEBRATE PALEOECOLOGY, WILDFIRES AND BIODIVERSITY OF COASTAL APPALACHIA IN THE CRETACEOUS (CENOMANIAN) WOODBINE FORMATION AT THE ARLINGTON ARCHOSAUR SITE, NORTH TEXAS

Schein, J., Poole, J., Lacovara, K. A SHARK-BITTEN HADROSAURID FEMUR FROM THE BASAL HORNERSTOWN FORMATION, NEW JERSEY, U.S.A.: ONE OF THE YOUNGEST NON-AVIAN DINOSAUR REMAINS KNOWN

Turner, S., Snyder, D., Daeschler, E., Sullivan, R. SUPER SPINY OR SPINY SUPPER: GYRACANTHIDES SHERWOODI (NEWBERRY), AN UPPER DEVONIAN CARTILAGINOUS FISH FROM PENNSYLVANIA, U.S.A.

Snyder, D., Turner, S. A DEVONIAN ‘IN-GROWING’ FINSPINE: PATHOLOGICAL DEFORMITY IN A GYRACANTH FISH

Ryan, M., Cumbaa, S. THE VERTEBRAL COLUMN OF THE PACHYOSTEOMORPH ARTHRODIRE DUNKLEOSTEUS TERRELLI

Boyle, J., Ryan, M., Snively, E., Hlavin, W., Scott, E. THE JAW ONTOGENY OF DUNKLEOSTEUS TERRELLI (PLACODERMI: ARTHRODIRA) SUGGESTS AN ACTIVE PREDATORY HABIT THROUGHOUT GROWTH

Richards, K., Clack, J. CHONDRICHTYANS IN THE CARBONIFEROUS OF THE BRITISH DERBYSHIRE PEAK DISTRICT

Itano, W. FUNCTION OF THE SYMPHYSEAL TOOTH WHORLS OF EDESTUS

Ivanov, A. CHONDRICHTYANS FROM THE MIDDLE PERMIAN OF RUSSIA

Johnson, G. SHARKS FROM THE GERALDINE BONEBED, LOWER PERMIAN OF TEXAS

Ngasala, S. PARSIMONY ANALYSIS OF ENDEMICITY (PAE) OF LUNGFISH GENERA

Devlin, K., Sumida, S. NEW INFORMATION ON THE HYPOBRANCHIAL SKELETON OF THE EARLY PERMIAN LEPOSPONDYL LYSOROPHID AMPHIBIAN BRACHYDECTES

Hosgor, I., Fortuny, J. NEW PERMIAN AND TRIASSIC VERTEBRATES FROM TURKEY (SE ANATOLIA)
THURSDAY AFTERNOON, OCTOBER 18, 2012
POSTER SESSION II (CONTINUED)

51  Fortuny, J., Marcé-Nogué, J., Steyer, J. 3D FINITE ELEMENT ANALYSIS OF A CAPITOSAURIAN SKULL (TEMNOSPONDYLII) FROM THE TRIASSIC OF MADAGASCAR

52  Henrici, A., Baez, A., Grande, I. FIRST REPORT OF AN ANURAN FROM THE FOSSIL BUTTE MEMBER (EARLY EOCENE, WASATCHIAN) OF THE GREEN RIVER FORMATION, WYOMING

53  Parham, J., Ksepka, D., Polly, P., Van Tuinen, M., Benton, M. THE FOSSIL CALIBRATION DATABASE: A NEW BIOINFORMATIC TOOL FOR DATING DIVERGENCES OF EXTANT LINEAGES BY SYNTHESIZING PALEONTOLOGICAL AND MOLECULAR SEQUENCE DATA

54  Warnock, R., Joyce, W., Parham, J., Lyson, T., Donoghue, P. EXPLORING UNCERTAINTY IN THE CALIBRATION OF THE MOLECULAR CLOCK

55  Lawver, D. FOSSIL AND MODERN TURTLE EGGSHELL: TESTING THE VALIDITY OF EGGSHELL CHARACTERS IN CLADISTIC ANALYSES

56  Moscato, D., Jasinski, S. FIRST RECORD OF FOSSIL CHELYDRIDAE AND TRIONYCHIDAE FROM THE PLEISTOCENE OF SONORA, MEXICO

57  Vermillion, W., Polly, P. SPECIES DELIMITATION BASED ON THE LIMITS OF CLIMATE AND MORPHOLOGY IN PALEONTOLOGY: A GEOMETRIC MORMPHOMETRIC ANALYSES OF CHRYSEMYS PICTA PLEASTRONS


59  Bourque, J., Hulbert Jr., R., Wood, A. ASSESSING SPECIES DIVERSITY AND INTRASPECIFIC VARIABILITY IN SHIELD-TAILED TORTOISES (TESTUDINIDAE, HESPEROTESTUDO) SPANNING THE EARLY CLARENDONIAN THROUGH LATE RANCHOLABREAN OF FLORIDA

60  Chapman, S., Sterli, J., Lyson, T., Joyce, W. THE ANATOMY AND PHYLOGENETIC PLACEMENT OF THE CRETACEOUS STEM TURTLE NAOMICHELYS SPECIOSA

61  Vineyard, D., Mateus, O., Jacobs, L., Polcyn, M., Schulp, A. A NEW MARINE TURTLE FROM THE MAASTRICHTIAN OF ANGOLA

62  Doman, J., Roach, B., Lyson, T. EVIDENCE FOR PERIODS OF INCREASED ARIDITY DURING THE LATEST CRETAEOUS OF NORTH AMERICA: A DESCRIPTION OF SEVERAL MASS DEATH ASSEMBLAGES OF TURTLES

63  Williams, S., Lyson, T. TAPHONOMIC AND PALEOENVIRONMENTAL IMPLICATIONS OF A NEW MASS DEATH ASSEMBLAGE OF BAENID TURTLES FROM THE HELL CREEK FORMATION (LATEST MAASTRICHTIAN) OF SOUTHEASTERN MONTANA

64  Jansen, M., Klein, N. A NEARLY COMPLETE TURTLE (TESTUDINES: EUCRYPTODIRE) FROM THE UPPER JURASSIC OF CENTRAL GERMANY, AND ITS PALEOECOLOGY

65  Hendricks, S., Yacobucci, M. THE BIOMECHANICAL IMPLICATIONS OF CRYSTALLITE ORIENTATION IN CROCODILIAN TOOTH ENAMEL

66  Dzikiewicz, K. BUILDING A BETTER DATABASE: PROTEIN IDENTIFICATION AND LONGEVITY IN CROCODILIAN BONE AND TEETH

67  Holbrook, L., Geisler, J. TAXA AS HYPOTHESES

68  Marquart, C. THE TAXONOMIC CHALLENGES OF UNDERSTANDING PHENOTYPE IN THE FOSSIL RECORD

69  Martin, A., Page, M., Skaggs, S., Vance, R. DENS OF THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) AS TRACES AND THEIR PREDICTIVE VALUE FOR FINDING LARGE ARCHOSAUR BURROWS IN THE GEOLOGIC RECORD

70  Fortier, D., Rincón, A. PLEISTOCENE CROCODILIANS FROM VENEZUELA, AND THE DESCRIPTION OF A NEW SPECIES OF CAIMAN
Furui, S., Kobayashi, Y., Chiba, K. A NEW TOMISTOMINE FROM THE OSAKA GROUP IN KISHIWADA CITY, OSAKA PREFECTURE, JAPAN

Carter, A., Boles, Z., Schroeter, E., Lacovara, K. A JUVENILE HYPOSAURUS ROGERSII SKULL FROM THE HORNERSTOWN FORMATION OF NEW JERSEY

Boles, Z., Lacovara, K. THE FIRST HISTOLOGICAL DESCRIPTION OF THORACOSAURUS NEOCESARIENSIS: CRETACEOUS/PALOEogene HORNERSTOWN FORMATION OF NEW JERSEY

Voegele, K., Patel, A., Ullmann, P., Schein, J., Lacovara, K. INSIGHTS FROM A NEW SPECIMEN OF THE GAVALOID CROCODYLIAN THORACOSAURUS NEOCESARIENSIS FROM THE MAASTRICHTIAN-DANIAN HORNERSTOWN FORMATION, SEWELL, NJ

Xu, A., Henn, M., Woodward, S., Farke, A. ANATOMY, SYSTEMATICS AND TAPHONOMY OF AN ALLIGATOROID CROCODYLIAN SKELETON FROM THE KAIPAROWITS FORMATION (LATE CAMPANIAN) OF SOUTHERN UTAH

Adams, T. CROCODYLIFORM DIVERSITY FROM THE EARLY CRETACEOUS TRINITY GROUP (APTIAN-ALBIAN) OF TEXAS, WITH THE DESCRIPTION OF NEW TAXA FROM THE TWIN MOUNTAINS FORMATION

Allen, E. INVESTIGATION OF NORTH AMERICAN GONIOPHOLIDID CROCODYLIFORMS IN A PHYLOGENETIC CONTEXT

Fronimos, J. MORPHOMETRIC ANALYSIS OF INTRACOLUMNAR AND INTRASPECIFIC VARIATION IN CERVICAL VERTEBRAE OF THE GREAT BLUE HERON (ARDÉA HERODIAS): IMPLICATIONS FOR PHYLOGENETIC CHARACTER SELECTION IN SAUROPOD DINOSAURS

Chiba, K., Brink, K., Kobayashi, Y., Suzuki, D. MORPHOMETRICS OF RATITE FEMORA AND IMPLICATIONS FOR SEXUAL DIMORPHISM IN DINOSAURS

Bourdon, E., Milner, A., Walsh, S. VIRTUAL BRAIN ENDOCASTS SHED NEW LIGHT ON THE EARLY EVOLUTION OF MODERN BIRDS (NEORNITHES)

Seymour, K., Hinic-Frlog, S., Evans, D. A NEW FOSSIL BIRD FROM THE UPPER EOCENE GREEN RIVER FORMATION OF WYOMING

Stidham, T., Hoganson, J., Person, J. NEW MIDDLE PALEOCENE (TIFFANIAN NALMA) BIRDS FROM NORTH DAKOTA

Thomas, D., James, H., Carrano, M., Madden, O. SEARCHING FOR EVIDENCE OF FOSSIL FEATHER COLOR WITH SPECTROSCOPY

Yury-Yáñez, R., Ossa, L., Rubilar-Rogers, D., Sallaberry, M. INFERRING GROWTH IN GIANT PENGUINS FROM THE PALEOGENE OF ANTARCTICA AND THE NEOGENE OF SOUTH AMERICA

Chavez-Hoffmeister, M. MEASURING THE PENGUIN HUMERUS: THE IMPACT OF INTRASPECIFIC VARIATION ON QUANTITATIVE CHARACTERS

Romick, C., Witmer, L. ONTOGENY OF THE BRAIN ENDOCASTS OF OSTRICHES (AVES: STRUTHIO CAMELUS), WITH IMPLICATIONS FOR INTERPRETING EXTINCT DINOSAUR ENDOCASTS

Early, C., Sclafani, M., Balanoff, A., Ksepka, D. COMPARATIVE NEUROANATOMY OF FOSSIL AND LIVING WATERBIRDS

Weeks, S., Chadwick, A. A REGIONALLY EXTENSIVE LANCIAN SEISMITE SERVES AS A TIME SYNCHRONOUS STRATIGRAPHIC MARKER FOR MAPPING DINOSAUR BONEBEDS IN NORTHEASTERN WYOMING
FRIDAY MORNING, OCTOBER 19, 2012
SYMPOSIUM: PHYLOGENETIC AND COMPARATIVE PALEOBIOLOGY: NEW QUANTITATIVE APPROACHES TO THE STUDY OF VERTEBRATE MACROEVOLUTION
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Tobin Hieronymus, Kerin Claeson, Patrick O’Connor, Lars Schmitz and Graham Slater

8:00 Clarke, J., Middleton, K. BAYESIAN APPROACHES TO THE INVESTIGATION OF MORPHOLOGICAL RATE HETERGENEITY IN DISTINCT ANATOMICAL SUBREGIONS
8:15 Brown, J., Slater, G. ON THE UTILITY OF LIKELIHOOD MODELS FOR PHYLOGENETIC RECONSTRUCTION FROM DISCRETE MORPHOLOGICAL CHARACTERS
8:30 Mounce, R., Wills, M. EXAMINING CHARACTER CONGRUENCE AND COMPATIBILITY OF VERTEBRATE CLADISTIC DATA - EMPIRICAL APPROACHES APPLIED COMPARATIVELY ACROSS CLADES
8:45 Bapst, D. TIME-SCALING TREES IN THE FOSSIL RECORD
9:00 Lloyd, G., Friedman, M., Bell, M. CONFIDENCE INTERVALS ON NODE AGE ESTIMATES IN VERTEBRATE PHYLOGENY
9:15 Simpson, C. MEASURING SPECIES SELECTION IN THE MOLECULAR PHYLOGENETIC RECORD
9:30 Slater, G. FOSSILS, PHYLOGENIES AND MODELS OF QUANTITATIVE TRAIT EVOLUTION
9:45 Marcot, J., Glynn, A. A PHYLOGENETIC APPROACH TO DETERMINE THE CONTRIBUTION OF LINEAGE EVOLUTION TO PALEOECOLOGICAL CHANGE: AN EXAMPLE USING MAMMALIAN UNGULATES OF NORTH AMERICA
10:00 BREAK
10:15 Hunt, G., Fitzjohn, R., Carrano, M. EVOLUTIONARY DYNAMICS OF LARGE BODY SIZE IN NON-AVIAN DINOSAURS
10:30 Organ, C., Janes, D. EVOLUTION OF SEX CHROMOSOMES IN DINOSAURS
10:45 Schmitz, L., Hinic-Frlog, S., Motani, R. GLOSSY FEATHERS AND NOCTURNAL ACTIVITY: INERENCE OF MICRORAPTOR FEATHER COLORS USING A PHYLOGENETIC FRAMEWORK
11:00 Price, S., Hopkins, S., Botero, C. UNDERSTANDING MAMMALIAN DIETARY EVOLUTION USING A PHYLOGENETIC AND COMPARATIVE APPROACH
11:15 Hieronymus, T., Simons, E. BONY ATTACHMENTS OF FLIGHT FEATHERS IN NEORNITHINE BIRDS: ANATOMY, HISTOLOGY AND FUNCTIONAL VARIATION
11:30 O’Connor, P., Hieronymus, T., Stevens, N., Sertich, J. MORPHOLOGICAL EVOLUTION IN BASAL MESOEUCROCODYLIANS: TRACKING BODY SIZE AND DENTAL TRENDS IN NOTOSUCHIA
11:45 Claeson, K., Aschliman, N., Underwood, C. GUITARFISH PARAPHYL AND THE ORIGIN OF SKATES AND RAYS: ESTIMATING ACCUMULATION RATES OF VERTEBRAL FUSION AMONG BATOID FISHES
12:00 Wainwright, P. THE IMPACT OF CORAL REEFS ON FISH DIVERSIFICATION

FRIDAY MORNING, OCTOBER 19, 2012
TECHNICAL SESSION IX
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4
MODERATORS: Randall Irmis and Michelle Stocker

8:00 Bever, G., Lyson, T., Bhullar, B. THE QUADRATOMAXILLARY LIGAMENT AND ITS IMPLICATIONS FOR THE EVOLUTION OF CRANIAL FENESTRATION IN REPTILES
8:15 Rabi, M., Wings, O., Joyce, W. THE HOMOLOGY OF THE BASIPTERYGOID PROCESS IN EUCRYPTODIRAN TURTLES AND ITS PHYLOGENETIC IMPLICATIONS
FRIDAY MORNING, OCTOBER 19, 2012
TECHNICAL SESSION IX (CONTINUED)

8:30  Vitel, N., Burroughs, R. VARIATION IN COMPLEX SYSTEMATIC PROBLEMS: A CASE STUDY

8:45  Lively, J. TESTING LATE CRETACEOUS LARAMIDIAN PALEOBIOGEOGRAPHIC HYPOTHESES: EVIDENCE FROM THE EVOLUTION OF BAENID TURTLES

9:00  Gignac, P., Kley, N. LUGOL’S IODINE AS A CONTRAST AGENT IN X-RAY μCT IMAGING: METHODOLOGICAL REFINEMENTS AND POTENTIAL SIGNIFICANCE FOR INFERRING SOFT-TISSUE ANATOMY IN FOSSIL VERTEBRATES

9:15  Butler, R., Stocker, M., Rauhut, O., Lautenschlager, S., Bronowicz, R. SYSTEMATIC AND ANATOMICAL RE-EVALUATION OF BASAL PHYTOSAURS FROM THE LATE TRIASSIC OF CENTRAL EUROPE, WITH IMPLICATIONS FOR LATE TRIASSIC BIOSTRATIGRAPHY

9:30  Nesbitt, S., Sidor, C., Angielczyk, K., Smith, R., Parker, W. DERIVATION OF THE AETOSAUR OSTEODERM CARAPACE: EVIDENCE FROM A NEW, EXCEPTIONALLY PRESERVED “STEM AETOSAUR” FROM THE MIDDLE TRIASSIC (ANISIAN) MANDA BEDS OF SOUTHWESTERN TANZANIA


10:00 BREAK

10:15  Molnar, J., Pierce, S., Turner, A., Hutchinson, J. VERTEBRAL MORPHOLOGY AND AXIAL MECHANICS IN EARLY CROCODYLOMORPHS AND MODERN CROCODILES

10:30  Young, M., Brusatte, S., Beatty, B., De Andrade, M., Desojo, J. CRANOIODENTAL ANATOMY AND FEEDING MECHANICS OF DAKOSAURUS MAXIMUS AND PLESIOSUCHUS MANSELII, TWO CONTEMPORARY LARGE-BODIED, MACROPHAGOUS METriorhynchid CROCODYLOMORPHS FROM THE LATE JURASSIC OF EUROPE

10:45  Stocker, M., Bronch, C., Kirk, E. SPATIAL AND TEMPORAL SHIFTS IN PALEOGENE CROCODYLIFORM DIVERSITY AND A NEW GLOBIDONT ALLIGATOROID FROM THE MIDDLE EOCENE OF WEST TEXAS

11:00  Conrad, J., Jenkins, K., Dunsworth, H., Harcourt-Smith, W., McNulty, K. NEW SPECIMENS OF ‘CROCODYLUS’ PIGOTTI (CROCODYLIDAE) FROM RUSINGA ISLAND, KENYA, AND A REFINED UNDERSTANDING OF THE SPECIES

11:15  Watanabe, A., Slice, D. THE ONTOGENY OF CRANIAL MORPHOLOGY IN CROCODILIANS AND ITS PHYLOGENETIC SIGNIFICANCE: A GEOMETRIC MORPHOMETRIC APPROACH

11:30  Schachner, E., Sarrazin, J., Farmer, C. UNIDIRECTIONAL AIRFLOW AND PULMONARY ARCHITECTURE IN ALLIGATOR MISSISSIPPIENSIS AND THE IMPLICATIONS FOR THE EVOLUTION OF THE AVIAN RESPIRATORY SYSTEM

11:45  Hutchinson, J. HOW DID BOUNDING AND GALLOPING GAITS EVOLVE IN CROCODYLOMORPHA?

12:00  Nestler, J., Wilberg, E., Patterson, J. EXPLORING CROCODYLIAN DIVERSITY IN AN ENVIRONMENTAL CONTEXT: IMPLICATIONS FOR THE FOSSIL RECORD

FRIDAY MORNING, OCTOBER 19, 2012
TECHNICAL SESSION X
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Kenneth Angielczyk and Robin Beck

8:00  Angielczyk, K., Roopnarine, P. DO TETRAPOD HERBIVORES MATTER? ECOSYSTEM ROBUSTNESS, OLSON’S COMMUNITY TYPES AND THE PRIMACY OF INSECTS

8:15  Castanhinha, R., Araújo, R., Costa Júnior, L., Angielczyk, K., Martins, R. A NEW TATARIAN DICYNODONT FROM MOZAMBIQUE
FRIDAY MORNING, OCTOBER 19, 2012
TECHNICAL SESSION X (CONTINUED)

8:30  Beck, A., Scheckel, J.  MORPHOLOGIC INDICATORS OF FOSSORIALITY AND THE EVOLUTION OF BURROWING IN DICYNODONTS (AMNIOTA: SYNAPSIDA)

8:45  Abdala, F., Jasinoski, S., Fernandez, V.  ONTOGENY OF THE EARLY TRIASSIC THRINAXODON LIORHINUS (THERAPSIDA, CYNODONTIA). DENTAL MORPHOLOGY AND REPLACEMENT

9:00  Blob, R., Butcher, M., Gosnell, W., Maie, T.  LOCOMOTOR LOADING OF THE FEMUR IN OPOSSUMS PROVIDES INSIGHT INTO THE EVOLUTION OF FEMORAL SHAPE IN SYNAPSIDS


9:30  Kammerer, C., Fröbisch, J., Angielczyk, K., Smith, R.  PERMIAN ORIGINS OF THE POST-EXTINCTION THERAPSID RECOVERY FAUNA

9:45  Sidor, C., Vilhena, D., Angielczyk, K., Nesbitt, S., Peecook, B.  A NETWORK APPROACH TO STUDYING FAUNAL PROVINCES ACROSS SOUTHERN PANGEA DURING THE PERMIAN AND TRIASSIC

10:00 BREAK

10:15  O’Meara, R., Asher, R.  DETERMINATE GROWTH IN MORGANUCODON WATSONI

10:30  Schultz, J.  MAJOR TRANSFORMATION IN MASTICATORY AND DENTAL FUNCTIONS IN EARLY MAMMALS

10:45  Krause, D., Hoffmann, S., Groenke, J.  THE FIRST CRANIAL REMAINS OF A GONDWANATHERIAN MAMMAL

11:00  Smith, T., Codrea, V.  A TRANSYLVANIAN CRETACEOUS MAMMAL WITH RED IRON PIGMENTS IN TOOTH ENAMEL

11:15  Chen, M.  LOCOMOTOR INERENCE OF FOSSIL MAMMALS BASED ON QUANTITATIVE MORPHOMETRIC ANALYSIS OF THE POSTCRANIAL SKELETON OF SMALL-BODIED EXTANT TAXA

11:30  Grossnickle, D.  THE EFFECT OF THE CRETACEOUS ANGIOSPERM RADIATION ON EARLY MAMMAL TAXONOMIC DIVERSITY AND MORPHOLOGICAL DISPARITY

11:45  Wilson, G., Ekdale, E., Hoganson, J.  A PARTIAL SKULL OF DIDELPHODON VORAX FROM THE LANCIAN-AGE HELL CREEK FORMATION OF SOUTHWESTERN NORTH DAKOTA, U.S.A.

12:00  Beck, R., Voss, R., Jansa, S.  A COMPREHENSIVE GENUS-LEVEL PHYLOGENY OF LIVING AND EXTINCT MARSUPIALS BASED ON CRANIODENTAL AND MOLECULAR DATA

FRIDAY AFTERNOON, OCTOBER 19, 2012
TECHNICAL SESSION XI
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Oliver Rauhut and Martin Ezcurra

1:45  Persons, W., Currie, P.  ADAPTIVE CURSORIAL TRENDS AMONG THEROPOD DINOSAURS AND AN ATTEMPT TO LOOK BEYOND ALLOMETRY

2:00  Leary, B., Kavanagh, K.  PEDAL DIGIT IV PROPORTIONS REVEAL BODY-SIZE ASSOCIATED CONSTRAINT ON DINOSAUR FOOT MORPHOLOGY

2:15  Noto, C.  WHAT BIG CLAWS YOU HAVE: IMPLICATIONS OF MORPHOLOGICAL VARIATION IN THEROPOD MANUAL UNGUALS

2:30  Ezcurra, M.  PHYLOGENETIC ANALYSIS OF LATE TRIASSIC - EARLY JURASSIC NEOTHEROPOD DINOSAURS: IMPLICATIONS FOR THE EARLY THEROPOD RADIATION

2:45  Rauhut, O., Diego, P.  A NEW BASAL TETANURAN THEROPOD FROM THE EARLY MIDDLE JURASSIC OF PATAGONIA, ARGENTINA
FRIDAY AFTERNOON, OCTOBER 19, 2012
TECHNICAL SESSION XI (CONTINUED)

3:00 Araújo, R., Castanhinha, R., Mateus, O., Martins, R. LATE JURASSIC THEROPOD EMBRYOS FROM PORTO DAS BACARAS, LOURINHÃ FORMATION, PORTUGAL

3:15 Mateus, O., Carrano, M., Taquet, P. OSTEOLOGY OF THE EMBRYONIC THEROPODS FROM THE LATE JURASSIC OF PAIMOJO, PORTUGAL

3:30 Simon, D., Varricchio, D., Jackson, F., Robison, S. GIANT THEROPOD EGGS FROM THE ALBIAN-CENOMANIAN WAYAN FORMATION OF IDAHO: TAXONOMIC, PALEOGEOGRAPHIC AND REPRODUCTIVE IMPLICATIONS

3:45 Lamanna, M., Casal, G., Martínez, R. A NEW ABELISAURID (THEROPODA: CERATOSAURIA) SKELETON FROM THE UPPER CRETACEOUS BAJO BARREAL FORMATION OF CHUBUT PROVINCE, ARGENTINA

4:00 Wilson, J. SMALL THEROPOD DINOSAURS FROM THE LATEST CRETACEOUS OF INDIA

FRIDAY AFTERNOON, OCTOBER 19, 2012
TECHNICAL SESSION XII
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Jacques Gauthier and Derek Larson

1:45 Jiang, D., Motani, R., Tintori, A., Rieppel, O., Sun, Z. TWO NEW EARLY TRIASSIC MARINE REPTILES FROM CHAOHU, ANHUI PROVINCE, SOUTH CHINA

2:00 O’Keefe, F., Byrd, C. THE ONTOGENY OF THE SHOULDER IN POLYCOTYLUS LATIPPINUS (PLESIOSAURIA: POLYCOTYLIDAE) AND ITS BEARING ON PLESIOSAUR VIVIPARITY

2:15 Strganac, C., Ferguson, K., Jacobs, L., Polcyn, M., Mateus, O. AGE AND PALEOECOLOGY OF MOSASAURS AND PLESIOSAURS FROM THE LATE CRETACEOUS SOUTH ATLANTIC MARGIN AT BENTIABA, ANGOLA

2:30 Konishi, T. A NEW RECONSTRUCTION OF THE HIP IN HYDROPEDAL MOSASAURS (SQUAMATA, MOSASURIDAE): FROM ATTACHED TO DETACHED

2:45 Lindgren, J., Kaddumi, H., Polcyn, M. TAIL FIN EVOLUTION IN MOSASAURS (SQUAMATA, MOSASURIDAE)

3:00 Gauthier, J., Kearney, M., Maisano, J., Rieppel, O. ASSEMBLING THE SQUAMATE TREE OF LIFE: PERSPECTIVES FROM THE PHENOTYPE AND THE FOSSIL RECORD


3:30 Demar, Jr., D., Varricchio, D., Head, J., Moore, J., Wilson, G. A NEARLY COMPLETE FOSSIL IGUANIAN FROM THE UPPER CRETACEOUS (CAMPANIAN) TWO MEDICINE FORMATION OF WESTERN MONTANA

3:45 McCartney, J., Stevens, N. A NEW OPHIDIOFAUNA FROM THE LATE OLIGOCENE NSUNGWE FORMATION OF TANZANIA AND THE RISE OF COLUBROID SNAKES (REPTILIA, SERPENTES)

4:00 Larson, D., Evans, D. TOOTH VARIATION IN VARANUS KOMODOENSIS AND IMPLICATIONS FOR INTRASPECIFIC VARIATION IN EXTINCT XIPHODONT CARNIVORES
FRIDAY AFTERNOON, OCTOBER 19, 2012
TECHNICAL SESSION XIII
RALEIGH CONVENTION CENTER, ROOM 306 A-C, LEVEL 3
MODERATORS: Wighart Koenigswald and Stephen Chester

1:45 De Bast, E., Smith, T. DIVERSITY OF THE MAMMALS FROM HAININ, BELGIUM, THE OLDEST PALEOCENE MAMMAL FAUNA OF EUROPE

2:00 Clemens, W., Wilson, G. PATTERN OF IMMIGRATION OF PURGATORIIDS AND OTHER EUTHERIANS INTO THE NORTHERN NORTH AMERICAN WESTERN INTERIOR

2:15 Chester, S., Bloch, J., Clemens, W. TARSAL MORPHOLOGY OF THE OLDEST PLESIADAPIFORM PURGATORIUS INDICATES ARBOREALITY IN THE EARLIEST PRIMATES

2:30 Williamson, T., Silcox, M. NEW DISCOVERIES OF PRIMATES FROM THE EARLY PALEOCENE NACIMIENTO FORMATION (TORREJONIAN NALMA), SAN JUAN BASIN, NEW MEXICO: A WINDOW ON THE FIRST PRIMATE ADAPTIVE RADIATION

2:45 Atwater, A., Holroyd, P., Davis, E. EXTRINSIC AND INTRINSIC FACTORS IN THE EVOLUTION AND EXTINCTION OF NORTH AMERICAN FOSSIL PRIMATES

3:00 Ramdarshan, A., Marivaux, L., Merceron, G. ADAPTIVE RADIATIONS AND ECOLOGICAL DIVERSITY OF EUROPEAN ADAPIFORMS IN WESTERN EUROPE

3:15 Gingerich, P. EOCENE DARWINIUS, EUROPOLEMUR AND NOTHARCTUS (PRIMATES, ADAPOIDEA): WHAT IS A CLAW, WHAT IS A GROOMING CLAW, AND WHEN DID GROOMING CLAWS EVOLVE?

3:30 Koenigswald, W. HYPOTHETICAL MODEL FOR THE EVOLUTION AND DIFFERENTIATION IN PEDAL DISTAL PHALANGES OF PRIMATES

3:45 Kirk, E., Kemp, A., Simons, E., Seiffert, E. MORPHOLOGY OF THE PETROSAL AND BONY LABYRINTH IN AFRADAPIS LONGICRISTATUS (PRIMATES, ADAPIFORMES)

4:00 Beard, K., Chaimanee, Y., Chavasseau, O., Lazzari, V., Jaeger, J. THE COLONIZATION OF AFRICA BY EARLY CENOZOIC ANTHROPOID PRIMATES: NEW DATA FROM THE EOCENE PONDAUNG FORMATION OF MYANMAR

FRIDAY AFTERNOON, OCTOBER 19, 2012
POSTER SESSION III
RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Miguel, R., Gallo, V., Morrone, J. DISTRIBUTIONAL PATTERNS OF †MAWSONIIDAE (SARCOPTERYGII: ACTINISTIA): A TRACK ANALYSIS

2 Gibson, S. SEMIONOTID FISHES (NEOPTERYGII: SEMIONOTIFORMES) FROM THE UPPER TRIASSIC CHINLE FORMATION OF SOUTHERN UTAH: NEW SPECIES AND COMMENTS ON THE RELATIONSHIPS OF FISHES WITHIN THE FAMILY SEMIONOTIDAE

3 Wilson, L., Furrer, H., Colombo, M., Salzburger, W., Sánchez, M. PATTERNS OF CRANIOFACIAL SHAPE CHANGE IN THE EXTINCT SPECIES FLOCK OF THE ACTINOPTERYGIAN FISH GENUS SAURICHTHYS: PALAEOBIOLOGICAL AND PALAEOECOLOGICAL IMPLICATIONS AND A COMPARISON WITH EXTANT SPECIES FLOCKS

4 Lin, H., Sun, Z., Tintori, A., Lombardo, C., Jiang, D. PERLEIDIFORM ACTINOPTERYGIANS FROM THE PELSONIAN (MIDDLE ANISIAN, MIDDLE TRIASSIC) OF YUNNAN PROVINCE, SOUTHWESTERN CHINA

5 Wu, F., Sun, Y., Hao, W., Jiang, D. ABASAL SAURICHTHYIFORM (ACTINOPTERGII) WITH A PECULIAR NEUROCRANIUM AND JAW MECHANISM FROM THE MIDDLE TRIASSIC OF SOUTHWESTERN CHINA
FRIDAY AFTERNOON, OCTOBER 19, 2012
POSTER SESSION III (CONTINUED)


7 Stringer, G. LATE CRETACEOUS FISH OTOLITHS FROM NORTHEAST MISSISSIPPI: IMPLICATIONS FOR NORTH AMERICAN TELEOSTEAN EVOLUTION AND DISTRIBUTION

8 Murray, A., Wilson, M. THREE NEW BASAL ACANTHOMORPH FISHES FROM THE LATE CRETACEOUS OF MOROCCO

9 Sload, E., Heckert, A., Schneider, V. MEASURING MICROVERTEBRATES: A CASE STUDY USING A RARE RECORD OF A HYBODONT SHARK FROM THE UPPER TRIASSIC OF NORTH CAROLINA

10 Mehling, C., Callahan, W., Maisey, J., Martin, G. THE RISE OF ISCHYRHIZA: A ROSTRUM FROM ALABAMA

11 Shimada, K. DENTITION OF LATE CRETACEOUS SHARK, PTYCHODUS MORTONI (ELASMOBRANCHII: PTYCHODONTIDAE)

12 Wilson, A., Newbrey, M., Brinkman, D., Neuman, A. AGE AND GROWTH IN MYLEDAPhus BIPARTITUs, A LATE CRETACEOUS FRESHWATER GUITARFISH FROM ALBERTA, CANADA

13 De Figueiredo, A., Pinheiro, F., Dentzien-Dias, P., Fortier, D., Schultz, C. A NEW FRESH-WATER HYBODONTID SHARK FROM LIMA CAMPOS BASIN (EARLY CRETACEOUS), BRAZIL, AND ITS PALEOGEOGRAPHIC CONTEXT

14 Gates, T. VARIATIONS IN ECOMORPHOLOGICAL DIVERSITY OF SHARK TEETH FROM LATE CRETACEOUS THROUGH MODERN MARINE ECOSYSTEMS OF NORTH CAROLINA

15 Gallardo, C., Shimada, K., Schumacher, B. A NEW LATE CRETACEOUS MARINE VERTEBRATE ASSEMBLAGE FROM THE BASAL GREENHORN LIMESTONE IN SOUTHEASTERN COLORADO, U.S.A.

16 Bice, K., Shimada, K., Kirkland, J. LATE CRETACEOUS MARINE FISHES FROM THE UPPER GREENHORN LIMESTONE IN SOUTHEASTERN NEBRASKA, U.S.A.

17 Morgan, M., Barry, J., Cerling, T., Nelson, S., Pilbeam, D. ISOTOPIC VARIATION AND NICHE SPACE IN MIDDLE AND LATE MIocene SIWALIK MAMMALS FROM PREDOMINANTLY C3 ECOSYSTEMS

18 Eastham, L., Begun, D., Kordos, L. ISOTOPIC INDICATORS OF SEASONAITY AT A LATE MIocene PRIMATE LOCALITY IN HUNGARY

19 Tucker, S., Voorhies, M. ARTIODACTYLS FROM THE LATE MIocene (HEMPHILLIAN) WYMAN CREEK LOCAL FAUNA, KEYA Paha COUNTY, NEBRASKA

20 Bormet, A., Lawing, A. ECOMORPHOLOGICAL VARIATION OF THE DISTAL PHALANX IN THE CERVIDAE: DO CAPTIVE MODERN ANALOGUES SKEW RESULTS?

21 Kaufman, A., Schubert, B., DeSantis, L. A PALEOECOLOGICAL ANALYSIS OF LATE PLEISTOCENE CERVID REMAINS FROM GUY WILSON CAVE, SOUTHERN APPALACHIANS, TENNESSEE

22 Heckeberg, N., Rössner, G., Asher, R., Wörheide, G. PHYLOGENETIC POSITION OF PROCErVULUS (CERVIDAE, ARTIODACTYLA, MAMMALIA) AND IMPLICATIONS OF CHARACTER EVOLUTION IN CERVIDS

23 Hoffman, J., Clementz, M. SILICA INGESTION IN GRAZING BISON AND ARIDITY: IMPLICATIONS FOR MICROWEAR ANALYSIS


25 Sheets, H., Prothero, D. PECCARIES (MAMMALIA, ARTIODACTYLA, TAYAUSSIDAE) FROM THE MIOCENE-PLIOcene PIPE CREEK SINKHOLE LOCAL FAUNA, INDIANA
FRIDAY AFTERNOON, OCTOBER 19, 2012  
POSTER SESSION III (CONTINUED)

26 Montellano, M., Rincón, A., Solorzano, A. RECORD OF TAYASSUIDS IN ?PLIOCENE-QUATERNARY DEPOSITS IN VENEZUELA


28 Schellhorn, R. RECONSTRUCTING HABITATS WITH CANNON BONES

29 O’Brien, H. THE ROLE OF FOSSIL EVIDENCE IN INFERRING ANCESTRAL CHARACTER STATES: A CASE-STUDY USING ARTIODACTYL THERMOREGULATORY CRANIAL VASCULATURE

30 Evans, T. ELONGATE BONE ORIENTATION IN RIVERS: BONE AZIMUTHS AND POLARITIES DO NOT CORRELATE WITH FLOW DIRECTION

31 Hu, H., Pagnac, D., Martin, J., Wu, M., Fang, J. FIRST OCCURRENCES OF FELIDAE AND CANIDAE (MAMMALIA: CARNIVORA) FROM THE CHITING FORMATION (PLEISTOCENE) OF SOUTHWESTERN TAIWAN

32 Alba, D., Fortuny, J., De Esteban-Trivigno, S., Robles, J., Almécija, S. ENCEPHALIZATION AND BRAIN MORPHOLOGY IN EXTINCT, FALSE SABER-TOOTHED CATS (BARBOUROFELIDAE)

33 Orcutt, J., Davis, E., Hopkins, S. GIANT FELID POSTCRANIA & THE EARLY EVOLUTION OF NORTH AMERICAN CATS

34 Kennedy, N., Bhatt, R. A GEOMETRIC AND KINEMATIC BACKBONE MODEL OF THE CHEETAH, ACINONYX JUBATUS, AND ITS APPLICATION TO UNDERSTANDING THE SPINAL KINETICS OF MIRACINONYX TRUMANI

35 King, L., Wallace, S. PHYLOGENETIC PLACEMENT OF PANTHERA ATROX BASED ON CRANIALMANDIBULAR CHARACTERS

36 Hartstone-Rose, A., Kuhn, B., Nalla, S., Werdelin, L., Berger, L. A NEW SPECIES OF CANID FROM THE MALAPA HOMININ SITE, GAUTENG, SOUTH AFRICA

37 Fox-Dobbs, K., Lightner, E., Clementz, M. PALEOECOLOGICAL AND PALEOENVIRONMENTAL RECONSTRUCTIONS OF LATE QUATERNARY MAMMALIAN FAUNAS FROM EASTERN WYOMING AND COLORADO

38 Smith, M., Polly, D. REGIONAL PATTERNS OF MODERN SYMPATRY IN NORTH AMERICAN QUATERNARY MAMMAL FAUNAS


40 Milideo, L., Graham, R. TAPHONOMIC DIFFERENCES BETWEEN FOX AND WOLF DENS

41 Balisi, M., Badgley, C. DIETARY BEHAVIOR AND RESOURCE PARTITIONING AMONG LARGE CARNIVORANS OF LATE PLEISTOCENE RANCHO LA BREA

42 Haupt, R., DeSantis, L. INTEGRATING DENTAL MICROWEAR TEXTURE ANALYSIS AND GEOCHEMICAL DATA IN AN EXTANT CARNIVORE (PUMA CONCOLOR): LESSONS LEARNED FROM MODERN ECOLOGY OF APPLICATION TO PALEOECOLOGICAL STUDIES

43 Strait, S. MYRMECOPHAGOUS MAMMAL MICROWEAR

44 Hartman, S. INVESTIGATING THE IMPACT OF COMPETING INTERPRETATIONS OF PECTORAL GIRDLE PLACEMENT AND APPENDICULAR FUNCTION ON SAUROPOD HEAD HEIGHT

45 Tschopp, E., Mateus, O. EVIDENCE FOR PRESENCE OF CLAVICLES AND INTERCLAVICLES IN SAUROPOD DINOSAURS AND ITS IMPLICATIONS ON THE FURCULA-CLAVICLE HOMOLOGY
Fiorillo, A., Tykoski, R., May, P. THE FIRST ARTICULATED CERVICAL SERIES OF AN ADULT ALAMOSAURUS SANJUANENSIS (DINOSAURIA: TITANOSAURIA) AND AN ALAMOSAURUS SKELETAL RECONSTRUCTION AT THE PEROT MUSEUM OF NATURE AND SCIENCE

Schroeter, E., Lacovara, K. HISTOLOGY OF NORMAL AND DEFORMED ARGENTINEAN TITANOSAUR FEMORA

Fanti, F., Contessi, M., Andrea, C. A NEW REBBACHISAURID SAUROPOD FROM TUNISIA

Paulina Carabajal, A. FIRST INSIGHTS INTO THE DICRAEOSAURID (SAUROPODA: DIPLODOCOCOIDEA) INNER EAR: THE ENDOCRANIAL MORPHOLOGY OF AMARGASARUS CAZAUI STUDIED USING CT SCANS


WITHDRAWN

Woodruff, C., Horner, J. A RE-EVALUATION OF THE VERTEBRAL SOFT TISSUE RECONSTRUCTION WITHIN DINOSAURIA BASED ON ALTERNATE EXTANT ANALOGUES

Whitlock, J., Lamanna, M. A REANALYSIS OF CM 11162, A SKULL OF APATOSAURUS (SAUROPODA: DIPLODOCIDAE)

Otero, A., Pol, D., Powell, J. PHYLOGENETIC RELATIONSHIPS OF MUSSAURUS PATAGONICUS: TESTING THE EFFECT OF ONTOGENETICALLY VARIABLE CHARACTERS ON TREE TOPOLOGY

Sverdlova, N., Fechner, R., Perry, S. PARAMETRIC COMPUTATIONAL FLUID DYNAMICS SIMULATION OF THE RESPIRATORY HEAT LOSS IN SAUROPODOMORPH DINOSAURS: THE ROLE OF LONG TRACHEA

O’Connell, T., Wilson, J., Zalmout, I. AIR SPACE PROPORTION IN A DORSAL VERTEBRA OF A NEW TITANOSAUR (DINOSAURIA: SAUROPODA) FROM JORDAN

Burns, M., Currie, P. QUANTITATIVE ANALYSES OF CRANIAL CHARACTERS IN PANOPLOSARUS AND EDMONTONIA (ANKYLOSAURIA: NODOSAURIIDAE) AND THEIR TAXONOMIC IMPLICATIONS FOR THE CLADE

Vanburen, C., Arbour, V., Evans, D. CERVICAL FUSION IN ANKYLOSAURIA: ANATOMY AND FUNCTION

Krumenacker, L., Britt, B. THE FIRST RADIOMETRIC DATES FOR THE WAYAN FORMATION OF IDAHO, STRATIGRAPHIC PLACEMENT OF FOSSIL LOCALITIES, AND REGIONAL CORRELATIONS

Gay, R. DOES THE EARLY JURASSIC KAYENTA FORMATION PRESERVE MORE THAN ONE SPECIES OF SCUTELLOSARUS?

WITHDRAWN

Hayashi, S., Zhao, Q., Watabe, M., Carpenter, K., Xu, X. PHYLOGENETIC AND ONTOGENTIC VARIATIONS OF BONE HISTOLOGY IN THYREOPHORAN OSTEODERMS

Spencer, M. POSTCRANIAL OSTEOLOGY OF EARLY ORNITHISCHIAN DINOSAURS AND THE ANCESTRAL BODY PLAN OF ORNITHISCHIA
FRIDAY AFTERNOON, OCTOBER 19, 2012
POSTER SESSION III (CONTINUED)

64 Fechner, R., Gößling, R., Sverdlova, N. ON THE MECHANICAL LOADING OF THE PUBIS IN EXTANT ARCHOSAURS AND ITS RELEVANCE FOR THE RECONSTRUCTION OF SOFT TISSUES IN ORNITHISCHIAN DINOSAURS

65 Fearon, J., Varricchio, D. COMPARATIVE PECTORAL AND FORELIMIT MORPHOLOGY OF ORNITHOPODA: DOES ORYCTODROMEUS CUBICULARIS EXHIBIT SPECIALIZATION FOR DIGGING?

66 Jackson, F., Varricchio, D., Corsini, J. AVIAN EGGS FROM THE EOCENE CHADRON FORMATION, NEBRASKA, AND WILLWOOD FORMATION, WYOMING

67 Kirchner-Smith, M. INFERRING LOCOMOTOR CAPABILITIES OF THE EXTINCT TERROR BIRD GASTORNIS USING GEOMETRIC MORPHOMETRICS

68 Stubbs, A., Ksepka, D. COMPUTER TOMOGRAPHY INVESTIGATIONS INTO CRANIAL PNEUMATICITY IN A SMALL OLIGOCENE SULID (STEGANOPODES:SULIDAE)

69 Moyer, A., Schweitzer, M. MELANOSOMES...OR MICROBES?

70 Wang, X., Dyke, G. ASYMMETRIC VANES OF LIVING AND FOSSIL BIRD FEATHERS INDICATE MECHANICAL FUNCTION RATHER THAN FLIGHT ABILITY

71 O'Connor, J. DIETARY EVOLUTION IN MESOZOIC BIRDS

72 Aotsuka, K., Hatcher, J., Janzic, A., Sato, T. DIVERSITY OF THE HESPERORNITHIFORMES (AVES) FROM THE UPPER CRETAEOUS PIERRE SHALE IN SOUTHERN MANITOBA, CANADA

73 Tanaka, T., Kobayashi, Y., Kano, M., Kurihara, K. THE FIRST RECORD OF A HESPERORNITHIFORM FROM JAPAN

74 Chiappe, L., Pomeroy, D. A TAXONOMIC REVISION OF THE SAPEORNITHIDAE (AVES: PYGOSTYLLIA) FROM LIAONING PROVINCE, CHINA

75 Li, Z., Zhou, Z., Clarke, J. A LARGE-BODIED BASAL ENANTIORNITHINE BIRD FROM THE EARLY CRETAEOUS OF CHINA WITH A PROPOSED RAPTORIAL FEEDING ECOLOGY

76 Smith, D., Harris, J. A RECONSIDERATION OF THE STATUS OF THE UPPER JURASSIC PTERODACTYLOID PTEROSAUR MESADACTYLS ORNITHOSPHYOS FROM THE MORRISON FORMATION OF COLORADO

77 Wilkins, P., Senter, P. A PALEONTOLOGICAL AND NEONTOLOGICAL INVESTIGATION OF THE CLAIM THAT THE PTEROSAUR SCAPHOGNATHUS CRASSIROSTRIS SURVIVED INTO THE SEVENTEENTH CENTURY

78 Foth, C., Brusatte, S., Butler, R. CRANIAL MORPHOMETRICS, DISPARITY AND EVOLUTIONARY HISTORY OF PTEROSAURIA (DIAPSIDA: ARCHOSAURIA)

SATURDAY MORNING, OCTOBER 20, 2012
TECHNICAL SESSION XIV
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Ryosuke Motani and Erin Maxwell

8:00 Leblanc, A., Reisz, R. DENTAL HISTOLOGY OF DIADECTOMORPHA AND THE EVOLUTION OF CEMENTUM AND ALVEOLAR BONE WITHIN AMNIOTA


8:30 Marjanović, D., Witzmann, F. FINALLY GROWN UP: IS THIS WHAT A MORPHOLOGICALLY ADULT LISSAMPHIBIAN LOOKS LIKE? NEW DATA FOR ONTOGENETICS AND PHYLOGENETICS FROM AN OLIGOCENE NEWT (SALAMANDRIDAE: PLEURODELINEAE)
SATURDAY MORNING, OCTOBER 20, 2012
TECHNICAL SESSION XIV (CONTINUED)

8:45 Anderson, J., Maddin, H., Wilson, S., Pardo, J. NEW INSIGHTS INTO THE ORIGIN OF EXTANT AMPHIBIANS FROM THE FOSSIL RECORD AND HIGH RESOLUTION COMPUTED TOMOGRAPHY

9:00 Tsuji, L., Sidor, C. CRANIAL ANATOMY, PHYLOGENETIC RELATIONSHIPS AND BIOGEOGRAPHY OF BUNOSTEGOS AKOKANENSIS (PARAREPTILIA: PAREIASAURIDAЕ)

9:15 Reisz, R., MacDougall, M., Modest, S. NEW SMALL PARAREPTILES FROM THE LOWER PERMIAN OF RICHARDS SPUR, OKLAHOMA, AND THE EARLY DIVERSIFICATION OF PARAREPTILES IN LAURASIA

9:30 Müller, J., Danto, M. THE ENIGMATIC REPTILE KADALIOSAURUS FROM THE LOWER PERMIAN OF GERMANY AND THE MONOPHYLY OF ARAEOSCELIDIAN DIAPSIDS

9:45 Schoch, R., Sues, H. A DISTINCTIVE NEW ARCHOSAURIFORM REPTILE FROM THE MIDDLE TRIASSIC (LADINIAN) OF GERMANY AND ITS PHYLOGENETIC RELATIONSHIPS

10:00 BREAK


10:30 Fraser, N., Li, C., Rieppel, O. A LONG-SNOTED PROTOROSAURIAN FROM THE MIDDLE TRIASSIC OF SOUTHERN CHINA

10:45 Peecook, B., Sidor, C., Nesbitt, S., Angielczyk, K., Steyer, J. A NEW SILESAURID DINOSAURIFORM FROM THE MIDDLE TRIASSIC (ANISIAN) NTAWERE FORMATION OF ZAMBIA REINFORCES PATTERNS OF ASSEMBLAGE DISSIMILARITY ACROSS SOUTHERN PANGAEA

11:00 Sookias, R., Benson, R., Butler, R. MACROEVOLUTIONARY TRENDS IN BODY SIZE DURING THE THERAPSID-ARCHOSAUROMORPH TRANSITION

11:15 Morris, Z., Werning, S. HISTOLOGICAL VARIATION SUGGESTS UNUSUAL LEVELS OF DEVELOPMENTAL PLASTICITY IN THE STEM ARCHOSAUR VANCLEAVEA

11:30 Kelley, N., Motani, R., Embree, P. A NEW LOWER TRIASSIC ICHTHYOPTERYGIAN FAUNA FROM FOSSIL HILL, NEVADA

11:45 Motani, R., Ji, C., Tomita, T., Jiang, D. ABSENCE OF SUCTION FEEDERS AMONG ICHTHYOSAURS AND IMPORTANCE OF MECHANISM-BASED QUANTIFICATION IN FUNCTIONAL INFERENCES

12:00 Maxwell, E., Vincent, P. CHANGES IN ICHTHYOSAUR BODY SIZE DURING THE EARLY TOARCIAN EXTINCTION EVENT

SATURDAY MORNING, OCTOBER 20, 2012
TECHNICAL SESSION XV
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4
MODERATORS: Clint Boyd and Eric Morschhauser

8:00 Pei, R. GEOMETRIC MORPHOMETRIC STUDY OF THE EVOLUTION OF THE HIND LIMB IN NON-AVIAN DINOSAURS

8:15 Prieto-Marquez, A., Gates, T., Zanno, L. LATE CRETACEOUS TECTONIC EVENTS TRIGGERED NORTH AMERICAN MEGAHerbIVORE DINOSAUR CLADOGENESIS

8:30 Mallon, J. DIETARY NICHE PARTITIONING AS A MEANS FOR THE COEXISTENCE OF MEGAHerbIVOROUS DINOSAURS FROM THE DINOSAUR PARK FORMATION (UPPER CAMPANIAN) OF ALBERTA, CANADA

8:45 Boyd, C. ADDRESSING THE ‘HYPSILOPHODONTID’ PROBLEM IN ANALYSES OF BASAL ORNITHISCHIAN RELATIONSHIPS: NEW TAXA, NEW DATA, NEW HYPOTHESIS

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9:00  Osi, A., Prondvai, E., Butler, R., Weishampel, D.  PHYLOGENY, HISTOLOGY AND INFERRED BODY-SIZE EVOLUTION IN A NEW RHABDODONTID DINOSAUR FROM THE LATE CRETACEOUS OF HUNGARY


9:30  Erickson, G., Krick, B., Norell, M., Sawyer, W.  COMPLEX DENTAL STRUCTURE AND WEAR BIOMECHANICS IN HADROSAURID DINOSAURS

9:45  Woodward, H., Horner, J., Farlow, J.  PALEOBIOLOGICAL IMPLICATIONS OF GROWTH HISTORY AND HISTOVARABILITY IN A POPULATION OF THE HADROSAURID DINOSAUR MAIASAURA PEEBLESORUM

10:00 BREAK

10:15  Forster, C., Poole, K., De Klerk, W., Chinsamy-Turan, A., Roberts, E.  A NEW TAXON OF IGUANODONTOID DINOSAUR FROM THE KIRKWOOD FORMATION (VALANGINIAN) OF SOUTH AFRICA BASED ON AN ASSEMBLAGE OF JUVENILE SPECIMENS

10:30  Dalla Vecchia, F., Prieto-Marquez, A., Gaete, R., Galobart, À.  PHYLOGENY, BIOGEOGRAPHY AND HIGH CLADE DIVERSITY OF LAMBEOSAURINE DINOSAURS OF THE EUROPEAN ARCHIPELAGO

10:45  Morschhauser, E.  PHYLOGENETIC SIGNIFICANCE OF AUORACERATOPS RUGOSUS (ORNITHISCHIA: CERATOPSIA) AND THE PHYLOGENY OF BASAL NEOCERATOPSIA

11:00  Levitt, C.  VARIATION IN CERATOPSIAN HISTOLOGY AND GROWTH: NEW DATA FROM SOUTHERN LARAMIDIA AND IMPLICATIONS FOR PALEOENVIRONMENTAL DIFFERENCES


11:30  Makovicky, P., Erickson, G., Gao, K., Zhou, C.  CERATOPSIANS DIDN’T JUST GET BIGGER: EVIDENCE FOR DWARFISM IN PSITTACOSAURUS

11:45  Bykowski, R.  USING TRAIT-BASED ANALYSES TO UNDERSTAND CERATOPSIAN COMMUNITIES IN LARAMIDIA DURING THE LATE CRETACEOUS

12:00  Arbour, V., Badamgarav, D., Currie, P.  A NEW ANKYLOSAUROID DINOSAUR FROM THE UPPER CRETACEOUS BARIUUNGOYOT FORMATION OF MONGOLIA: NEW CRANIAL CHARACTERS FOR ANKYLOSUARINE ANKYLOSAUROIDS AND A REASSESSMENT OF ANKYLOSUARID POSTCRANIAL SPECIMENS FROM MONGOLIA
SATURDAY MORNING, OCTOBER 20, 2012
TECHNICAL SESSION XVI (CONTINUED)

9:00 Meachen, J., O’Keefe, F. MORPHOLOGICAL VARIATION IN THE MANDIBLES OF SMILODON FATALIS FROM RANCHO LA BREA IN RESPONSE TO CLIMATE AND ENVIRONMENTAL CHANGES

9:15 Wroe, S., Chamoli, U., Parr, W., Ridgely, R., Witmer, L. 3D BIOMECHANICAL MODELLING OF MARSUPIAL AND PLACENTAL SABRE-TOOTHS: A DIFFERENT KIND OF BITE FOR AN EXTREME POUCHEO PREDATOR

9:30 Rizk, O., Carr, M., Hlusko, L. PALEOBIOLOGY OF PREVIOUSLY UNEXAMINED DIRE WOLVES (CANIS DIRUS) FROM THE EARLIEST EXCAVATIONS OF THE LA BREA TAR PITS


10:00 BREAK

10:15 Friscia, A., Slater, G. TEMPO AND MODE OF ECOMORPHOLOGICAL DIVERSIFICATION IN CARNIVORA

10:30 Werdelin, L. COLLAPSE OF THE EASTERN AFRICAN LARGER CARNIVORE GUILD: CAUSES AND CONSEQUENCES

10:45 Bibi, F., Kraatz, B., Craig, N., Beech, M., Hill, A. COMPLEX SOCIAL STRUCTURE IN PROBOSCIDEA FROM A REMARKABLE LATE MIOCENE TRACKWAY SITE IN THE UNITED ARAB EMIRATES

11:00 Cherney, M., Fisher, D., Rountrey, A., Calamari, Z. ISOTOPE ANALYSES SUPPORT USE OF CT SCANS FOR IDENTIFYING ANNUAL INCREMENTS IN SNOWMASS MASTODON MANDIBULAR TUSKS

11:15 Wicks, T., Shanahan, T., Maupin, C., Gorman, M., Bell, C. THE ISOTOPIC RECORD OF LAGOMORPHS AT HALL’S CAVE

11:30 Kimura, Y., Uno, K., Cerling, T., Patnaik, R. ISOTOPE DIETARY SIGNALS IN MURINE RODENTS FROM THE NEOGENE SIWALIK GROUP LAGS LARGE MAMMALS BY ONE MILLION YEARS

11:45 Flynn, L. SYNERGISM IN DENSER FOSSIL RECORDS: ECOLOGICAL COMPLEXITY EMERGES FOR MIDDLE MIOCENE SIWALIK RHIZOMYINE RODENTS

12:00 Smiley, T., Badgley, C., Behrensmeyer, A. STABLE OXYGEN AND CARBON ISOTOPES RECORD SEASONAL VARIATION IN DRINKING WATER AND DIET OF MODERN LARGE HERBIVORES IN AMBOSELI NATIONAL PARK, KENYA

SATURDAY AFTERNOON, OCTOBER 20, 2012
TECHNICAL SESSION XVII
RALEIGH CONVENTION CENTER, BALLROOM A, LEVEL 4
MODERATORS: Michael Habib and Jonathan Mitchell

1:45 Hall, J., Habib, M., Hone, D., Chiappe, L. A NEW MODEL FOR HINDWING FUNCTION IN THE FOUR-WINGED THEROPOD DINOSAUR MICRORAPTOR GUI

2:00 Habib, M., Hall, J., Hone, D., Chiappe, L. AERODYNAMICS OF THE TAIL IN MICRORAPTOR AND THE EVOLUTION OF THEROPOD FLIGHT CONTROL

2:15 Kambic, R., Gatesy, S. TURNING IN THEROPODS

2:30 Balanoff, A., Bever, G., Rowe, T., Norell, M. THE ORIGIN OF THE AVIAN BRAIN BASED ON A VOLUMETRIC ANALYSIS OF ENDOCRANIAL EVOLUTION WITHIN COELUROSAURIA

2:45 Wilson, L. THE EFFECTS OF CLIMATE AND BEHAVIOR ON AVIAN BONE MICROSTRUCTURE: A COMPARATIVE OSTEOHISTOLOGY STUDY OF HESPERORNITHIFORMS FROM THE LATE CRETACEOUS WESTERN INTERIOR SEAWAY

3:00 Mitchell, J., Makovicky, P., Gao, K. PALEOECOLOGY OF THE JEHOL BIRDS INFERRED FROM MODERN BIRD ECOMORPHOLOGY
3:15 Ksepka, D., Ware, J., Lamm, K. FLYING ROCKS AND FLYING CLOCKS: EXPLAINING DISCREPANCIES BETWEEN FOSSIL AGES AND MOLECULAR DATES IN BIRDS

3:30 Smith, N., Clarke, J. VARIATION IN THE ENDOCRANIAL ANATOMY OF THE CHARADRIIFORMES (AVES): SENSORY SYSTEM EVOLUTION ASSOCIATED WITH THE TRANSITION TO WING-PROPELLED DIVING

3:45 Ando, T., Fordyce, R. DID MARINE MAMMALS OUTCOMPETE GIANT DIVING BIRDS?

4:00 Meijer, H., James, H., Sutikna, T., Due, R., Tocheri, M. COMPARING LATE PLEISTOCENE WITH PRESENT-DAY AVIAN COMMUNITY STRUCTURE ON FLORES ISLAND, INDONESIA

SATURDAY AFTERNOON, OCTOBER 20, 2012
TECHNICAL SESSION XVIII
RALEIGH CONVENTION CENTER, BALLROOM B, LEVEL 4
MODERATORS: Ross Secord and Carly Manz

1:45 Secord, R., Williamson, T., Weil, A. STABLE ISOTOPE ECOLOGY OF EARLY PALEOCENE (PUERCAN AND TORREJONIAN) MAMMALS FROM THE SAN JUAN BASIN, NEW MEXICO

2:00 Yapuncich, G., Boyer, D., Maiorino, S., Bolortsetseg, M. NEW DATA FOR EVALUATING FUNCTIONAL MORPHOLOGY IN PTILODONTIDAE (ALLOTHERIA, MULTITUBERCULATA) USING DIGITAL PREPARATION

2:15 Habersetzer, J., Gunnell, G. FIRST APPEARANCE OF ENLARGED INNER EARS IN ECHOLOCATING BATS

2:30 Manz, C., Bloch, J., Silcox, M. BASICRANIAL MORPHOLOGY OF PALEogene NYCTITHERIIDAE (MAMMALIA, EULIPOTYPHLA?) AND EVIDENCE FOR EULIPOTYPHLAN AFFINITIES

2:45 Ruf, I., Volpato, V., Billet, G., De Muizon, C., Lehmann, T. INNER EAR ANATOMY OF LEPTICTIDIA (LEPTICTIDA, MAMMALIA) REVEALS HIGHLY AGILE LOCOMOTION

3:00 Ahrens, H., Ruff, C., Rose, K. THE MECHANICS OF FOSSORIALITY IN MAMMALIA AND THE LOCOMOTOR BEHAVIOR OF PALAEANODONTA (PHOLIDOTAMORPHA)

3:15 Hooker, J. THE OLDEST PSEUDORHYNcocyonIDS: THEIR BEARING ON RELATIONSHIPS OF THIS EUROPEAN STEM PLACENTAL FAMILY

3:30 Spaulding, M., Flynn, J. A VIRTUAL ENDOCAST AND ENDOCRANIAL FEATURES OF OODECTES (MAMMALIA: CARNIVORAMORPHA)


4:00 Stucky, R., Miller, I., Clyde, W., Bowring, S., Chinnery, B. BIOSTRATIGRAPHY AND CORRELATION OF VERTEBRATE AND PLANT FOSSILS FROM THE WIND RIVER FORMATION (YPRESIAN, EARLY TO MIDDLE EOCENE) OF CENTRAL WYOMING IN NORTH AMERICA

SATURDAY AFTERNOON, OCTOBER 20, 2012
TECHNICAL SESSION XIX
RALEIGH CONVENTION CENTER, BALLROOM C, LEVEL 4
MODERATORS: Joshua Miller and Anthony Barnosky

1:45 Shoemaker, L., Clauset, A. THE EVOLUTION OF BODY MASS DISTRIBUTION AND DIVERSIFICATION WITHIN EQUIDAE

2:00 Marcy, A., Hadly, E., Fendorf, S. AT THE BEST ANGLE: INCREASED INCISOR PROCUMBENCY ALLOWED POCKET GOPHERS (THOMOMYS BOTTAE) TO CLAIM CLIMATE-HARDENED SOILS
SATURDAY AFTERNOON, OCTOBER 20, 2012
TECHNICAL SESSION XIX (CONTINUED)

2:15  Polly, P.  DR JESTER AND MR QUEEN: SPECIATION IN MAMMALS WITH LARGE GEOGRAPHIC RANGES IS A BIOTIC AND ABIOTIC PROCESS THAT REQUIRES MANY GLACIAL-INTERGLACIAL CYCLES

2:30  Davis, E., McGuire, J., Koo, M.  TESTING THE ACCURACY OF ECOLOGICAL NICHE MODELS USING THE LAST GLACIAL MAXIMUM FOSSIL RECORD OF MAMMALS

2:45  Yann, L., DeSantis, L.  EFFECTS OF PLEISTOCENE CLIMATIC REGIMES ON DIETARY NICHES AND ENVIRONMENTAL HETEROGENEITY IN FLORIDA

3:00  Du, A., Faith, J., Behrensmeyer, A., Patterson, D., Villasenor, A.  THE EFFECTS OF CRANIODENTAL SAMPLING ON ECOLOGICAL VARIABLES IN MODERN AND FOSSIL MAMMAL LANDSCAPE ASSEMBLAGES

3:15  Miller, J.  TEMPORAL MEGABIAS: LATITUDINAL CONTROLS ON TIME-AVERAGING OF TERRESTRIAL DEATH ASSEMBLAGES AND THEIR ECOLOGICAL DATA

3:30  Behrensmeyer, A., Western, D., Badgley, C., Miller, J., Odock, F.  THE IMPACT OF MASS MORTALITY ON THE LAND SURFACE BONE ASSEMBLAGE OF AMBOSELI PARK, KENYA

3:45  Boessenecker, R., Schmitt, J.  TAPHOFACIES ANALYSIS OF THE NEOGENE PURISIMA FORMATION IN NORTHERN CALIFORNIA INDICATES STRONG DEPOSITIONAL CONTROL ON MARINE VERTEBRATE PRESERVATION IN SHALLOW MARINE DEPOSITS

4:00  Barnosky, A., IB286 Working Group  PRELUDE TO THE ANTHROPOCENE: TWO NEWLY-DEFINED NORTH AMERICAN LAND-MAMMAL AGES

SATURDAY AFTERNOON, OCTOBER 20, 2012
POSTER SESSION IV
RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1  Miyashita, T.  CRANIAL MUSCULATURE OF LIVING JAWLESS FISHES TESTS CYCLOSTOME MONOPHYLY AND CONSTRAINS THE HEAD ANATOMY OF A GNATHOSTOME ANCESTROR

2  Chang, M., Chen, G., Liu, H.  REVISION OF A MIOCENE CARASSIUS-LIKE CYPRINID LUCYPRINUS (TELEOSTEI, PISCES) FROM EAST CHINA AND ITS BEARING ON FRESHWATER FAUNAL EXCHANGE BETWEEN EUROPE AND ASIA

3  Divay, J., Murray, A.  THE ICHTHYOFAUNA, PALAEOENVIRONMENT AND PALAEOCLIMATE OF THE MID-MIOCENE WOOD MOUNTAIN FORMATION, SASKATCHEWAN, CANADA

4  Horner, V., Horner, J.  STURGEON DORSAL OSTEODERM ONTOGENY: A TRANSFORMATIONAL MODEL FOR MARGINOCEPHALIAN SQUAMOSAL ORNAMENTS

5  Tulu, Y., Chinsamy-Turan, A.  MIO-PLIOCENE ELASMOBRANCH FAUNAS OF WESTERN CAPE, SOUTH AFRICA: SALDANHA STEEL VERSUS LANGEBAANWEG “E” QUARRY

6  Andrianavalona, T., Ramihangihajason, T., Rasoiamiaramanana, A., Ward, D., Samonds, K.  MIOCENE SHARK FAUNA FROM NOSY MAKAMBY (MAHAJANGA BASIN, NORTHWESTERN MADAGASCAR)

7  Argyriou, T., Cook, T., Murray, A.  NEW ADDITIONS TO THE ELASMOBRANCH FAUNA FROM THE MIOCENE OF JABAL ZALTAN, LIBYA

8  Nance, J., Symister, C., MacFadden, B., Godfrey, S.  RARE EARTH ELEMENT GEOCHEMISTRY OF CALVERT CLIFFS (MIocene, CHESAPEAKE GROUP): A PRELIMINARY REPORT

9  Symister, C., MacFadden, B., Hendy, A., Pimiento, C., Degracia, C.  DIAGENESIS AND PALEOENVIRONMENTAL CHANGES IN NEOGENE FOSSILS AND ENVIRONMENTS FROM PANAMA: EVIDENCE FROM REE PROXIES
SATURDAY AFTERNOON, OCTOBER 20, 2012
POSTER SESSION IV (CONTINUED)

10 Carpenter, N., Smith, G. BEGINNINGS OF NEOGENE FISH DIVERSITY IN WESTERN NORTH
AMERICA: THE 15 MA SUCKER CREEK FORMATION, IDAHO AND OREGON

11 Liu, J., Tseng, Z., Wilson, M., Murray, A. BODY SHAPE DIFFERENCES BETWEEN NORTH AMERICAN
AND ASIAN FOSSIL CATOSTOMIDS AND ONTOGENETIC CHANGE IN EARLY CYPRINIFORMS

12 Stevens, W., Claeson, K., Stevens, N. ALESTID FISHES FROM THE LATE OLIGOCENE NSUNGWE
FORMATION OF TANZANIA

13 Callahan, W., Schein, J., Schroeter, E., Parris, D., Lacovara, K. FIRST RECORD OF THE
SYNECHODONTIFORM SHARK SPHENODUS (NEOSELACHII, ORTHACODONTIIDAE) FROM THE
DANIAN OF NORTH AMERICA

14 Odunze, S., Stevens, N., Cooper, L., Obi, G. PALEOGENE Ichthyofauna of the IMO and AMEKI
FORMATIONS, SOUTHEASTERN NIGERIA

15 Marivaux, L., Salas-Gismondi, R., Tejada, J., Antoine, P. A PLATYRRHINE TALUS FROM THE EARLY
MIocene of the AMAZONIAN MADRE DE DIOS SUB-ANDEAN ZONE: THE FIRST FOSSIL PRIMATE
FROM PERU

16 Gilbert, C., Patel, B., Patnaik, R., Fleagle, J. RENEWED PALEONTOLOGICAL INVESTIGATIONS IN THE
UPPER AND LOWER SIWALIKS OF INDIA: IMPLICATIONS FOR PRIMATE EVOLUTION VIS A VIS
PALEOCIMATE CHANGE

17 Pérez De Los Ríos, M., Alba, D., Moyà-Solà, S. TAXONOMIC ATTRIBUTION OF THE DRYOPITHECINE
TEETH (PRIMATES: HOMINIDAE) FROM THE MIDDLE MIocene OF LA GRIVE (FRANCE)

18 Constantino, P., Godfrey, L., Meador, L., Schwartz, G. RECONSTRUCTION OF SUBFOSSIL LEMUR BITE
FORCES USING DENTAL FRACTURE MECHANICS

19 Muldoon, K., Godfrey, L., Crowley, B. THE ROLE OF ELEVATION IN UNDERSTANDING THE
BIogeographic DISTRIBUTION OF THE EXTINCT LEMURS OF MADAGASCAR

20 Abdel Gawad, M., Miller, E., Hamdan, M., El Barkooky, A., El Sharkawi, M. VERTEBRATE AND
GEOLOGICAL SIGNATURES ON THE CONSTRUCTION OF MOGHRA FORMATION, NORTH WESTERN
DESERT, EGYPT

21 Villasenor, A., Behrensmeyer, A., Bobe, R., Reed, K. A TALE OF TWO BASINS: COMMUNITY
STRUCTURE DYNAMICS THROUGH SPACE AND TIME IN THE HADAR AND TURKANA BASINS,
EThIOPIA AND KENYA

22 Hensley-Marschand, B. PRELIMINARY FAUNAL ANALYSIS OF THE DONGGUTUO SITE, NIHEWAN
BASIN, CHINA

23 Hatala, K., Richmond, B., Harcourt-Smith, W., Liutkus, C., Zimmer, B. A SNAPSHOT OF THE ANATOMY,
LOCOMOTION AND SOCIAL BEHAVIOR OF EARLY MODERN HUMANS AS EVIDENCED BY FOSSIL
FOOTPRINTS AT ENGARE SERO, TANZANIA

24 Gatesy, S., Ellis, R. A BIPLANAR X-RAY METHOD FOR 3-D ANALYSIS OF TRACK FORMATION

25 Calede, J. COMPARATIVE TAPHONOMY OF ARIKAREEAN DEPOSITS OF OREGON AND MONTANA

26 López-Antoñanzas, R., Flynn, L., Knoll, F. MULTIPLE INTERCONTINENTAL DISPERALS OF THE
RHIZOMYINAE (SPALACIDAE, RODENTIA)

27 Tomida, Y. A NEW GENUS OF THE FAMILY OCHOTONIDAE (LAGOMORPHA, MAMMALIA) AND
LAGOMORPH FAUNAL CHANGES AT THE AOERBAN AREA IN CENTRAL INNER MONGOLIA, CHINA

28 Bamba, K., Croft, D. VARIATION WITHIN MODERN CHINCHILLID POPULATIONS AND
IMPLICATIONS FOR TAXONOMY OF FOSSIL POPULATIONS

PARALLEL EVOLUTION OF GIANT SIZE AND RIDGED ENAMEL IN TWO SPECIES
SATURDAY AFTERNOON, OCTOBER 20, 2012
POSTER SESSION IV (CONTINUED)

30 Stegner, M., Ferrer, E. DRIVERS OF JAW SHAPE IN NEOTOMA: MANDIBULAR GEOMETRIC MORPHOMETRICS AND IMPLICATIONS FOR MORPHOLOGICAL PARTITIONING

31 Thies, M., Tutalo, R., Labbe, M., Lewis, P. ASSESSING THE DIFFICULTIES OF GENUS-LEVEL DIAGNOSES OF FOSSIL RODENTS

32 Villavicencio, N., Maguire, K., McGuire, J. USING STABLE ISOTOPES AND TOOTH MORPHOLOGY TO RECONSTRUCT PALEOEKOLOGY: A PILOT STUDY USING MICROTORUSCALIFORNICUS

33 Lightner, E., Clementz, M., Fox-Dobbs, K., Minckley, T., Kornfeld, M. USING STABLE ISOTOPE ANALYSIS OF COPROLITES TO DETERMINE PALEODIET OF LATE PLEISTOCENE MAMMALS

34 Ferrusquia-Villafranca, I., De Anda-Hurtado, P., Ruiz-González, J. EXTINCT AND EXTANT QUATERNARY MAMMALS FROM SAN LUIS POTOSÍ, EAST-CENTRAL MEXICO: FAUNAL TURNOVER AND CLIMATE CHANGE

35 Jass, C., Horne, G., Critchley, D. NEW QUATERNARY VERTEBRATE RECORDS FROM CAVE DEPOSITS IN JASPER NATIONAL PARK, ALBERTA, CANADA

36 Buchholtz, E. SOMITE - LATERAL PLATE INTERACTION AS A DEVELOPMENTAL CONTROL ON EVOLUTION OF TETRAPOD AXIAL MORPHOLOGY

37 Uhen, M. NEW SPECIMENS OF MIDDLE EOCENE WHALES (CETACEA, PROTOCETIDAE) FROM NEW JERSEY

38 Corrie, J. FUNCTIONAL MORPHOLOGY OF ELONGATED VERTEBRAE IN BASilosaurus TO INTERPRET AQUATIC LOCOMOTION PATTERNS

39 Murakami, M., Hirayama, R. FIRST RECORD OF A PONTOPORIID CETACEAN (ODONTOCETI: INIOIDEA) FROM LATE MIOCENE OF CHIBA, JAPAN


41 Churchill, M., Clementz, M., Kohno, N. BODY SIZE RECONSTRUCTION FOR FOSSIL NORTH PACIFIC PINNIPEDIA (MAMMALIA: CARNIVORA): PROBLEMS AND IMPLICATIONS


43 Fletcher, T. PALEOClimAte OF THE DINOSAUR-BEARIng, MID-CRETACEous WINTon FORMATION, CENTRAL-WESTERN QUEENSLAND, AUSTRALIA: NEW OBSERVATIONS BASED ON LEAF MARGIN ANALYSIS, CLIMATE LEAF ANALYSIS MULTIVARIATE PROGRAM, BIOCLIMATIC ANALYSIS AND FOSSIL WOOD GROWTH INDICES


45 WITHDRAWN

46 Watabe, M., Tsogtbaatar, K. DINOSAURIAN OOFaUNA FROM THE UPPERMOST CRETACEOUS NEMEGT FORMATION IN MONGOLIA

47 Oser, S. FLUVIAL SEDIMENT AND EGGSHELL INTERACTIONS: A METHOD FOR ASSESSING TRANSPORT IN FOSSIL EGGSHELL ACCUMULATIONS
SATURDAY AFTERNOON, OCTOBER 20, 2012
POSTER SESSION IV (CONTINUED)

48 May, K., Druckenmiller, P. TRACKS IN THE ARCTIC: A DINOSAUR ICHNOFOSSIL ASSEMBLAGE FROM THE UPPER CRETACEOUS PRINCE CREEK FORMATION, NORTHERN ALASKA

49 Schanz, T., Lins, Y., Viefhaus, H., Sander, M. QUANTITATIVE INTERPRETATION OF DINOSAUR TRACKS REVISITED

50 Falkingham, P., Gatesy, S. RECONSTRUCTING LIMB KINEMATICS OF SMALL BIPEDAL DINOSAURS TRAVERSING SEMI-FLUID SUBSTRATES

51 Deblieux, D., Madsen, S., Kirkland, J., Inkenbrandt, P., Santucci, V. SIGNIFICANT MESozoIC VERTEBRATE FOSSIL LOCALITIES DISCOVERED DURING CONTINUING PALEONTOLOGICAL RESOURCE INVENTORY AND MONITORING AT ARCHES NATIONAL PARK

52 Ribeiro, V., Mateus, O. CHRONOLOGY OF THE LATE JURASSIC DINOSAUR FAUNAS, AND OTHER REPTILIAN FAUNAS, FROM PORTUGAL

53 Hattori, S. ANALYSIS OF THE THEROPOD HALLUX FOR UNRAVELLING THE EVOLUTION OF FOOT FUNCTION

54 Sorkin, B. AERIAL ABILITY IN BASAL DEINONYCHOSAURIA

55 Cuff, A., Rayfield, E. FUNCTIONAL MECHANICS OF ORNITHOMIMOSAUR CRANIA COMPARED TO OTHER THEROPODS

56 Hendricks, C., Araújo, R., Mateus, O. THE NONAVIAN THEROPOD QUADRATE: SYSTEMATICS USEFULNESS, MAJOR TRENDS AND PHYLOGENETIC MORPHOMETRICS ANALYSIS

57 Sissons, R., Gilbert, M., Snively, E. LOCOMOTOR FORCES AND STRESS IN THE METAPODIA OF ADULT OSTRICH STRUTHIO CAMELUS AND JUVENILE ALBERTOSAURUS SARCOPHAGUS (TYRANNOSAURIDAE): CORRELATING ANATOMY, DYNAMICS AND FINITE ELEMENT ANALYSIS

58 Tsuihiji, T., O’Connor, P. RECONSTRUCTION OF MUSCULAR AND PNEUMATIC SYSTEMS IN THE NECK AND ANTERIOR TRUNK OF ABELISAURIDAE: INSIGHTS FROM MAJUNGASAURUS CRENATISSIMUS (DINOSAURIA: THEROPODA)

59 Sankey, J. SOMETHING’S FISHY: WAS ONE OF THE MOST ABUNDANT LATEST CRETACEOUS THEROPODS A FISH-EATER?

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WEDNESDAY, OCTOBER 17, THROUGH SATURDAY, OCTOBER 20
SVP 2012 EDUCATION AND OUTREACH POSTER SESSION
RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors will be present at their posters: Wednesday, October 17, from 4:15 – 5:15 p.m.
Posters must be removed by 6:30 p.m., Saturday, October 20

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3 Dewar, E. WRITING ABOUT VERTEBRATE PALEONTOLOGY AND MORPHOLOGY AS A WAY TO IMPROVE COLLEGE STUDENTS’ WRITING SKILLS
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WEDNESDAY, OCTOBER 17, THROUGH SATURDAY, OCTOBER 20
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RALEIGH CONVENTION CENTER, EXHIBIT HALL A, LEVEL 1
Authors will be present at their posters: Thursday, October 18, from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m., Saturday, October 20

1 Ushimura, E. MICROSTRUCTURE OF THE SERRATED MARGIN OF EXTANT AND FOSSIL SHARKS WITH ORTHODENTINE AND OSTEODENTINE

2 Pelletier, V. 1:1 POSTCRANIAL RECONSTRUCTION OF THE BASAL EUPELYCOSAUR AEROSAURUS WELLESI

3 Miller-Camp, J. ARE LYSTROSAURUS DECLIVIS AND LYSTROSAURUS MURRAYI SEPARATE SPECIES OR SEXUAL DIMORPHS?

4 Melstrom, K. DESCRIPTION OF A JUVENILE DIPLODOCUS FROM DINOSAUR NATIONAL MONUMENT, UTAH AND ITS ONTOGENETIC IMPLICATIONS

5 Brocklehurst, N. SKULL SHAPE VARIATION IN LEPIDOSAURS: THE INFLUENCE OF ECOLOGY AND PHYLOGENY

6 Yamada, E. EFFECTS OF DIETARY DIFFERENCES BETWEEN TWO EXTANT RUMINANTS IN SYMPATRIC HABITAT ON ENVIRONMENTAL RECONSTRUCTION BY MESOWEAR ANALYSIS

7 Crofts, S. MODELING FUNCTIONAL TRADE-OFFS OF TEETH FROM EXTINCT AND EXTANT HARD PREY CRUSHING TAXA

8 DeBlois, M. PLESIOSAUR FLIPPER HYDRODYNAMICS AND ITS IMPLICATIONS ON PLESIOSAUROMORPH AND PLIOSAUROMORPH ECOMORPHOLOGY

9 van Heteren, A. THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC ANALYSES OF URSIDAE ARE ABLE TO PREDICT FUNCTIONAL ADAPTATIONS OF FOSSILS
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ONTOGENY OF THE EARLY TRIASSIC THRXANOON LIOHRINUS (THERAPSIDA, CYNOPTONTIA), DENTAL MORPHOLOGY AND REPLACEMENT ABDALA, Fernando, Bernard Price Institute for Palaeontological Research, Johannesburg, South Africa; JASINSKI, Sandra, Department of Zoology, Cape Town, South Africa; FERNANDEZ, Vincent, Bernard Price Institute for Palaeontological Research, Johannesburg, South Africa

The non-mammalianiform cynodont Thrxanoon liohrinus is one of the most common representatives of the post-dinosaur-extinction fauna of the Lyctrosaurus Assemblage Zone of the South African Karoo Basin. Thrxanoon is also one of the best known Triassic cynodonts with a well-known cranio-dental and postcranial anatomy. Here we present a detailed study on variation of the dental morphology and replacement in Thrxanoon liohrinus. For this study we analysed five specimens ranging from 37 to 87 mm in skull length using micro computed tomography (μCT) scanning techniques, which were supplemented by detailed anatomical analysis of four specimens with a basal skull length of approximately 30 mm to 96 mm. Our results confirm the alternate appearance of the postcanines and the posterior migration of the postcanine series (including the loss without replacement of the anteriormost postcanines). Even when most of the observations point to a posterior-to-anterior replacement wave, the evidence is not clear-cut. A new classification was designed to describe accurately the morphology of postcanines, taking into consideration the number of sectorial cusps, presence and pattern of the lingual cingulum, and presence of labial cingular cusps. The lower postcanines are clearly more complex (and more numerous) than the upper postcanines; only the lower postcanines have more than three sectorial cusps and a cingular collar on the lingual margin. Complexity of the postcanines increases from the smallest individual to specimens of 75 mm of skull length, but complexity decreases in larger specimens. On several specimens, erupting canines can be observed through the replacement pit while the complexity of the replacement pattern was assessed using X-ray micro-computed tomography. The virtual extraction of functional and replacement teeth permitted us to conclude that in most of the cases, the upper canines were replaced anteriorly while lower canines were replaced posteriorly. The presence of two simultaneous replacements of the upper canine tooth was observed in two small juveniles, suggesting a higher rate of canine replacement at younger age. Incisors also had a sequential replacement pattern, and more replacement teeth were present in medium-sized individuals.

VERTEBRATE AND GEOLOGICAL SIGNATURES ON THE CONSTRUCTION OF MOGHR A FORMATION, NORTH WESTERN DESERT, EGYPT ABDEL GAWAD, Mohamed K., Cairo University, Giza, Egypt; MILLER, Ellen, Wake Forest University, Winston-Salem, NC, United States; HAMDAN, Mohamed, Cairo University, Giza, Egypt; EL BAROOKKY, Ahmed, Cairo University, Giza, Egypt; EL SHARKAWI, Mohamed, Cairo University, Giza, Egypt

Information from the geology and paleontology of Wadi Moghra, early Miocene, Qattara Depression, Egypt combine to indicate the Moghra animals occupied a tide-dominated estuary paleoenvironment. Work on the sedimentology of the area reveals that the Moghra Formation is characterized by a series of shale-sandstone interbedded units, with an ichnofossil assemblage comprised of Ophiomorpha, which indicate an intertidal zone, and Thalassinoides, which indicate a subtidal environment. The root system of mangrove trees is present in some places, which also suggests the presence of tidal flats or beaches.

Vegetation and the Mammal Assemblage Zone (Aptian-Albian) of the Twin Mountains Formation, Texas, United States

Thalassinoides, which indicate a subtidal environment. The root system of mangrove
depression, Egypt combine to indicate the Moghra animals occupied a tide-dominated

Technical Session X (Saturday, October 20, 3:00 pm)
The Mechanics of Fossoriality in Mammalia and the locomotor behavior of Palaeanodonta (Pholidotamorpha)

AHIENS, Heather E., Johns Hopkins School of Medicine, Baltimore, MD, United States; RUFF, Christopher B., Johns Hopkins School of Medicine, Baltimore, MD, United States; ROSE, Kenneth D., Johns Hopkins School of Medicine, Baltimore, MD, United States

Fossoriality has evolved multiple times within Mammalia, providing numerous examples of adaptive convergence. Some of the most cited examples of morphological convergence in the postcranial include additional features in the vertebral column, a stout humerus with prominent muscle attachment sites, a long and inflected olecranon process, and a broad ulna with fusions and additional sesamoids. Despite many descriptive studies, there are few taxonomically broad biomechanical analyses of fossoriality in mammals. The goals of this project were to use beam modeling and mechanical advantage of long bones to determine whether different digging modes could be distinguished in extant taxa and to determine the locomotor behavior of Palaeanodonta, an extinct Paleogene group that includes taxa hypothesized to be moderately to extremely fossorial. The extant sample included eleven species, nine fossorial and two generalized, and the fossil sample included five extant families of palaeeanodonts. The number of teeth was restricted for the fossor for nearly complete specimens. Anteroposterior and mediolateral breadth measurements of the humerus and femur were used to calculate polar section modulus (Zp) and polar second moment of area (J), which measure bending and torsional strength and rigidity, respectively. Length of the olecranon process and total length of the ulna were used to calculate mechanical advantage of the ulna. 95% prediction intervals constructed from non-fossorial diggers (our large modern sample) and analyses of variance (ANOVA) on the residuals from the regression of scratch diggers were used to assess whether there was a distinction between the following locomotor modes: specialized (non-fossorial), scratch, hook and pull, humeral rotation, and head lift. Humeral rotation and head-lift digging can be distinguished from scratch digging on the basis of humeral bending and torsional strength and rigidity, as well as the mechanical advantage of the ulna on the basis of both the ANOVA and examination of prediction intervals. Femoral strength and rigidity were significantly different between the base of the ANOVA; however, individuals of all locomotor modes fell within the 95% prediction intervals. Though none of the palaeeanodonts sampled exhibited mechanical measures outside the range of extant mammals, the group is characterized by an increased mechanical advantage of the ulna compared to extant fossorial mammals of similar body size. Most palaeeanodonts were likely scratch diggers, with only Dipsasalis ourcetes recovered as a head-lift digger. The discrimination of more than one locomotor style in Palaeanodonta provides promising results that suggest these mechanical properties can detect differences in digging mode in other extinct mammals.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)
ENCEPHALIZATION AND BRAIN MORPHOLOGY IN EXTINCT, FALSE SABERTOOTHED CATS (BARBOUROFELIDAE)

ADRA, David M., Instituto de Paleontología Miquel Crusafont, UAB, Barcelona, Spain; FORTUNY,Josep, Institut de Paleontologia Miquel Crusafont, UAB, Barcelona, Spain; DE ESTEBAN-TRIVIGNO, Soledad, Institut Català de Paleontologia Miquel Crusafont, UAB, Barcelona, Spain; ROBLES, Josep M., Institut Català de Paleontologia Miquel Crusafont, UAB, Barcelona, Spain; ALMEÇIA, Sergio, American Museum of Natural History & NYCEP, New York, NY, United States

Barbouroufels are an extinct family of feliform carnivores from the Miocene of Africa, Eurasia and North America, including the paraphyletic Afromilini and the more derived and monophyletic Barbouroufelinae (Sansanosmilus, Albasuris and Barbouroufelis). Barbouroufels evolved a sабer-toothed morphology independently from nimravids and the saber-toothed felids ( Machairodontinae). In North America, barbouroufelins coexisted for several million years with machairodonts, but in Europe the former became extinct short after the arrival of the latter. According to published endocast descriptions of Sansanosmilus and Barbouroufelis, barbouroufels would display an archaic brain sulcal pattern more similar to that of nimravids than to that shared by machairodontines and saber-toothed felids, thus suggesting the existence of cognitive differences between the two groups. This is tentatively supported by published brain volume estimations based on external cranial measurements. In order to further evaluate the differences in brain morphology and encephalization between barbouroufels and machairodontines, here we report two barbouroufelin virtual endocasts based on computed tomography (CT) scans of...
the following two crania: Alhambonisilus jordani IPS49575 from Abocador de Can Mata sector C8-B/C (Vallès-Penedès Basin, Spain; ca. 11.5 Ma, Aragonian, Middle Miocene), housed in the Institut Català de Paleontologia Miquel Crusafont (Spain); and Barbourofelis morrisi AMNH FAM 61870 from the Leptarctus Quarry (Merritt Dam Member, Ash Hollow Formation, Nebraska, USA; ca. 11.5-9.5 Ma, Clarendonian, Middle to Late Miocene) housed at the American Museum of Natural History (AMNH, USA). On morphologic grounds, *Alhambonisilus* and *Barbourofelis* differ from extant felids and resemble the more primitive barbourofelid *Sansanosmilus* in several features, such as displaying two main neocortical sulci (coronolateral and suprasylvian). Moreover, compared to extant felids, the two barbourofelids studied here display a higher cranial fissure and less developed simoid gyri, indicating the possession of lower auditory abilities and a smaller portion of the neocortex devoted to processing somatosensory and motor inputs. Finally, our brain volume measurements (78 cm³ for *A. jordani* and 112 cm³ for *B. morrisi*) and the body mass estimates based on the length of these crania (46 and 61 kg, respectively) confirm that barbourofelids displayed a lower degree of encephalization compared to both carnivores and felids. Barbourofelins especially contrast with machairodontines, which appear slightly more encephalized on average than extant felids. Overall, our results confirm the hypothesis that barbourofelids differed in neuroanatomical traits and associated cognitive features from sabertooth felids.

**POSTER SESSION IV (Saturday, October 20, 4:15 - 6:15 pm)**

**A BASAL MOSASAURID FROM THE EARLY TURONIAN OF UTAH**

ALBRIGHT, III, L. B., University of North Florida, Jacksonville, FL, United States; TITUS, AL White County Museum, El Dorado, AR, United States; RICHARDSON, H. S., Grand Staircase-Escalante National Monument, Kanab, UT, United States; CLITES, Erica C., Glen Canyon National Recreation Area, Page, AZ, United States; BIRTHISEL, Tyler A., Grand Staircase-Escalante National Monument, Kanab, UT, United States

The early history of Mosasauridae in North America is shrouded in obscurity. Specimens are extremely rare and diagnostic material has previously been found only in middle Turonian marine strata of Kansas and Texas, and in early Turonian strata of Mexico. In early 2012 a new basal mosasaurid specimen was found in the late Cenomanian-middle Turonian age Tropic Shale of southern Utah, in Glen Canyon National Recreation Area. The nature of its recovery suggests that the specimen was originally mostly articulated but broke up during Holocene weathering and transport. Fragments of the cranium and mandible were recovered, along with a significant portion of the cervical, dorsal, and caudal vertebral series. The neural arches are missing, suggesting that a juvenile is represented, and the individual appears to have measured between 2-2.5 meters in length. The specimen was found entirely ex situ, but can be readily aligned to have come from between the informal named “C” and “D” bentonite horizons, probably closer to the former. This places the specimen from within the lower portion of the *Mytiloceras kassmati* biozone, probably within the *Vascoceras birchbyi* Ammonoid Biozone, and it is therefore middle Turonian early in age. The preliminary assessment of the cranial material suggests that a new taxon is represented, with significant differences in premaxillary similarity, but having gross postcranial similarity to *Dallasaurus turneri* and *Bussellosaurus cohoni* from the middle Turonian of Texas.

**POSTER SESSION II (Thursday, October 18, 4:15 - 6:15 pm)**

**INVESTIGATION OF NORTH AMERICAN GONIOPHOLIDID CROCODYLIFORMS IN A PHYLOGENETIC CONTEXT**

ALLEN, Eric R., University of Iowa, Iowa City, IA, United States

Broad-scale phylogenetic analysis is predicated on a thorough understanding of constituent taxa. Phylogeny reconstruction in crocodyliforms is dependent on taxon sampling, though currently several crocodyliform clades are not well understood. The goniopholidids are a taxa. Phylogeny reconstruction in crocodyliforms is dependent on taxon sampling, though currently several crocodyliform clades are not well understood. The goniopholidids are a clade important to the study of crocodyliform evolution, but unfortunately their phylogenetic status is not fully known, as several taxa are not constituents of Goniopholididae, and instead are more closely related to pholidosaurs and thalattosuchians, with *Viticus* falling basal to the clade and *Denazinosuchus* either as sister to *Viticus* or nested within Pholidosauridae, depending on the inclusion of a new crocodyliform from the Early Cretaceous Woodbine Formation of Texas.

**POSTER SESSION II (Thursday, October 18, 4:15 - 6:15 pm)**

**ENDOCAST SHAPE AND BRAIN PROPORTIONS IN PRIMATES**

ALLEN, Kari L., Department of Evolutionary Anthropology, Duke University, Durham, NC, United States; RICHARDSON, H. S., Department of Evolutionary Anthropology, Duke University, Durham, NC, United States

Qualitative differences in endocast shape have been described between extant strepsirrhine and anthropoid (platyrhine and catarhine) primates. It has been assumed that these trends are related to differences in relative brain size and brain proportions between these clades. However, global endocast shape and its relationship to brain proportions has yet to be quantitatively explored across the order. This problem is addressed here using three-dimensional geometric morphometric (GM) techniques.

Endocast shape is quantified via GM analysis of fourteen landmark coordinates, taken on three-dimensional virtual endocasts. The analysis includes data from four extant strepsirrhine, twelve platyrhine, and four catarrhine species. Virtual endocasts were segmented and rendered from microCT scans of dry skulls. Overall, endocast shape was explored via a Principal Components Analysis of Procrustes-aligned landmark data. Principal Component (PC) scores were examined for correlations to species means for body mass and residual endocast volume, via phylogenetic regression techniques. PC1 accounts for 42% of the variance in the data. This axis separates anthropoids from strepsirrhine primates, with strepsirrhines demonstrating higher scores for PC1. Shape changes associated with higher PC1 scores include: decreased superior-inferior height of the brain, a decreased degree of brain base flexion, increase in the relative and rostral projection of the olfactory bulb, and a more caudal placement of the cerebellar poles relative to the cerebral poles. PC1 scores were found to have a high degree of phylogenetic signal (lambda=1.0). Scores on this axis are not significantly correlated with log centroid size (p=0.69), or species means for log endocast volume (p=0.19) and log body mass (p=0.99); however, PC1 scores are correlated with relative brain size, even when phylogenetic effects are controlled for (p<0.005). PC2 accounts for an additional 20% of the variance, and is primarily driven by the maximum breadth of the cerebrum and cerebellum. This axis fails to distinguish modern taxonomic groups. PC2 scores are not significantly correlated with residual endocast volume (p=0.83), and are marginally related to log body mass (p=0.057).

These data provide support for qualitative observations that differences in encephalization are associated with endocast shape differences between strepsirrhine and anthropoid primates. This analysis further suggests that geometric morphometric methods will be useful for quantifying the distribution of endocast shape across primate evolution, and inferring functionally and phylogenetically important shifts in brain proportions in the primate fossil record.

**TECHNICAL SESSION VII (Thursday, October 18, 2:45 - 5:45 pm)**

**SIMPLE EQUATIONS FOR ESTIMATING BODY MASS IN MAMMALS (AND DINOSAURS)**

ALROY, John, Macquarie University, Sydney, Australia

Body mass is a major topic of paleobiological research, but it is notoriously difficult to estimate. Methods that are relevant to dinosaurs tend to either focus on one limb element at a time or require reconstructions of entire skeletons. Most of the former methods extrapolate from scaling patterns in mammals, which is problematic because scaling relationships among elements are generally different in dinosaurs. Such methods are also unable to handle trochoidea in limb lengths across different locomotor categories, with equations for bipedal taxa being virtually free of data. All such methods ignore the scapula. However, a comprehensive new data set shows that scapula length is actually the best single predictor of body mass. Therefore, distal forelimb length is a mildly helpful inverse predictor of mass. Body masses are also consistent with published estimates based on one or require reconstructions of entire skeletons. Most of the former methods extrapolate from scaling patterns in mammals, which is problematic because scaling relationships among elements are generally different in dinosaurs. Such methods are also unable to handle trochoidea in limb lengths across different locomotor categories, with equations for bipedal taxa being virtually free of data. All such methods ignore the scapula. However, a comprehensive new data set shows that scapula length is actually the best single predictor of body mass. Therefore, distal forelimb length is a mildly helpful inverse predictor of mass. Body masses are also consistent with published estimates based on one or require reconstructions of entire skeletons. Most of the former methods extrapolate from scaling patterns in mammals, which is problematic because scaling relationships among elements are generally different in dinosaurs. Such methods are also unable to handle trochoidea in limb lengths across different locomotor categories, with equations for bipedal taxa being virtually free of data. All such methods ignore the scapula. However, a comprehensive new data set shows that scapula length is actually the best single predictor of body mass.
not exist, restoration is untenable because hind limbs are not preserved, crushing makes it impossible to measure circumporens, or standard published measurements are the only available information.

Technical Session XIV (Saturday, October 20, 8:45 am)

NEW INSIGHTS INTO THE ORIGIN OF EXTANT AMPHIBIANS FROM THE FOSSIL RECORD AND HIGH RESOLUTION COMPUTED TOMOGRAPHY

ANDERSON, Jason S., University of Calgary, Calgary, AB, Canada; MADDIN, Hillary C., Harvard University, Cambridge, MA, United States; WILSON, Sian C., University of Calgary, Calgary, AB, Canada; PARDO, Jason D., University of Calgary, Calgary, AB, Canada

The origin of frogs, salamanders, and caecilians (collectively Lissamphibia) has been contentious question for a number of years. This controversy stems from the fact that extant amphibians and various ancient and fossil groups are non-overlapping regions. The morphology of lissamphibians are highly derived with respect to characters found in archaic frogs, and the fossils are not available for molecular work. With the publication of the term barred Gastrobrachus, many of the morphological gaps were spanned at least between frogs and salamanders and one group of fossil amphibians, the amphibian temnospondyls. However, that study hypothesized that caecilians were sister group to another group, the brachystelechid lepospondyls. This topology, assuming the consensus placement of lepospondyls as sister group to anamniotes and their stem is correct, is at odds with all molecular studies, which find support for a monophyletic origin of lissamphibians. Subsequent to this study, work has continued to test this lepospondyl-caecilian relationship, primarily though the exploration of internal braincase anatomy in extant and fossil amphibians using micro-Computed Tomography (micro-CT). Our work has extensively documented the range of variation within the braincase of caecilians, and has found a number of morphological characters that are congruent with current molecular phylogenies of this group. Work on the morphology of caecilian inner ears has highlighted previous studies that suggest that there is a progressive regression, and ultimate loss, of sensory epithelia related to both high-frequency tympanic and low-frequency opercular bearing pathways, which would be inconsistent with a lepospondyl origin for caecilians. Detailed micro-CT studies of lepospondyls have demonstrated some new potential characters linking microsauras and caecilians, but the preponderance of characters linking these two groups is correlated with fosorial locomotion. Further research has documented tooth development and replacement patterns in a taxonomically comprehensive sample of fossil and extant amphibians, including additionally raised a staged series and using synchrotron-CT we have established the 3D morphometric change during ontogeny of the salamander cranium as a baseline for comparisons with other salamanders with different life history strategies.

Technical Session XVII (Saturday, October 20, 3:45 pm)

DO TETRAPOD HERBIVORES MATTER? ECOSYSTEM ROBUSTNESS, OLSON’S COMMUNITY TYPES AND THE PRIMACY OF INSECTS

ANGELCZYK, Kenneth D., Field Museum of Natural History, Chicago, IL, United States; ROOPNARINE, Peter D., California Academy of Sciences, San Francisco, CA, United States

A major transition in tetrapod communities occurred in the Permian, as high-fiber herbivores diversified and became abundant. Using data from the Karoo Basin, we have shown that communities with low tetrapod herbivore diversity can display low robustness in the face of disturbances, with even small perturbations often causing high levels of extinction. These observations raise the possibility that ecosystem robustness was an important factor in the replacement of communities with low tetrapod herbivore diversity by those with greater herbivore diversity. To test this hypothesis, we used the Cascading Extinctions on Graphs (CEG) model to investigate the robustness of two communities with low tetrapod herbivore diversity: the fauna of the Carboniferous Upper Freeport Coal and the fauna of the Permo-Wellington Formation. Despite both having few or no tetrapod herbivores, the two communities show divergent responses to perturbation: the Upper Freeport Coal fauna displays very low robustness, whereas the Wellington Fm. community is highly robust. Experimental manipulation of the communities shows that their levels of robustness do not stem directly from their tetrapod herbivore diversities. Instead, the Wellington Fm. community is stabilized largely by its diverse assemblage of insects, particularly herbivorous insects. The Upper Freeport Coal community also has a diverse insect assemblage, but the majority are detritivores or carnivores that appear not to have the same stabilizing effect. Taken together, these results suggest that the diversification of tetrapod herbivores may have had only limited effects on ecosystem robustness; instead the radiation of insect herbivores may have been much more important in this regard. In his seminal work on terrestrial community ecology, Eather et al. classified communities into three types based on the relative diversities of tetrapod herbivores and whether sources of primary productivity were dominantly terrestrial or aquatic. Based on its tetrapod fauna, the Wellington Fm. community should be a Type I community (characterized by low terrestrial herbivore diversity) in Olson’s classification, but functionally it appears much more like a Type III community (with insect herbivores forming a key link between terrestrial producers and consumers). This raises the possibility that all of the classic Lower Permian faunas upon which Olson based his concept of Type I communities may not represent this community type at all, and that true Type I communities will need to be sought earlier in the fossil record (the Upper Freeport Coal may be an example).
Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 9:15 am)

CENOZOIC MAMMALS FROM AMAZONIA: DIVERSITY, ENVIRONMENT, AND BIOGEOGRAPHY
ANTOINE, Pierre-Olivier, University Montpellier 2, Montpellier, France

The Amazon Basin constitutes more than one third of South America’s emerged areas. Essentially covered by tropical rainforests and a dense river network, this area is today a major biodiversity hotspot, notably for mammals. Yet, the mode and timing of the settlement of the corresponding mammalian guilds are far from being well known, due to the virtual lack of well-constrained data, notably for the Paleogene period. Although dramatically under-investigated, pre-Holocene Cenozoic deposits from Western Amazonia contain a wide array of fossil mammals, most of them being highly relevant to test major evolutionary and/or biogeographic hypotheses.

The earliest Cenozoic mammals from Amazonia are middle Eocene in age (~41 Ma). They were recently recovered nearby Contamana, eastern Peru, and consist of both endemic groups (gondwananatherians, marsupials, xenarthrans and native ungulates of high latitude affinities) and early immigrants from Africa (South America’s earliest rodents). Another locality of eastern Peru, Santa Rosa (late Eocene-early Oligocene), yielded a somewhat similar mammalian guild, as well as a ‘possible bat’. A new locality, nearby Contamana, documents the late Oligocene period, with affinities to both Santa Rosa and Salla, Bolivia.

In the Madre de Dios Basin, southern Peru, a new early Miocene locality provides the earliest low-latitude ptyhrynarch primate. By contrast, several middle and late Miocene faunas discovered in the last decades, from western Brazil (Acre and Jurua) and eastern/southern Peru (‘Fitzgerald Local Fauna’; Madre de Dios), yield much more diversified mammalian guilds, including marsupials, xenarthrans, native ungulates, caviomorph rodents, primates, bats, aquatic placental (river dolphins and trichechid sirenians), and perhaps an early proboscidean of North American origin. Younger faunas, late Pleistocene-Holocene in age, widely postdate the Great American Interchange (~3.5 Ma), and accordingly include Northern invaders, such as perissodactyls, artiodactyls, proboscids, carnivores, and murid rodents, together with xenarthrans and toxodontid ungulates.

Palaeontological data as a whole point to the presence of tropical rainforests in Amazonia throughout the Cenozoic period, at least during mammal-yielding intervals, with obligate arboreal marsupials, rodents, and primates co-occurring with terrestrial hoofed ungulates. However, Western Amazonia hosted peculiar environments in the late early-early late Miocene interval, with marine ingressions and the settlement of the long-lived marine-like Pebas megalak. This episode played a pivotal role in the biotic differentiation of southern/northern South American ecosystems and corresponding mammalian guilds, as earlier faunas show relatively low degrees of endemism.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

DIVERSITY OF THE HESPERORNITHIFORMES (AVES) FROM THE UPPER CRETACEOUS PIERRÉ SHEALE IN SOUTHERN MANITOBA, CANADA
AOTSUKA, Keiichi, The University of Tokyo, Tokyo, Japan; HATCHER, Joseph, Canadian Fossil Discovery Centre, Morden, MB, Canada; JANZIC, Anița-Maria, Canadian Fossil Discovery Centre, Morden, MB, Canada; SATO, Tamaki, Tokyo Gakugei University, Tokyo, Japan

Hesperornithiformes (Aves; Ornithurae) is a group of Cretaceous foot-propelled diving birds. Their remains are most commonly reported from Campanian deposits in North America where the Western Interior Seaway existed during the Cretaceous, and numerous birds. Their remains are most commonly reported from Campanian deposits in North America where the Western Interior Seaway existed during the Cretaceous, and numerous...
NEW ADDITIONS TO THE ELSAMOBRAV FAUNA FROM THE MIOCENE OF JABAL ZALTAN, LIBYA

ARGYRIOU, Thodoris, University of Alberta, Edmonton, AB, Canada; COOK, Todd D., University of Alberta, Edmonton, AB, Canada; MURRAY, Alison M., University of Alberta, Edmonton, AB, Canada

In 2010, excavations and prospecting in the early-middle Miocene deposits of Maradah Formation in Jabal Zaltan, Libya, yielded a sizable and diverse faunal sample. The collected material corresponds to a mixture of paleoenvironments of both terrestrial (e.g., proboscids, rhinocerotids, bovids etc.) and aquatic nature (marine and freshwater fish, aquatic mammals, turtles, crocodiles etc.). A small but informative surface collection of elasmobranch remains was also made. The presence of fossil sharks and rays had been first noted almost 40 years ago, with the recognition of Carcharias (Odontaspis) acutissima (Odontaspisidae), Carcarodon sp. (Lamnidae), Hemipristis serra (Hemipteridae), Pristis sp. (Pristidae) and Myliobatis (Myliobatidae). The presence of the latter allowed us to confirm the presence of seven genera, five of which were previously unreported from the site. Lamniforms appear to be scarce as only one slender crowned tooth, attributed herein to Carcharias sp. (Odontaspisidae), was found. Carcarphiniforms, on the other hand, appear to be better represented in our sample, as eleven teeth belonging to four genera were recovered. Three specimens are attributed to Galeocerdo sp. cf. G. mawymbenus (Carcharhinidae) on the basis of their similarity with specimens described from the lower Miocene of Cabinda and Bololo in Western Africa. Carcharhinus sp. (Carcharhinidae) is represented by one upper jaw and one lower jaw tooth. The upper jaw tooth bears a peculiar, strong serration pattern that is not seen in any Miocene representatives of the genus, but resembles C. halocenischis from the late Eocene of Pakistan. Three specimens identified herein as Negaprion sp. (Carcharhinidae) were also collected. Moreover, two teeth allow us to ascertain the presence of Hemipristis serra (Hemipteridae) in the site. The Jabal Zaltan batea fauna is also enriched by the identification of Aetobatus sp. and Rhinoptera sp. (both Myliobatidae) based on three and one dental elements respectively. Unfortunately, no Carcarodon, Pristis or Myliobatis remains were recognized, a fact that could be attributed to our small sample size and collection bias. The elasmobranch finds, and their field association with other marine and terrestrial vertebrate fossils, are in accordance with the presumed depositional environment that corresponds to shallow estuarine to deltaic conditions.

Technical Session VII (Thursday, October 18, 3:45 pm)

PATTERNS OF DENTAL ERUPTION AND VARIABILITY IN MAMMALS

ASHER, Robert J., University of Cambridge, Cambridge, Cambridge; PATTINSON, David, University of Cambridge, Cambridge, Cambridge, United Kingdom; TABUCE, Rodolphe, Universite Montpellier II, Montpellier, France; GHEERBRANT, Emmanuel, Museum National d’Histoire Naturelle, Paris, France; HAUTHER, Lionel, University of Cambridge, Cambridge, France

Mammals are very conserved in their patterns of dental eruption. Nearly all known living and fossil mammals have no more than two generations at any given tooth locus. In addition, mammals usually undergo most replacement of their deciduous teeth prior to or close to sexual maturity and the attainment of adult body size. Their eruption order is also conserved, with anterior molars erupting early. Major exceptions to these generalizations are found among afrotherians and aradomellos (the only living xenarthans that exhibit diphyodonty). Both groups tend to erupt fewer than half of their permanent cheek teeth by the time they reach adult body size; both show a relatively high level of variability in dental eruption order. In order to test the hypothesis that afrotherians and xenarthrans share late eruption of adult teeth as a synapomorphy, we present new data quantifying the relationship between skull size and proportion of fully erupted, permanent teeth in mammals. We also compare eruption sequences to test if dental eruption order is more variable in afrotherians and xenarthrans than in other groups. Our results show that in addition to afrotherians and diphyodont xenarthrans, late eruption of adult teeth is common among terrestrial artiodactyls and perissodactyls, and characterizes some feliforms and lemuriforms. In contrast, our sample of marsupials, eulaceceans, caniforms, basal feliforms, scandentians, and most primates show extensive overlap between their period of growth and the eruption of most permanent cheek teeth, suggesting that these taxa erupt their permanent dentitions earlier in ontogeny than afrotherians and xenarthrans. Furthermore, we discuss material of Eocene afrotherians, including proboscidea and aradomellos, as adult body size with few or no fully erupted, permanent cheek teeth. Mapped onto recent phylogenies of mammals, “late eruption” optimizes an afrotherian, possibly atlantogenatan, synapomorphy despite homoplasy elsewhere in the mammalian tree of life. Finally, our results indicate that chirocholdids (Afrotheria) are among the only mammals to deviate from early eruption at the first molar locus. Perhaps relatedly, afrotherians and xenarthrans show relatively high variation in eruption order across cheek tooth loci. We conclude that dental ontogeny is less constrained in both afrotherians and xenarthrans compared to other mammals, and may result from their shared ancestry.

Technical Session VIII (Friday, October 19, 2:45 pm)

EXTRINSIC AND INTRINSIC FACTORS IN THE EVOLUTION AND EXTINCTION OF NORTH AMERICAN FOSSIL PRIMATES

BENNETT, Amy L., University of Oregon, Eugene, OR, United States; HOLTROY, Patricia A., University of California Museum of Paleontology, Berkeley, CA, United States; DAVIS, Edward B., Department of Geological Sciences and Museum of Natural and Cultural History University of Oregon, Eugene, OR, United States

The North American Eocene fossil record has unequalled preservation of the diversification of early mammal groups as well as the extinction of many lineages through a period of climatic changes that include fluctuations in temperature and precipitation. Early primates are a particularly well-understood group, and we focused on onomymid primates, whose evolutionary history is well documented in the context of regional climate change and that have been characterized diurnally. Our study investigates possible drivers of onomymid evolution and extinction in North America, documenting the different evolutionary trajectories of different onomymid clades and the role of changing body mass in differential diversification rates. As a proxy for body mass, we gathered measurements of lower m1 area from more than 750 specimens representing 28 genera and 51 species that range from earliest Eocene to late Middle Eocene in age. We then analyzed these data in a phylogenetic framework to assess the relative importance of the different potential drivers of body mass change, and using differences in geologic age as an alternative to branch length in reconstructing ancestral body mass. Our results indicate that multiple factors, including intrachean competition, climate change, and ecosystem evolution, affected the diversification and extinction of these primates in the Paleogene. Our study highlights the importance of understanding and considering both intrinsic and extrinsic factors in developing models for diversification and extinction. The details of onomymid extinction can be used to inform a new understanding of primate extinction, which may help identify extinction efforts for extant organisms that share similar ecological niche spaces with Eocene primates.
other groups. This biogeographic pattern can be explained through either greater rates of diversification or greater species accommodation in topographically complex regions. We compared Neogene diversification of rodents for three regions in North America. The Columbia Basin of the Pacific Northwest and the northern Rocky Mountains were tectonically active over much of the Cenozoic and feature high topographic complexity today. The northern Great Plains have been tectonically quiescent with low relief over the Cenozoic. These three regions have distinctive geologic histories and substantial, well-documented fossil records. All three regions showed significant changes in diversity and faunal composition over the Neogene. Rodent faunas from the three regions differed in composition almost completely at the species level, although most families and many genera were shared among the regions, indicating greater provincialism than in modern faunas.

In the two montane regions, origins and extinctions peaked at the onset and close, respectively, of the Miocene Climatic Optimum (17–14 Ma), with significant changes in faunal composition accompanying these episodes of diversification. In the Great Plains, rodents showed considerable turnover, but infraordinal diversification (i.e., within a single major change in species diversity). The highest Neogene diversity occurred during the cooling that succeeded the Miocene Climatic Optimum. These histories suggest that climatic changes interacting with topographic complexity intensify macroevolutionary processes. Moreover, the middle Miocene and modern elevational diversity gradients appear to be unusual biogeographic configurations for the Neogene, suggesting caution in inferring past ecogeographic patterns from modern distributions.

Technical Session XVII (Saturday, October 20, 2:30 pm)
THE ORIGIN OF THE AVIAN BRAIN BASED ON A VOLUMETRIC ANALYSIS OF ENDOCRANIAL EVOLUTION WITHIN COELUROSAURIA
BALANOFF, Amy M., American Museum of Natural History, New York, NY, United States; BENGUELA, Gabriel S., New York College of Osteopathic Medicine, Old Westbury, NY, United States; ROWE, Timothy B., The Morphology of the University of Texas, Austin, TX, United States; NORELL, Mark A., American Museum of Natural History, New York, NY, United States
It has long been thought that, relative to other living reptiles, a distinct increase in endocranial volume diagnosates crown group birds. The common conclusion is that this volumetric jump is tied, at least in part, to the formidable cognitive requirements of avian powered flight. The intrinsics of what may be a dynamic and complex transformational pattern, however, are poorly understood and cannot be established without detailed and thorough sampling of the phylogenetically long avian stem. We undertook this task by concentrating on volumetric patterns of endocranial change within Coelurosauria, especially in the relatively narrow portion of the tree bracketing the origin of avian flight. Our novel approach uses high-resolution computed tomography to de-tide the endocranial cavity into homologous neuroanatomical partitions. These partitions correspond closely to the major regions of the brain, including the olfactory bulbs, cerebrum, optic lobes, cerebellum, and brain stem. Using a recent hypothesis of coelurosaurian relationships we inferred patterns of volumetric change, not only with regards to how these individual partitions are transforming relative to body size but relative to each other. This greatly expands on previous attempts whose scope was limited either to total endocranial volume or to most two regional partitions (cerebrum and non-cerebrum).

Our results confirm previous findings that total endocranial volume relative to body size does increase dramatically along the coelurosaurian backbone of the avian stem. We also found that this trend is driven primarily by at least three phases of cerebral volumetric expansion, none of which coincide with a phylogenetic position typically associated with the origin of avian flight. When the fossil record is considered, a volumetrically avian brain is not readily apparent before the archaeopterygian level endocranial volumes; endocranial volumes began to expand (at a much earlier phylogenetic position—a pattern congruent with a host of other character complexes historically identified with birds (e.g., feathers, furcula). The acquisition of a "flight-ready" brain at a more inclusive position on the tree is congruent with the possibility that other non-avian paravians may have been capable of some type of volant activity.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)
VARIATION WITHIN MODERN CHERNILLID POPULATIONS AND IMPLICATIONS FOR TAXONOMY OF FOSSIL POPULATIONS
BAMBA, Kanvaly, Case Western Reserve University, Cleveland, OH, United States; CROFT, Darin A., Case Western Reserve University, Cleveland, OH, United States
Chinchillids (Family Chinchillidae) were among the earliest cavimorph rodents to differentiate in South America, dating back to at least the early Oligocene. Their present distribution is across the Andean and sub-Andean areas of Argentina, Bolivia, Chile, Peru, Ecuador, and Paraguay. These generalized herbivores have a strong association with dry, high elevation environments. They appear in the Tinguirirican and Desadan South American Land Mammal Ages (Oligocene) but are a major constituent of most Miocene and younger localities in the southern two-thirds of the continent. These rodents can be recognized in the fossil record by their hypsodont cheek teeth organized into transverse laminae. Identifying genera and species has proven more difficult as it is unclear which criteria are most useful for distinguishing genera and species. Today, only three genera and six (possibly more) species remain. Assessment of morphological variation within species should provide a more robust way to distinguish extinct species. The goal of this study is to use variation in modern chinchillids to clarify the taxonomic identities of chinchillids at Quebrada Honda, Bolivia and other middle Miocene localities.

Seventy-nine modern chinchillid specimens from all three genera, five species and eight subspecies were examined. Several cranial characters were found to be useful in distinguishing genera: the size of the auditory bullae (enlarged in Chinchilla), shape of the external nares (consistently and strongly flared in Lagidium, occasionally and slightly flared in Lagostomus) and rostrum length (longer in Lagidium than Chinchilla). Useful dental characters were the number of laminae per cheek tooth (three for Chinchilla, two for Lagostomus save M3) and the morphology of the laminae. Lagostomus has rectangular-oval shaped laminae; the laminae of Lagidium are curved with especially large posterior laminae; laminae fusion is common in Chinchilla—the anterior two laminae of p4 express this consistently. Data suggest that the angle of the upper and lower tooth rows relative to the sagittal plane and relative tooth sizes may also be useful distinguishing characters. Among Lagidium species, variation was most evident in relative sizes of the posterior laminae (larger in L. peruanum than L. viscacia), morphology of the glabella (always flat in L. peruanum, often depressed in L. viscacia), and morphology of the supraorbital and nearby processes. Lagidium often has processes along the superior margin of the infraorbital foramen. Supraorbital processes are pronounced in L. viscacia caviieri and L. viscacia tucumanum but reduced in L. viscacia viscacia and L. viscacia fumatina.

Romer Prize Session (Thursday, October 18, 8:00 am)
LOCAL ENVIRONMENTAL CONDITIONS DRIVE VERTEBRATE DIVERSITY IMMEDIATELY PRIOR TO THE K/PG EXTINCTION: EVIDENCE FROM CENTRAL CANADA
BAMFORTH, Emily L., McGill University, Montreal, QB, Canada
The causes and timing of the Cretaceous mass extinction have been the subject of much debate for decades. Preservational, geographic and taphonomic biases render trends in biodiversity difficult to assess, and complicate the coupling of these trends with abiotic drivers. Here a multidisciplinary approach is used to elucidate spatial and temporal relationships between vertebrate diversity and paleoenvironment during the last 300,000 years of the Cretaceous period. Stratigraphic surveys of the latest Maastrichtian (65.5Ma) Frenchman Formation in Grasslands National Park, SK, Canada reveal three distinct, successive depositional cycles. Each cycle is considered a ‘time slice’ across which vertebrate diversity and paleoclimate signals can be assessed. From these time slices, some 8,000 fossils from twenty-eight vertebrate microsites were collected. A further 7,000 fossils were collected from nine microsites near Eastend, SK (ca. 200km west) for use in spatial diversity analysis. Fossils were identified and catalogued, and this data was used to calculate abundance-based diversity metrics. Paleotemperature fluctuations were determined using stable δ18O isotope data, while paleoclimate data was estimated from plant macrofossil assemblages. Vertebrate diversity was found to be highest in the oldest time slice. Diversity declined sharply in the middle time slice, then recovered to a second peak at the base of the youngest time slice. Following this peak, there was a marked decrease in diversity towards the boundary. Sites with the highest diversity were often found in mudstones, associated with paleoenvironmental indicators such as fossil leaf impressions, charcoal deposits and desiccation horizons. Analyses of isotope data linking temperature fluctuations to the peaks in diversity are as of yet inconclusive. Spatially, the Eastend sites had consistently higher diversity than contemporaneous Grasslands sites. These results demonstrate that biodiversity does not show a consistent decreasing trend towards the K-Pg
Boundary, but suggests spatial and temporal differences were driven primarily by local scale (=200km) environmental conditions.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 8:45 am)

TIME-SCALING TREES IN THE FOSSIL RECORD
BAPST, David W., University of Chicago, Chicago, IL, United States

As phylogenetic approaches to paleobiology become increasingly common, it is necessary that we consider the impact of our choice of methodologies on results. The temporal scaling of paleontological cladograms is a critical step in applying tree-based analyses of trait evolution and diversity. There are several routines that have been applied previously to time-scale phylogenetic branches but there has been no synthetic work comparing these methods. I present a new sampling rate conditioned method for time-scaling trees which uses an estimated sampling rate to create random samples of time-scaled trees, in order to bracket the uncertainty in branching times for a given set of taxa. This method can also consider possible ancestor-descendant relationships and resolve polytomies with better accuracy than random. This method is included in the software package 'paleotree' for the open - computing language R, along with an extensive toolbox for simulating diversification in the fossil record. Using these simulations to model realistic paleontological datasets, I tested how the choice of time-scaling methods affected the fidelity of various phylogeny-based analyses of macroevolution. To summarize, sampling-rate conditioned method performed best for estimating the rate of continuous trait evolution and had similar performance as other methods for fitting models of trait evolution. Estimates of phylogenetic signal had poor fidelity for all time-scaling methods. For estimating lineage richness, the time-scaling method with the most fidelity depended on the question being addressed.

Technical Session XIX (Saturday, October 20, 4:00 pm)

PRELUDE TO THE ANTHROPOCENE: TWO NEWLY-DEFINED NORTH AMERICAN LAND-MAMMAL AGES
BARNOSKY, Anthony D., University of California, Berkeley, CA, United States; IB286 WORKING GROUP; University of California, Berkeley, CA, United States

We propose criteria to recognize two new North American Land-Mammal Ages (NALMAs). Our goal is to clearly characterize (for North America) the progression of anthropogenically-driven biotic transitions that lead into the Anthropocene. By way of background, “Anthropocene” is an informal term now widely used to identify the period of Earth history that begins when Homo sapiens become a geological-scale force for planetary change. Discussions are underway about whether to formally recognize the Anthropocene as a new geological epoch, the beginning of which would be placed sometime between 1750 and 1950 A.D., depending on the particular criteria agreed upon. However, dramatic pre-18th century human influences on the global ecosystem also are clearly visible in the paleontological record as faunal changes associated with anthropogenically-driven dispersal events. On the global scale these are diachronous, spanning tens of thousands of years, and correspond with human influences on the global ecosystem also are clearly visible in the paleontological record of the Neotropics. This region, informally referred to as the “Santarosaean,” would be defined by the earliest appearance of new species. The older one, which would also define the beginning of the youngest NALMA, informally referred to as the “Saintaugustinean” and characterized by widespread occurrence of imported domestic species such as Sus scrofa, Bos taurus, Ovis aries, and Capra hircus. This paper suggests the LMA concept offers a viable way to distinguish and highlight the important, well-vascularised, parallel-fibred bone tissue in all samples. Based on the size ranges of the specimens and the presence of lines of arrested growth, one individual was determined to be a juvenile, another a skeletonally mature adult, and the remaining samples as belonging to still growing subadult animals. Through ontogeny the long bone samples showed that the overall longitudinal canal arrangement changes towards a reticulur pattern dominated by lamellar organization. True fibro lamellar bone was not present in any element.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

CHARACTERIZATION OF UNGULATE BULLCAU CUP SHAPE USING OUTLINE-BASED GEOMETRIC MORPHOMETRICS AND ITS IMPLICATION FOR MESOWEAR ANALYSIS
BARTON-ORTIZ, Christian R., University of Calgary, Calgary, AB, Canada; RANKIN, Brian D., University of Calgary, Calgary, AB, Canada; THEODOR, Jessica M., University of Calgary, Calgary, AB, Canada

The conventional mesowear method permits the reconstruction of ungulate diets based on the analysis of the buckcusp of the second upper molar. The variables considered in the original application of the method included the degree of relief of the cusps, high or low, and cusp shape which can be scored as sharp, round, or blunt. Despite the successful application of the mesowear method to different ungulate taxa, scoring of the mesowear variables can be subjective, and in many instances intra- and inter-observer error can be a concern. Moreover, cusp spines are assigned to categories along a continuum and, thus, important information regarding cusp shape can be lost (e.g., slightly rounded cusps are not distinguished from more rounded cusps). In this study, we investigated the application of outline-based geometric morphometric methods to better characterize ungulate buckcusp shape. A sample of 23 extant ungulate species (seven grazers, eight mixed-feeders, and eight browsers) was analyzed. This reference sample was then utilized to infer the diet of the latest Eocene (middle Chadronian) leptomerycid artiodactyl of the Gulf Creek local fauna, Cypress Hills Formation, Saskatchewan, Canada (Hendryomyx esulcatus, “Leptomeryx” speciosus, and “Leptomeryx” mammifer). For each specimen, two landmarks, defining the extremes of the cusp, and a series of sliding-semlandmarks along the cusp outline were digitized. Average cusp shape for every species was calculated and relative warped and discriminant function analyses conducted. The first relative warp explains over 80% of the variation and corresponds to change in cusp height, whereas the second relative warp describes change in cusp shape and accounts for over 10% of the variation. Discriminant function analysis using the relative warp scores showed an overall correct classification of 89% for the extant ungulates; in contrast, using the original mesowear variables, the overall correct classification of the same species was 79%. The three leptomerycids were classified as browsers and a multivariate analysis of variance identified significant differences between H. esulcatus and “L.” speciosus, with the former showing lower and rounder cusps. The refined mesowear analysis presented here documents a consistent, less subjective method to characterize cusp shape. Further expansion of the extant ungulate dataset will provide finer dietary classifications.

Technical Session IV (Wednesday, October 17, 3:45 pm)

A CLADISTIC APPROACH TO UNDERSTANDING DINOSAUR EGG DIVERSITY AND THE EVOLUTION OF REPRODUCTIVE TRAITS WITHIN DINOsaURs: PRELIMINARY RESULTS
BARTA, Daniel E., Montana State University, Bozeman, MT, United States; VARRICCHIO, David J., Montana State University, Bozeman, MT, United States; JACKSON, Frankie D., Montana State University, Bozeman, MT, United States

Although small a percentage of fossil eggs contain identifiable embryonic remains. Consequently, knowledge of eggshell structure and reproductive strategies remains incomplete for many dinosaur clades. Most previous cladistic analyses of dinosaur eggs and dietary studies (focus on dinosaur eggshells) with identified eggs with the goal of understanding the evolution of avian reproductive traits. In order to better assess the evolution of eggshells, and reproductive attributes across all dinosaurs and to assess the apparent temporal and phylogenetic bias in dinosaur eggshell preservation, we undertook a comprehensive cladistic analysis of representatives of each major dinosaur osteology. Using
two turtles as an outgroup, analysis produced a phylogeny with Megaloolithidae recovered as the basal-most dinosaur oofamily. Spheroolithidae and a polytomy of Dendroolithidae and Faveoolithidae (with or without Dictyoolithidae, depending on the level of consensus examined) are recovered more inclusively within the dinosaur clade. Strong support exists in consensus trees for a clade of derived maniraptorans, including modern avians, within the dinosaur clade.

In this study, as in past efforts, cladistic analysis of eggshell remains complicated by a limited number of characters and extensive homoplasy between some ootaxa. For example, the polytomy of Faveoolithidae through Dendroolithidae contains eggs variously assigned to sauroops (Faveoolithidae), therizinosauridae (Dendroolithidae), and theropods (Dicxyolithidae) by previous authors. Homoplasy or the expression of shared ancestral dinosaurian eggshell features may account for the consistent recovery of this clade in consensus trees in this study. The grouping of hadrosaur eggshell (Spherooolithidae) with that of saurichians also suggests homoplasy or the expression of dinosaurian synapomorphies. Independent evolution of hard-shelled eggs within hadrosaurs could potentially explain the long absence of identified ommatibiuch eggshell in the Mesozoic fossil record, though taphonomic bias should temper this interpretation. The topology of the derived maniraptorans and extant avian eggshell clade broadly concurs with existing phylogenies based on skeletal data.

This study highlights possible convergences in egg and eggshell microstructural characters that complicate taxonomic assignments of ootaxa that remain unidentified on the basis of embryonic remains. The phylogeny presented here provides additional support for the initial evolution of some avian reproductive traits within derived maniraptorans, but demonstrates that relationships among ootaxa outside this clade remain difficult to resolve as they conflict with established phylogenies based on skeletal characters.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

SCAPHOLUNATUM, OR SCAPHOID AND LUNATUM. THAT IS THE QUESTION.

THE CASE OF HYAENODON

BASTL, Katharina, Institut für Paläontologie, Vienna, Austria; NAGEL, Doris, Institut für Paläontologie, Vienna, Austria

The most obvious structural feature in the manus of Carnivora is the scapholunatum, which is not present in other Eocene/Oligocene predators (e.g. hyaenodontidae); in those forms the carpals stay separate as scaphoid and lunatum. This unused state is present in North American Hyaenodon. Interestingly, this observation was contradicted in the early literature with a description of a scapholunatum in European Hyaenodon. In order to address the question of whether this dramatic difference exists, the European skeletal material was reviewed. The study focused on a specimen from the late Eocene locality La Débruge (France) on which the statement was based. The morphology of the metapodials (broad, short and diverging), the terminal phalanx (not split) as well as the distal articulation facet of the scapholunatum (rsid-like) indicate that the specimen belongs to Carnivora and certainly not to Hyaenodon. Additionally, the carnivore Cynodontis is found in the same locality. Further material attributed to Hyaenodon and identified as scapholunatum could not be confirmed concerning their classification concerning the taxon and the element. Up to now, no corpus of a European Hyaenodon is known, but based on the distal radial facet, it should have articulated with a scaphoid and a lunatum as in North American taxa. Misidentifications lead to an enigmatic divergence that can now be refuted.

Technical Session XIII (Friday, October 19, 4:00 pm)

THE COLONIZATION OF AFRICA BY EARLY CENOZOIC ANTHROPOID PRIMATES: NEW DATA FROM THE EOCENE PONDUAU FORMATION OF MYANMAR

BEARD, K. C., Carnegie Museum of Natural History, Pittsburgh, PA, United States; CHAIMANEE, Yuawalak, Universite de Poitiers, Poitiers, France; CHAVASSEAU, Olivier, Universite de Poitiers, Poitiers, France; LAZZARI, Vincent, Universite de Poitiers, Poitiers, France; JAEGER, Jean-Jacques, Universite de Poitiers, Poitiers, France

Reconstructing the origin and early evolutionary history of Anthropoidea is a current focus of primate paleontology. Although classical hypotheses have typically supported an African origin for the anthropoid clade, the more recent discovery of basal members of the anthropoid clade in China and Myanmar suggests that the group originated in Asia. The latter result agrees with the recorded distribution of Tarsiiformes, the sister group of Anthropoidea. Given the Oligocene-Recent history of African anthropoids, the colonization of Africa by early anthropoids hailing from Asia to Africa sometime during the middle Eocene, shortly before Afrotheria first appears in the African fossil record, is a necessary result of their fossil record. Their vertebrate skeleton is divided into nine anatomical units, each scored for two variables (articulation and completeness). Patterns exhibited by the data, coupled with various statistical analyses, allow the extent of disarticulation and loss of completeness to be quantified; this in turn can be related to processes in the taphonomic pathway in the interval between death and final burial.

The method was used to compare preservation of Tanystropheus from the Middle Triassic Besano Formation, with two coeval taxa, the life habits of which are considered resolved: the pachypleurosaurs Serpianosaurus (aquatic) and the protorosaur Macrocnemus (terrestrial). Two null hypotheses are tested: that the taphonomy of Serpianosaurus and Macrocnemus is different; the taphonomy of Tanystropheus is more similar to either Serpianosaurus or Macrocnemus implying the most likely ecological niche for Tanystropheus.

Serpianosaurus exhibits high completeness and moderate articulation. In contrast, Macrocnemus and Tanystropheus are characterized by high completeness but low articulation. The main cause of this variation was the initial decay that occurred during the extended period of floating experienced by the Tanystropheus and Macrocnemus, relative to Serpianosaurus; this resulted in greater disarticulation on impact at the sediment surface and an enhanced rate of disarticulation subsequently. The patterns of articulation and completeness suggest that Serpianosaurus alone lived in an open marine setting.

Technical Session XVI (Saturday, October 20, 8:15 am)

COMPARISONS OF LIGHT MICROSCOPY-BASED DENTAL MICROWEAR AND DENTAL MICROWEAR TEXTURE ANALYSIS: IMPLICATIONS FOR TESTING HYPOTHESES OF FEEDING ECOLOGY IN EXTINCT VERTEBRATES

BEATTY, Brian L., New York College of Osteopathic Medicine, Old Westbury, NY, United States; MIHLBACHER, Matthew C., New York College of Osteopathic Medicine, Old Westbury, NY, United States

Dental microwear is increasingly used to test hypotheses about feeding ecology, yet too little is understood about the causative nature of observed dental wear features (e.g. pits and scratches). Tooth wear is an accumulation of many small contact events on a three dimensional surface in which size, shape, hardness and fracture toughness of dental materials and introduced abrasives are all important. Such damage is constantly being overprinted and is subject to chemical erosion and differences in enamel microstructure. Awareness of these variables is important in determining how one might best visualize discrete contact events and light microscopy dental microwear (LDM) and dental microwear texture analysis (DMTA) “see” these variables in non-analogous ways.

LDM records data on discrete contact events that result in the formation of microwear features. Such features can be easily distinguished from wear due to chemical erosion and other aspects of occlusal relief caused by enamel microstructure, such as vertical Hunter-Schreger bands. Although DMTA is less prone to observer error due to the inconsistencies of microwear feature identification during LDM, DMTA doesn’t recognize discrete microwear features and cannot yet distinguish microwear features from other effects, such as erosive wear and enamel microstructure effects. Although we anticipate these limitations may be surmountable in the future, care needs to be taken when employing DMTA to avoid these pitfalls.

To further compare the ability of LDM and DMTA in discriminating the feeding ecology of ungulates, we collected microwear data from the same tooth regions of the same specimen from four species with different feeding ecologies (Equus, Alces, Giraffa, and Dicerorhinus). DMTA analysis of the same teeth was done using a white light confocal microscope at the University of Arkansas, with variables of anisotropy, complexity, scale of maximum complexity, textural fill volume, and heterogeneity. When DMTA variables of anisotropy and complexity are compared to LDM variables pits and scratches, we find that LDM, although prone to higher rates of observer error, is more successful at discriminating animals of different feeding ecologies. More data are needed using both methods to better assess how useful they are in discriminating ungulate ecology and that of other vertebrate groups. Despite the data suggesting that LDM would more effectively discriminate ungulate diets, both methods measure the same surface in non-analogous ways, making a combination...
of both methods more likely leading to robust results and more insightful interpretations of feeding ecology.

Technical Session V (Wednesday, October 17, 3:00 pm)

FIRST EVIDENCE OF REMINGTONOCETIDAE (MAMMALIA, CETacea) OUTSIDE INDO-PAKISTAN: NEW GENUS FROM THE EARLY MIDDLE ECCENE OF EGYPT

BEBEI, Ryan M., Calvin College, Grand Rapids, MI, United States; ZALMOUT, Iyad S., University of Michigan, Ann Arbor, MI, United States; ABED EL-AZIZ, Ahmed A., Egyptian Environmental Affairs Agency, Wadi Al-Hitan World Heritage Site, Fayum, Egypt; ANTAR, Mohammed Sameh M., Egyptian Environmental Affairs Agency, Wadi Al-Hitan World Heritage Site, Fayum, Egypt; GINGERICH, Philip D., University of Michigan, Ann Arbor, MI, United States

Remingtonocetiids are semiaquatic archaeocete cetaceans known for their elongated narrow skulls, long necks, and robust pelves and hind limbs. The family currently includes five genera (Attocicetus, Remingtonocetus, Dalanistes, Andrewsiocetus, and Kutchicetus), which are known principally from the middle-to-late Lutetian Domanda Formation of Pakistan and the late Lutetian Harudi Formation of India. Some specimens have been recovered from other formations; however, all previous occurrences have been restricted to the Lutetian of Indo-Pakistan. A new genus of remingtonocetid cetacean has been recovered from the late Lutetian Midawara Formation of Egypt. The specimen includes a left in nominate with a complete ilium, ischium, and acetabulum; a nearly complete left femur; a four-vertebra sacrum; and partial lumbar and anterior caudal vertebral. The long, broad ilium and close of the acetabular notch compare closely with the inommates of other remingtonocetiids, though the ischium is much broader and flatter. The femur is generally similar in size and shape to known specimens of Remingtonocetus, but has a more vertically-oriented head with a wider neck and a shaft with more pronounced curvature in a posterior direction. The sacrum is composed of four vertebrae, three of which are at least partially fused together as in other remingtonocetiids, with very large dorsal sacral foramina. A well-preserved lumbar vertebra has curved zygapophyses, reniform epiphyses, and short transverse processes with only a modest degree of anterior or ventral inclination, comparing closely with lumbar vertebrae of Remingtonocetus. However, partial neural arches suggest that lumbar neural spines were inclined posteriorly rather than anteriorly. The new specimen increases the known taxonomic diversity of Remingtonocetiidae, illustrates additional variation in the morphology and locomotor repertoire of the group, and provides the first evidence of the family in Africa.

Technical Session X (Friday, October 19, 8:30 am)

MORPHOLOGIC INDICATORS OF FOSsORIALITY AND THE EVOLUTION OF BURROWING IN DICYNODontS (AMNIOtA: SYNAPSIDA)

BECK, Allison L., Augustana College, Rock Island, IL, United States; SCHHECKL, Jessica, Augustana College, Rock Island, IL, United States

Among the extinct ancestors of mammals, the Dicynodontia is a clade easily recognized by characteristic turtle-like beaks, toothless except for a pair of large tusks. Dicynodonts were the first evidence of the family in Africa. The additional variation in the morphology and locomotor repertoire of the group, and provides the first evidence of the family in Africa.

Technical Session X (Friday, October 19, 12:00 pm)

A COMPREHENSIVE GENUS-LEVEL PHYLOGENY OF LIVING AND EXTINCT MARSUPIALS BASED ON CRANIODENTAL AND MOLECULAR DATA

BECK, Robin M., University of New South Wales, Sydney, Australia; VOSS, Robert S., Department of Mammalogy, American Museum of Natural History, New York, NY, United States; JANSA, Sharon A., Department of Ecology, Evolution, and Behavior, J.F. Bell Museum of Natural History, University of Minnesota, Saint Paul, MN, United States

Comprising approximately 6% of extant mammalian species, and with a rich fossil record, Marsupialia represents a diverse and successful clade of mammals, such as the, macroevolutionary studies of Marsupialia have been hampered by the absence of a well-resolved higher-level phylogeny that incorporates a wide sampling of living and fossil taxa. Here we present results of a comprehensive phylogenetic study of Marsupialia, based on a novel dataset comprising 180 craniodental characters (many of which are entirely new) and ~2kb of sequence data from two nuclear genes (IRBP and GHR). Our study includes representatives of every currently recognised Recent marsupial genus and also a broad sampling of fossil taxa, focusing on well-preserved plesiomorphic forms that are likely to be useful in resolving interordinal and deep intraordinal relationships by breaking up long branches, and using the stem-metatherians Herpetotherium, Pucadelphys and Mayulesus as outgroups. Collectively, this represents a ~300% increase in taxon sampling over previous total evidence analyses of marsupial phylogeny. This project has led us to propose novel or revised interpretations of many aspects of marsupial craniodental morphology. For example, we conclude that the enlarged ‘gliriform’ lower incisor is plausibly homologous between paucituberculatans and dipoatodontans, and that the labial cusps of the upper molars of most dipoatodontans are stylar in origin. Maximum parsimony analysis of the morphological partition alone recovers monophyly of the currently recognised marsupial orders, but suprasubordinal relationships are weakly supported and some accepted clades (e.g. Australidelphia) are not recovered. However, analysis of the total evidence matrix results in a phylogeny that is highly congruent with recent molecular phylogenies at both the suprasubordinal and intraordinal levels, supporting monophyly of (inter alia) Australidelphia, Phalangerida, Australoplagiaulacoidea and Petauroidea. Novel results include placement of the fossil didelephiformian Sparassomys as a crown-group didedphal, placement of the fossil dasyuropharmonf Barinya as a stem-thylacid rather than stem-dasyurid, non-monophyly of Wynnardidae, and support for Eukalaedea as the ‘basal’ branch of Macropodidea. However, the relationships of some marsupial taxa, such as the marsupial mole Notoryctes and the enigmatic fossil Yalkaparidon, remain uncertain. The position of microbiotherians within Australidelphia, which is crucial for understanding the biogeographical relationship between South American and Australian marsupials, and the location of the root were also not clearly resolved. Nevertheless, our study should provide a solid phylogenetic foundation for future macroevolutionary analyses of Marsupialia.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

TWO NEONATE MOSASAURS (SQUALMATa) FROM THE NIobRARA FORMATION

BEHLKE, Adam D., Department of Geology and Geophysics, Yale University, New Haven, CT, United States; FIELD, Daniel J., Department of Geology and Geophysics, Yale University, New Haven, CT, United States

The Niobrara Formation of western Kansas represents one of the most famous mosasaur-bearing localities in the world. The relative abundance of mature mosasaurs compared to juveniles has led to the hypothesis that mosasaur birthing areas were located elsewhere, although the discovery of numerous juvenile mosasaurs in the Niobrara Formation in the last several decades led to a revision of this hypothesis, neonate mosasaur remains are still quite rare. Here, we report the fragmentary cranial remains of two neonate mosasaurs from the Niobrara Formation, heretofore erroneously cataloged as avian fossils in the collections of the Yale Peabody Museum. One specimen is represented by an isolated partial left dentary, while the other consists of a partial left dentary, partial right palatine, and other cranial elements. Comparison with other neonate mosasaurs reveals that these specimens are amongst the smallest individuals ever found, and shed new light on western Kansas as a possible mosasaur birthing area.

Technical Session XIX (Saturday, October 20, 3:30 pm)

THE IMPACT OF MASS MORTALITY ON THE LAND SURFACE BONE ASSEMBLAGE OF AMBOSELI PARK, KENYA

BEHRENISMEYER, Anna K., Smithsonian Institution, Washington, DC, United States; WESTERN, David, African Conservation Center, Nairobi, Kenya; BADGLEY, Catherine, Museum of Paleontology, Ann Arbor, MI, United States; MILLER, Joshua H., Florida Museum of Natural History, Gainesville, FL, United States; ODOCK, Fredrick L., Kenya Wildlife Service, Kitale, Kenya

The partial collapse of the mammalian herbivore community in Amboseli National Park, Kenya, in 2009 provided an opportunity to compare catastrophic mortality with the atritional skeletal record previously documented in this ecosystem. Mass mortality occurred during the early drought, when over 11,000 individuals (primarily grazers) died in a period of 8 months. Amboseli has large permanent springs and swamps, and herbivores died from starvation rather than thirst. Taphonomic surveys documented skeletal remains on 20 established transects. The number of drought deaths far exceeded the initial recyling capacity of local scavengers, mainly spotted hyena. In 2010, skeletons were relatively complete and scavenger impact was low, with characteristic patterns of damage to particular
skeletal parts. Drought-death carcasses occurred in all habitats and were concentrated near the swamps, but there were no piles of skeletons representing boneyed accumulations. Relative few juveniles and many prime adults were recorded in the drought death bone sample, thus demographic profiles of affected species did not match the standard model for a standing cattle herd. DeHority et al. (2008) also found that: 1) Pliophoca sp. was common in the mid-Cretaceous of eastern North America; 2) Pliophoca was not rare at Ayrton's Site (1988); and 3) purported fossil monachines "Pericola" and "Pliophoca" from the Lee Creek mine likely provide evidence of sexual dimorphism in the same taxon that is distantly related to Pliophoca. Based on our phylogenetic framework we confirm that the origin and dispersal of Pliophoca monachines was centered in the Mediterranean and with subsequent dispersal to the Caribbean and central North Pacific prior to mid-Pliocene closure of the Central American Seaway.

Technical Session IX (Friday, October 19, 8:00 am) THE QUADRATOMAIRY LIGAMENT AND ITS IMPLICATIONS FOR THE EVOLUTION OF CRANIAL FENESTRATION IN REPTILES BEVER, Gabriel S., New York College of Osteopathic Medicine, Old Westbury, NY, United States; LYSON, Tyler R., Yale University, New Haven, CT, United States; BHULLAR, Bhat-Anjan S., Harvard University, Cambridge, MA, United States

The characteristic absence of temporal fenestration in turtles has long influenced the hypothesis that the group originated outside the diapsid radiation that includes crown Lepidosauria and Archosauria. Recent phylogenetic analyses almost invariably reject this hypothesis, with the implication that the anapsid skull of turtles reflects a derived loss of fenestration rather than the conservation of the ancestral reptilian condition. Through a closing of the temporal region at some point along the turtle stem is a requirement of the current molecule-dominated matrices, the only direct anatomical evidence proffered to support such a transformation is an observation made in the 1920s that extant turtles express a quadratojugal (QML) ligament (QML) which is present in crown representatives of osteichthyans as a unique feature of reptiles; however, narrowing its origin to Diapsida remains accepted as the unossified homolog of the diapsid lower temporal bar. Considering the historical importance placed on patterning of the amniote temporal region and the possibility of strengthening the consensus between paleontology, soft-tissue anatomy, and molecular-based phylogenetics, we investigated the implications of the QML by addressing two basic questions. 1) Is a homolog of the squamate QML present in turtles and if so, what is its distribution within the turtle crown? 2) Is it justified inferring that the presence of the QML reflects the structural ground plan of a diapsid skull?

Based on our dissection of a series of crown turtles, mammals, squamates, and archosaurs, we conclude that: 1) the ancestral crown turtle did contain a QML, 2) the turtle QML is homologous to that of squamates and delineates the ventral margin of the cheek as a distinct thickening of the temporal fascia, and 3) a homologous QML is also present in crown archosaurs but apparently not in crown mammals. This distribution supports the QML as a unique feature of reptiles; however, narrowing its origin to Diapsida depends on its absence in extinct parareptiles, which may be unknowable. It is becoming increasingly probable that the ancestral parareptile had some form of temporal opening, which means that regardless of whether turtles originated within Diapsida or Parareptilia, their completed anapsid morphology likely derived. We also critically reevaluated osteological characters of the temporal region with the goal of restricting assumptions of process. Preliminary results, not surprisingly, indicate high homoplasy. The most elevated levels were recovered when the origin of turtles was confined to the lepidosaur stem as opposed to within Parareptilia or to the stem of Archosauria.

Technical Session XVI (Saturday, October 20, 10:45 am) COMPLEX SOCIAL STRUCTURE IN PROBOSCIDEA FROM A REMARKABLE LATE MIOCENE TRACkWAY SITE IN THE UNITED ARAB EMIRATES BIBI, Faysal, Museum für Naturkunde, Berlin, Germany; KRAATZ, Brian, Western University of Health Sciences, Pomona, CA, United States; CRAIG, Nathan, Independent Scholar, Balboa Island, CA, United States; BEECH, Mark, Historic Environment Department, Abu Dhabi Tourism & Culture Authority, Abu Dhabi, United Arab Emirates; HILL, Andrew, Yale University, New Haven, CT, United States

Evidence for social behavior, group size and structure in the fossil record is generally limited to rare and exceptional fossil finds. Living elephants are an example of a group that exhibits complex and well-studied social behavior. Despite a rich proboscidean fossil record going back to the early Eocene, evidence on the antiquity of characteristic elephant behavior has remained virtually unknown. We here present on the exceptional fossil trackway site of Mlesea 1, from the late Miocene Baynunah Formation (8–6 Ma) of the United Arab Emirates. Mlesea 1 preserves long trackways of a herd of proboscideans transected by that of a solitary individual. We used kite aerial photography to image the site and produce an orthographically-corrected photosafo from which the trackways were mapped and measured.

Living elephant societies are sex-segregated and multi-tiered, centered around matriarchal family units and solitary or loosely associated adult males. The trackways at Mlesea 1 provide direct evidence that herds of closely related proboscideans were probably sex-segregation were also present in late Miocene proboscideans. The tight grouping, sub-parallel alignment, and low incidence of intersection or overlap in the main group of trackways indicates these were made by a herd of individuals walking together. Site mapping indicates there were no less than 13
individuals in the herd, and stride length profiles and resulting body mass estimates reveal a diversity of sizes including at least one small juvenile individual. This is commensurate with the size of modern elephant family units, and represents a rare example of social group size determination in the fossil record. In comparison, stride lengths for the solitary trackway are the largest recorded at the site, indicating that they were most likely made by a solitary elephant bull.

Though phylogenetic inference already indicated that elephant-like behavior should exist in the late Miocene, Mleisa 1 preserves some of the longest continuous trackways known for fossil vertebrates anywhere, with that of the solitary individual traceable over a distance of 260m. The study of Mleisa 1 also demonstrates the efficacy of kite aerial photography for the scientific study of sites of large magnitude.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

LATE CRETACEOUS MARINE FISHES FROM THE UPPER GREENHORN LIMESTONE IN SOUTHEASTERN NEBRASKA, U.S.A.

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The Greenhorn Limestone is a Cretaceous rock formation deposited in the middle of an epicontinental sea in North America, the Western Interior Seaway. The half of the formation is represented by the Jettmore Chalk and Pfeifer Shale members, and they are together characterized by chalky shale beds interbedded by limestone layers rich in inarticulate brachiopods. These shale beds mark the maximum transgressive phase of the Greenhorn Cyclothem during the early Turonian. Vertebrate remains are known to occur sporadically in these beds, but there is limited information about their taxonomic diversity.

The University of Nebraska State Museum, Lincoln, houses an assemblage of fossil marine fishes from the upper half of the Greenhorn Limestone in southern Jefferson County, Nebraska, USA. These fossils are the results of surface collecting from the Jettmore-Pfeifer interval. The ichthyofauna consists of at least ten taxa, including six chondrichthyans (Psychodus anonymus, P. occidentalis, P. cf. P. whipplei, Cardiabodon venator, Cretoxyrhina mantelli, and Squilicorax cf. S. falcatus) and four osteichthyans (Xiphactinus audax, Plotosus indet., Enchodus gladiolus, and E. shamardi). The fish assemblage is small with a likely collecting bias towards larger taxa, but the fauna is important because it provides a glimpse into the paleoecology of the Western Interior Seaway during its peak transgression. In particular, it is noteworthy that the taxa are remarkably diverse ecologically, comprising durophagous (Psychodus), large predaceous (Cardiabodon and Cretoxyrhina), and medium-sized opportunistic (Squalicorax) sharks as well as small (Enchodus), medium-sized (plotosid), and large (Xiphactinus) bony fishes.

The deposition of the upper Greenhorn Limestone represents an important time frame in the history of the Western Interior Seaway, notably marking the rise and radiation of the geologically earliest mosasaurs in North America. The present study of the type Greenhorn fish fauna suggests that the evolution of mosasaurs appears to have taken place in a stable fish community in the seaway. This is because practically all the fish taxa recognized also occur stratigraphically below (e.g., basal Lincoln Limestone) and above (e.g., Fairport Chalk). The geologic horizon.

Technical Session X (Friday, October 19, 9:00 am)

LOCOMOTOR LOADING OF THE FEMUR IN OPOSSUMS PROVIDES INSIGHT INTO THE EVOLUTION OF FEMORAL SHAPE IN SYNAPSIDS

BLOB, Richard W., Clemson University, Clemson, SC, United States; BUTCHER, Michael T., Youngstown State University, Youngstown, OH, United States; GOSSELL, W. C., Clemson University, Clemson, SC, United States; MAIE, Takashi, Clemson University, Clemson, SC, United States

The cross-sectional shape of the femur shows a distinctive pattern of change through the evolution of the synapsid lineage. Among basal mammals (e.g., the horse), limb bones show a highly adapted and somewhat specialized morphology. In contrast, among gorgonopsian and therocephalian taxa in which the limbs are flattened anteroposteriorly (i.e., in the plane of knee flexion and extension). For taxa using scansorial habits, and crouched limb posture, the opossum provides a more appropriate functional model than large cursorial taxa for the likely locomotor behavior of synapsids during the evolutionary transition away from sprawling locomotion. Our results from opossums contrast with previous data from large cursorial taxa. Both strain gauge and force platform recordings show considerable mediolateral femoral bending in opossums, despite the forward direction of travel. Force platform data also indicate that these patterns result from substantial contraction of hindlimb adductor muscles on the medial aspect of the femur, opposing a lateral torque induced by the ground reaction force. In the context of these loading data, the pattern of femoral shape change in therapsid taxa is no longer functionally surprising. If their hindlimb orientation was similar to that of opossums, then the greatest femoral bending in basal therapsids was also likely mediolateral. Thus, anteroposterior flattening would have distributed bone material to reinforce the mediolateral axis, improving resistance to bending in the primary direction of loading.

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geologic Time (Wednesday, October 17, 8:45 am)

EARLY EOCENE MAMMALS FROM THE HOT TROPICS OF NORTHERN SOUTH AMERICA

BLOCH, Jonathan I., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; RINCON, Aido F., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; HEAD, Jason J., Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE, United States; HERRERA, Fabiany, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; JARAMILLO, Carlos A., Smithsonian Tropical Research Institute, Albrook Panama

Recent estimates of mean-annual temperature (MAT) in the early Eocene tropics based on the TEX86 temperature proxy indicate temperatures of 31.5 ± 2.3 °C, approaching the MAT maxima of modern tropical forests and mammalian communities (about 35°C). Tropical temperatures during early Eocene hyperthermal events were likely much higher, suggesting the possibility of coincident widespread equatorial heat-death. Terrestrial Paleogene mammals from the northern tropics of South America have been largely unknown, limiting our ability to directly test this hypothesis. A notable exception is the primitive xenungulate *Enchodus bacatanensis* from the Bogotá Formation, Colombia. While previous studies of preserved pollen had indicated a middle-late Eocene age, possibly contemporary (or slightly older) than a pre-Itaboraian aged “Caradóvia Zone,” recently published U/Pb detrital zircon dates indicate an early Eocene (53.6 ± 1.1 Ma) age for the mammal-bearing level of the Bogotá Formation. Ongoing fieldwork in the type locality of *E. bacatanensis* has already resulted in recovery of many additional vertebrate fossils including fish, amphibians, reptiles, and mammals. New mammal finds include an enigmatic small-bodied ungulate and multiple metatherians including several bunodont taxa referable to the Protodidelphidae. Although best known from late Paleocene-earl Eocene of Brasil (Itaboraí), protodidelphids have also been recovered from the late early Eocene of central and western Patagonia, Argentina, and it has been suggested that their widespread occurrence corresponds to the presence of extensive tropical environments throughout South America. Presence of medium-sized herbivore ungulates, a diversity of frugivorous omnivorous marsupials, arboreal taxa, bovids and iguanian lizards, and fossil leaves just before the Early Eocene Climatic Optimum and close to the Eocene Thermal Maximum 2 (about 53.7 Ma) in tropical South America indicates that diverse tropical ecosystems survived at temperatures approaching their MAT maxima in the past.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

A MULTI-PHASE REAPPRAISAL OF DIET AND MICROHABITAT IN CHADRIANON AND ORELLAN UNGULATES FROM NEBRASKA BASED ON STABLE ISOTOPES, MESOWEAR AND HYPSODONTY INDEX

BOARDMAN, Grant S., University of Nebraska, Lincoln, NE, United States; SECORD, Ross, University of Nebraska, Lincoln, NE, United States

We infer diet and microhabitat for 12 ungulate taxa from Chadrian (latest Eocene) and Orellan (earliest Oligocene) age deposits of the White River Group in Nebraska. This period of time is especially interesting because it samples an interval of climate change associated with the onset of Arctic glacial conditions. We use carbon and oxygen isotopes in tooth enamel (δ13C and δ18O) to infer ancient habitats based on δ13C values in modern vegetation, corrected for changes in atmospheric composition and physiological enrichment from diet to enamel. Oxygen isotopes in enamel (δ18O) can be used to recognize semi-aquatic species. Mesowear data and hypsodonty index (HI) are used to interpret diet. Mesowear measures total dietary abrasion in ungulate dentition by assessing cusp shape and relief. We categorize “lifetime” diet by comparing the mesowear of fossil taxa to those of modern taxa of known diet via principle component and cluster analyses. Lastly we compare HI, which is strongly correlated with diet, with mesowear results to test consistency between proxies.

We studied 11 ungulate taxa from the Chadrian, and 7 from the Orellan, with a total of 6 range-through taxa: *Subhyracodon (rinochoerid)*, *Hyracodon (hyracodontid)*, *Mesohippus (equid)*, *Archaeotherium (entelodont)*, *Agriotherium (agriotheriid)*, and *Merycoidodon (merycoidodontid)*. Hypsodonty index values apply only to domesticated taxa and indicate that taxa were brachydont, and thus probably browsers, but mesowear suggests that *Subhyracodon*, *Trigonias* (also a rhinocerotid), *Eotylopus* (an orycedontid), *Aepitotherium* (an arctocyonid), and *Orellana* were probably mixed-feeders. High mean carbon values (−9‰ to −8‰) and mesowear suggest that *Mesohippus* and *Agriotherium* were browsers in open microhabitats.
Fossils, Genes and the Evolution of the Vertebral Column in Archosaurs

BOEHMER, Christine, Ludwig-Maximilians-Universität, Munich, Germany

The integration of fossils, morphology and genes in order to understand the evolution of life has gained in importance over the past two decades. In the majority of cases, this approach only allows the use of processes of individual development to indirectly interpret phenotypic change during evolution. Here, the direct correlation between genetic expression and morphological variation is analyzed for the first time. In vertebrates, the functions of Hox genes include the specification of vertebral shape. It has been proposed that a unique or highly distinct axial Hox code (a combination of Hox genes) expressed in each somite specifies differing vertebral morphologies. This idea was tested here, and results applied to fossil taxa. First, the Hox code for the formation of the presacral vertebral column in recent archosaurs was established. The available genetic information was expanded via whole-mount in situ hybridization experiments on embryos of nile crocodile. Next, the direct linkage between changes in Hox gene expression and the morphology of presacral vertebrate was tested in chickens, alligator and crocodile. Correlation was identified between the degree of shape change between successive vertebrae (assessed qualitatively and also quantitatively via landmark analysis) and the number of active Hox genes in the corresponding axial region, and was supported by statistical tests based on the morphometric results. Because morphological similarity is therefore directly caused related to Hox gene expression, it was possible to use axial shape variation in recent archosaurs with varying vertebral count as a proxy for Hox gene expression. Finally, these results were applied to fossil species. Hox gene patterns in extinct archosaurs, including sauropodomorphs, were established on the basis of quantifiable changes in morphology. Analysis of the shape of the cervical vertebrae in extinct and extant archosaurs revealed a pattern of 3 subunits within the neck in crocodilians. This pattern changed to one of 4 subunits in basal sauropods, and 5 morphological subgroups are recognized in groups with longer necks such as sauropod dinosaurs and birds. The observed variation in morphological subregions of the neck in dinosaurs and birds results from specific expansions of Hox gene activity. These results show that morphological disparity within the vertebral column can be used to reconstruct underlying genetic information. The analyses thus not only provide new insights into the evolution of axial patterning in archosaurs, but represent an important case study of the direct application of principles of evolutionary developmental biology in paleontology.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

THE YUKAGIR BISON: A COMPLETE FROZEN MUMMY OF THE EXTINCT BISON PRISCUS FROM YAKUTIA, RUSSIA

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The Yukagir bison is the most complete frozen and partially mummified carcass of extinct BISON PRISCUS. The discovery was made by Yukagir community members in August 2011. Quick burial of the Yukagir bison, and permafrost conditions facilitated preservation of all body parts, from internal organs to the head with intact fleshy snout, ears, horns, and tail, containing vivianite. Preliminary microbiological studies confirmed that the exterior mummy tissues did not contain any traces of dangerous infectious viruses and bacteria, such as anthrax (Bacillus anthracis) and foot-and-mouth disease virus (Bovine viral diarrheaea). The samples for microflora taken from interior parts of the body are being analyzed for pathogens. The ongoing studies of the Yukagir bison are AMS dating; carbon and oxygen isotope analyses, X-ray computed tomography (CT scan), and DNA analysis, designed to inflict minimal body damage to the unique specimen.
many more growth lines (>20 lines). These markers likely represent the expansion of the osteoderm and the development of the ridges along the dorsal surface. Annulli and lines of arrested growth (LAGs) are deposited annually in some extant animals allowing for an estimation of minimum ontogenetic age. Between 10-13 LAGs are preserved in the femur that can be traced around the entire cross-section, indicating a minimum age of 10 years. Some modern crocodilians (e.g. *Alligator mississippiensis* and *Crocodylus niloticus*) reach sexual maturity between the ages of 10-20 years while adult size is not reached until later. Thus, this specimen was likely at or near sexual maturity but far from fully-grown.

**Technical Session VI (Thursday, October 18, 2:15 pm)**

**WHAT LIES BENEATH: SUB-ARTICULAR LONG BONE SHAPE SCALING IN EUGERUDEAN MAMMALS AND SAURISCHIAN DINOSAURS SUGGESTS DIFFERENT LOCOMOTOR ADAPTATIONS**

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Both eugeredian mammals and saurischian dinosaurs (*Aves* inclusive) evolved lineages of giant terrestrial herbivores. However, previous morphometric analyses have not revealed significant differences in long bone dimensions and shape between giant mammals and saurischian dinosaurs, suggesting that both lineages had dynamically similar gait and postures. However, the shape of the sub-articular bone and calcified cartilage deep to the articular cartilage is seldom considered. The humeri and femora of all mammals have a well-formed, bony epiphysis capped by a thin layer of articular cartilage loaded a distance away from the metaphysis. In contrast, archosaurs, including sauropods, have thick, cartilaginous epiphyses loaded over a broad region near the metaphysis. With increasing size, different patterns of shape change in the sub-articular surface are predicted if epiphyseal loading regimes between eugeredian mammals and saurischian dinosaurs were not dynamically similar. Therefore, we tested the hypothesis that the sub-articular shape of eugeredian mammal and saurischian dinosaur humeri and femora scale differently with increasing size using geometric morphometrics. Our sample included taxa from sprawling outgroups (*Sphenodon, Chlamydosaurus, Daphoenotherium, Sebecosaurus*, and *Patagosaurus*). Outgroup comparison is made with non-avian theropod dinosaurs and non-neornithine birds such as *Archaeopteryx* and *Enallolius*. Anatomical characters used for phylogenetic analysis include: (1) position/orientation of the sub-articular bone; (2) form/path of cranial nerves, blood vessels and sinuses; (3) size of various brain regions relative to overall brain size. We aim to (1) provide a clearer picture of the evolution of various brain regions from the origin of birds to the present, and (2) shed new light on the early diversification of modern birds. This will enable testing of the hypothesis that telecerebral expansion conferred modern birds with an advantage over more basal avian clades at the end of the Cretaceous.

**Poster Session III (Monday, October 17, 4:15 - 6:15 pm)**

**VORTEX BRAIN ENDOCAUSIS: SKEW RESULTS**


Recent studies of the brain anatomy of Palaeogene birds using high resolution X-ray computed tomography (CT) have provided an important source of phylogenetic information for avian systematics. Although the basalmost diversifications of modern birds (Neornithes) are well supported by both molecular and morphological studies, the phylogenetic placement of many Cenozoic avian groups remains controversial. We used CT slice data to obtain virtual brain endocasts for a broad selection of extinct and extant avian species. The sample consists of 50 living species encompassing all major neornithine clades, plus several key Cenozoic taxa including *Lithornis* (*Lithornithidae*), *Daeornis* (*Pelagornithidae*), *Pterygotus* (*Phaethontidae*), *Halyornis* (*Halconeornithidae*), *Sepharomacronyx* (*Sepharomacronyidae*), and *Patagosaurus* (*Patagosauridae*). Outgroup comparison is made with non-avian theropod dinosaurs and non-neornithine birds such as *Archaeopteryx* and *Enallolius*. Anatomical characters used for phylogenetic analysis include: (1) position/orientation of the brain; (2) form/path of cranial nerves, blood vessels and sinuses; (3) size of various brain regions relative to overall brain size. We aim to (1) provide a clearer picture of the evolution of various brain regions from the origin of birds to the present, and (2) shed new light on the early diversification of modern birds. This will enable testing of the hypothesis that telencerebral expansion conferred modern birds with an advantage over more basal avian clades at the end of the Cretaceous.

**Poster Session III (Friday, October 19, 1:45 - 3:45 pm)**

**DORSAL OR ROSTRAL NOSTRILS? TESTING FLESHY NOSTRIL POSITION AND AIRFLOW IN SAIROPODS USING COMPUTATIONAL FLUID DYNAMICS**

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The enlarged and caudally retracted bony nasal opening in sauropods has led to conflicting ideas regarding nostril placement. As a soft-tissue structure with few direct bony associations, the fleshy nostril has proven problematic for sauropod life restorations and, more importantly, for understanding sauropod nasal physiology. Early work based on presumed aquatic lifestyles placed the nostrils high on the head. More recent interpretations—based on the anatomy of sauropods and extant outgroups—have argued for a nostril position farther down the snout. We test these varying nostril positions using computer simulations of fluid dynamics. Conservative hypotheses of nasal capsule morphology in the macronarian *Camarasaurus* and the diplodocid *Diplodocus* were generated based on osteological correlates for soft-tissue boundaries using the software *Avizo*, *Maya*, and *Madshop*. Fleshy nostril and choana placement were manipulated iteratively to test the range of hypotheses proposed. These models were subjected to a computational fluid dynamic analysis using * Fluent*, simulating a single breath during resting respiration. Fleshy nostril position greatly affected air movement throughout the nasal capsule. Modeling dorsally placed nostrils in *Camarasaurus* resulted in a direct route to the throat, leaving unrealistically stagnant airfields in both the rostral end of the nasal capsule and the caudodorsally placed olfactory chamber. Reorientation of the fleshy nostril, however, resulted in an airflow pattern more consistent with that seen in our studies of extant saurisps, including a separation of the airfield into two streams, a relatively fast-moving air stream directed to the oropharynx, along with a slower moving olfactory stream. Further manipulation of the airflow was performed to better reflect airflow patterns seen in extant archosaurs. This anatomical arrangement would have enhanced airflow into the olfactory chamber, which is consistent with olfactory bulb size in *Camarasaurus*. The most complicated bony airway of *Diplodocus* was more informative of general nasal capsule shape. The caudally retracted bony nasal opening, coupled with the rostrally shifted choana, produced a sinuous airway even when the fleshy nostril was modeled in its traditional dorsal position, but, again, leaving the rostral portion of the nasal capsule as an unrealistic cul-de-sac. A more rostrally positioned fleshy nostril resulted not only in an airway more consistent with our extant findings, but also a very long S-shaped airway. Both taxa exhibit intimate associations of nasal vasculature with the nasal capsule, particularly in the rostral region that was so sensitive to modeled nostril position, suggesting considerable potential for heat-exchange in these sauropods.

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ASSESSING SPECIES DIVERSITY AND INTRASPECIFIC VARIABILITY IN SHIELD-TAILED TORTOISES (TESTUDINIDAE, HEPEROSTETURO) SPANNING THE EARLY CLARENDONIAN THROUGH LATE RANCHOLABREAN OF FLORIDA

BOURQUE, Jason R., Florida Museum of Natural History, Gainesville, FL, United States; HULBERT Jr., Richard C., Florida Museum of Natural History, Gainesville, FL, United States; WOOD, Aaron R., Florida Museum of Natural History, Gainesville, FL, United States

An extinct clade of small (adult carapace length 15–26 cm) land tortoises persisted in Florida from at least the middle–late Miocene to the end of the Pleistocene, a duration of 11–12 million years. Three species have been formally named from the southeastern United States: Hesperostetudo alleni (late Miocene); Hesperostetudo mlynarskii (middle Pleistocene); and Hesperostetudo incisa (late Pleistocene). Members of this clade possess a round to oval tail shield (sacral nuchal) comprised of a single nuchal articulate isolated from the rest of the vertebral column, a unique feature among testudinids. An extensive sample of both previously and recently collected Hesperostetudo fossils from the middle to late Miocene, early Pliocene, and early through late Pleistocene of Florida fill in major temporal gaps in the fossil record. These fossils have increased the available material needed to attempt quantitatively and qualitatively analyzing evolutionary patterns within this clade. Specimens largely comprise isolated shell bones, but include two partial shells from the late Hemphillian Swift Mine, and one complete and two partial shells (as well as six whole and partial tail bucklers) from the Blancan Inglis 1C locality. Three-dimensional (3D) geometric morphometric analyses of isolated nuchals, pygals, epiplastra, and xiphiplastra were conducted using a surface laser-scanner to locate semi-landmarks in a xyz-grid system encompassing the full 3D surface of each element. Principal components analyses were then used to find clusters in morphospace. The combined results from the analyses were used to delimit and better define species. Phylogenetic analyses resulted in two morphologically distinct lineages within this clade inhabited Florida from the Miocene through Pleistocene: the

Recent advances with additional data regarding the anatomy of ‘hypsilophodontid’ taxa from the latest Cretaceous of North America gleaned from a thorough restudy of published specimens and examination of several recently discovered specimens referable to both previously described and newly recognized ‘hypsilophodontid’ taxa. These new data were compiled into a dataset designed to assess basal ornithischian relationships that included 39 ornithischian terminal taxa (all species exemplars), including 27 ‘hypsilophodontid’ taxa. The recovered strict consensus topology is the most highly resolved phylogenetic hypothesis of basal ornithischian relationships yet proposed and agrees with other recent hypotheses in reconstructing the phylogenetic relationships. A phylogenetic analysis of basal ornithischians from the late Triassic of China and the Early Jurassic of North America suggests that the neornithischians were derived from a clade of basal, non-cerapodan ornithischians, and that the clade included forms that clade is recovered as non-cerapodan basal neornithischians, and a new clade is recovered as the sister taxon to Cerapoda that contains many ‘hypsilophodontid’ taxa. This dataset was also analyzed using Bayesian methods to determine, via comparison of Bayes factors, whether there is support for partitioning the data by anatomical subregions (e.g., cranial versus postcranial) or if a single partition model is preferred. The results of this latter analysis provide a quantitative means of assessing the traditional assumption that cranial characters are more important for resolving ornithischian relationships than postcranial characters.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

THE JAW ONTOGENY OF DUNKLEOSTEUS TERRELLI (PLACODERM: ARTHRODIRA) SUGGESTS AN ACTIVE PREDATORY HABITAT THROUGHOUT GROWTH

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One of the driving forces of evolution is competition for resources between individuals. Competition for food is likely to be more intense among members of a single species that share an ecological niche. Ontogenetic niche shifts within some taxa (e.g., Copper Sharks) allow for resources to be partitioned between age and/or size stages, often with notable differences in jaw shape or size that influence the various growth stages. This phenomenon has a deep historical record, although it is difficult to verify in fossil species. The Upper Devonian (Famennian) apex predator, Dunkleosteus terrelli, would presumably have been vulnerable to predation at smaller growth stages, and an inferior competitor to adults. To test if D. terrelli may have gone through ontogenetic niche shifts we examined a growth series of infrafossils (lower jaws) to test if there were significant changes in size or shape throughout ontogeny. One notable morphological feature (dentition) was examined and seven linear dimensions of more than 60 D. terrelli infrafossils were measured. The infrafossils typically bear two shearing cusps on the anterior portion and occasionally a row of denticles posterior to these cusps. Although the area containing the posterior denticles is poorly preserved on most specimens, denticles of the same proportional size and shape were noted on both very small and very large specimens suggesting that they do not vary ontogenetically (assuming no sexual dimorphism). The linear dimensions were analyzed for non-linear trends that would suggest shifts in function. Results indicate that the overall shape of the infrafossils was isotropic throughout growth, and that the smallest known juveniles (total infrafossil length ~48mm, estimated total skull length ~125mm) of Dunkleosteus were active predators, just like many modern shark taxa. Subtle allometric growth between the functional length and blade length results in an increased concentration of force at the anterior cusp tip as the animal grew, allowing them to hunt larger placoderms with thicker dermal plates (indeed bite-marked placoid plates suggest opportunistic cannibalism). However, lower mandible stress in juvenile Dunkleosteus suggests a proportionally stronger jaw despite slightly inferior mechanical advantage. Morphometric results suggest that the jaws of Dunkleosteus functioned similarly throughout life, and that only the size of their prey changed as they grew larger. An inference of niche shifts during ontogeny based on mandible shape changes is not supported.
modification. In contrast, centrosaurine bonebeds are predominantly attributed to mass mortality events (flooding) encompassing dozens to hundreds of individuals from all size classes. These monodominant disarticulated bonebeds are more often associated with high energy, thick paleo-channel deposits and are thought to be hydraulically reworked from overbank deposits, displaying higher amounts taphonomic modification. However, most of these data are from northern Laramidia (e.g., Montana and Alberta).

Our sedimentologic and taphonomic study of two new chasmosaurine bonebeds from the middle Campanian Kaiparowits Formation in southern Utah provides insight into ceratopsid taphonomic patterns and paleoenvironmental associations. These Kaiparowits Formation sites are similar to other chasmosaurine bonebeds in being rare compared to isolated chasmosaurine specimens, comprising 2–3 individuals, exhibit low taphonomic modification, and little hydraulic reworking. One Kaiparowits bonebed was deposited as disarticulated skeletal remains in a channel, whereas the other includes articulated skeletons in a crevasse splay setting.

Because all ceratopsian bonebeds exhibit broadly similar depositional, palaeoclimatic, tectonic, and basin settings, an alternate explanation is necessary for the rarity of chasmosaurine bonebeds. Nonetheless, through the Kaiparowits Formation’s sedimentation rates (42 cm/ka), chasmosaurine bonebeds are still rare in northern Laramidian formations where sedimentation rates are much lower (4-12.5 cm/ka), which suggests this does not solely explain the difference in preservation. Because chasmosaurine bonebeds are typically found in overbank deposits, and the Kaiparowits Formation has a higher ratio of overbank-hosted deposits to paleochannels, one would expect chasmosaurine bonebeds to be more common in the Kaiparowits Formation, but this is not the case. Therefore, differences between chasmosaurine and centrosaurine bonebeds appear to be better attributed to behavior or ecology, where chasmosaurines were solitary or lived in small groups, but centrosaurines congregated in larger social groups at least occasionally.

Preparers’ Session (Thursday, October 18, 11:45 am)
STATE-OF-THE-ART DIGITAL DATA COLLECTION OF PALEONTOLOGICAL RESOURCES: COMPARING METHODS OF CAPTURE AND QUANTIFYING RESULTS OF 3D POINT CLOUD DATA
BREITHAUPF, Brent H., DOI-Bureau of Land Management, Cheyenne, WY, United States; MATTHEWS, Nefra A., DOI-Bureau of Land Management, Denver, CO, United States; NOBLE, Tommy A., DOI-Bureau of Land Management, Denver, CO, United States
During the last decade there has been a marked increase in the use of 3D data capture for the purpose of documentation, evaluation, and preservation of palaeontological resources. Subjects can vary from an isolated tooth to an entire bonebed or from a single fossil footprint to an entire tracksite. The most notable methods for capturing 3D data of palaeontological subjects are LIDAR and photogrammetry. Photogrammetric point cloud data (PCPD) contain both the exterior physical dimensionality of a subject and a high quality image texture registered precisely for each data point (x,y,z,r,g,b file). Excellent results can be achieved from photogrammetry when the software solves for a robust camera calibration and when overlapping photographs are taken with proper geometry. Resulting PCPD can easily achieve submillimeter precision and be used to produce accurate rapid prototypes. Because of the computational power of the new generation of photogrammetric software, hundreds of photograms can be processed in a reasonable time to create the dimensionality of subjects “in the round.” Advances to software and cameras allow this technique to be used on palaeontological specimens of all shapes and sizes in the field, lab, and collections. Relatively low-cost and even free online services allow curators, collections managers and preparators to document material in their collections for research, management, and preparation purposes. Three-dimensional image datasets provide a permanent digital record of subjects "in the round." Advances to software and cameras allow this technique to be used in the documentation of palaeontological resources in accordance with current palaeontological legislation (PPRA). In addition, open source software is available for manipulating, scaling, and comparing point cloud data. This not only makes it affordable to use and compare 3D data obtained from various sources, but also makes it possible to conduct scientific evaluation of palaeontological subjects. Several studies have been conducted comparing LIDAR and photogrammetry methods. Recent comparisons demonstrate that photogrammetry can be generated at a level that meets (or exceeds) the instrument specifications for the LIDAR unit used in the comparison. Once a PCPD is generated, analytical tools support direct 3D comparison of anatomical features, such as individual skull bones or tracks within a trackway. Virtually every palaeontologist has the basic equipment (i.e., scale bar and camera) necessary to successfully create palaeontologically useful PCPD.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
DENTAL HISTOLOGY AND TOOTH IMPLANTATION IN EARLY PERMIAN NON-MAMMALIAN SYNAPSIDSY
BRINK, Kirstin S., University of Toronto Mississauga, Mississauga, ON, Canada; LEHBLANC, Aaron R., University of Toronto Mississauga, Mississauga, ON, Canada; SANDER, P. Martin, University of Bonn, Bonn, Germany; REISZ, Robert R., University of Toronto Mississauga, Mississauga, ON, Canada
The tooth implantation of non-mammalian synapsids has been previously described as protodontic or subodontic, based on the macroscopic observation that the tooth root is implanted in a shallow socket and separated from neighboring teeth by bone or other connective tissues. However, the mode of tooth implantation in non-mammalian synapsids is poorly known, because the teeth and tooth attachment tissues of these lineages have never been described histologically in any detail. Here, we describe for the first time the tooth attachment of marginal and palatal teeth of sphenacodontids and the marginal dentition of a mystrosoanoid varanapid using histological methods. Dental and palatal teeth of Sphenacodon, Dimetrodon natans, Dimetrodon grandis, and an undescribed varanapid from Oklahoma as well as the teeth of the pterygoid flange and the palatal surface of the pterygoid of Dimetrodon limbatisus were examined in longitudinal and transverse sections. We observed that the labial walls of the tooth bearing elements are higher than the lingual walls in all four taxa, creating a superficially pleurodont implantation, but all marginal teeth are implanted in true sockets lined with vascularized alveolar bone. The teeth are ankylosed to the alveolar bone, and the roots of the tooth do not pierce through a layer of acellular cementum. The pterygoid teeth of Dimetrodon are also connected to alveolar bone by a layer of acellular cementum. Interestingly, these non-mammalian synapsids exhibit plicidentine (infilling of the dentine at the tooth root), a first for Synapsida. The dentine infoldings in Sphenacodon and Dimetrodon have a four-lobed shape below the level of the jaw line, which becomes convoluted closer to the base of the tooth. By comparison, plicidentine in the varanapid does not possess the four lobes present in sphenacodontids and is instead highly convoluted throughout the root of the tooth. We hypothesize that plicidentine in these non-mammalian synapsids played a role in increasing the surface area of attachment for cementum and alveolar bone at the base of the tooth root. The results of this analysis suggest that development of palatal and marginal dentitions in non-mammalian synapsids is regulated by similar mechanisms regardless of the tooth position in the skull. The occurrence of plicidentine, cementum, and alveolar bone in Early Permian synapsids suggests that the presence of these tissues is pleiomorphic for Synapsida.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 9:00 am)
SOUTHERN NORTHERN CROCODILES: BOREALOSUCHUS FROM THE CAMPAIGN OF ALABAMA AND THE EARLY BIOGEOGRAPHIC HISTORY OF CROCODILIANS IN NORTH AMERICA
BROCHU, Christopher A., University of Iowa, Iowa City, IA, United States; DENTON, Robert K., GeoConcepts Engineering, Inc., Ashburn, VA, United States; GRANDSTAFF, Barbara S., University of Pennsylvania, Philadelphia, PA, United States; PARRIS, David C., New Jersey State Museum, Trenton, NJ, United States; SCHIEEN, Jason P., New Jersey State Museum, Trenton, NJ, United States
The eusuchian Borealosuchus is endemic to North America and preserves critical evidence for the phylogenetic relationships and historical biogeography of the earliest crocodylians. It is the best known from deposits of Maastrichtian through middle Eocene age in the Western Interior, but the lineage has also been found along the Atlantic Coastal Plain, including a new species based on cranio-mandibular and postcranial remains from the Campanian Etowah Formation and Mooreville Chalk of Alabama. It is the oldest known species of Borealosuchus, and like B. threensis from the latest Maastrichtian-earliest Paleocene of New Jersey, it has virtually no external mandibular fenestra and bipartite ventral osteoderms. These are features shared with late Paleocene-Eocene B. wilsoni from western North America. Unlike either B. wilsoni or B. threensis, the new form retains a robust splenial symphysis. The lacrimal is unusually long, suggesting the derived rostral sutureal condition found in western Borealosuchus. Eastern Late Cretaceous Borealosuchus are more closely related to species from the late Paleocene and Eocene than they are to Maastrichtian-earliest Paleocene western members of the clade, suggesting a substantial unsampled history for the group. Most other eastern crocodylians belong to groups found in western North America, and the relationships between eastern North American and Eurasian or African crocodylians is limited to coastal groups (e.g. thyrassodons, dyrosaurids). Whether this pattern reflects dispersal or vicariance driven by the rising and falling Western Interior Seaway, and the number and timing of such events, is unclear. The absence of an external mandibular fenestra in the new species, as well as in early putative gavialoids and several
outgroups to Crocodylia, raises questions about the homology of the structure in extant crocodylians; and liability of Borealosuchus relative to other basal crocodylian clades in our results reveals sensitivity of crocodylian phylogenetic analyses to outgroup sampling.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

**SKULL SHAPE VARIATION IN LEPIDOSAURS: THE INFLUENCE OF ECOLOGY AND PHYLOGENY**

BROCKLEHURST, Neil, Museum für Naturkunde, Leibniz-Institut für Evolutions und Biodiversitätsforschung, Berlin, Germany

Studies on various vertebrate groups have unsurprisingly shown a link between cranial morphology and diet. Studies focused on lizards, however, have produced conflicting results, with some showing little correlation between diet and skull and tooth morphology, and others finding variation in snout shape between carnivorous and herbivorous groups. This investigation focused not only on lizards but also on Rhynchocephalia, both extant and extinct. Measurements were made on the cranium in ventral view, with landmarks positioned around the tooth row and adductor chamber to represent their shape. These landmarks were analysed using the geometric morphometric software Morphologika to examine how skull shape differs between species. Three significant principal components were identified by Morphologika. As Principal Component 1 (PC1) increases in value, the distance between the tooth rows increases, and the distance between the tooth rows and the adductor chambers decreases. As the value increases, the tooth rows shorten, and the adductor chamber increases in size. PC3 relates to the position of the quadrates relative to each other. As the value increases, the quadrates move closer together. Results show that species within the same clades tend to have similar cranial shapes, but within each clade morphology varies according to dietary specialisation.

**Studies on various vertebrate groups have unsurprisingly shown a link between cranial morphology and diet.**

**As the value of PC1 increases, the tooth rows shorten, and the adductor chamber increases in size.**

**EVIDENCE FOR TAPHONOMIC SIZE BIAS IN A MODEL MESOZOIC TERRESTRIAL ALLUVIAL-PARASYLIC SYSTEM**

BROWN, Caleb M., University of Toronto, Toronto, ON, Canada; EVANS, David C., University of Toronto/Royal Ontario Museum, Toronto, ON, Canada; CAMPIONE, Nicolás E., University of Toronto, Toronto, ON, Canada; O’BRIEN, Lorna J., University of Toronto, Toronto, ON, Canada; EBERTH, David A., Royal Tyrrell Museum, Drumheller, AB, Canada

The body-size distribution of dinosaurs reveals a prominent negative skew (towards large body size), a pattern opposite to modern terrestrial faunas. Here, we test if this pattern is a biological feature of dinosaur faunas or the result of taphonomic processes. We use the Dinosaur Park Formation (DPF: Campanian, Alberta) as a model to examine the relationship of body-size (estimated body mass) with taphonomic/sampling proxies, such as taxon completeness, taphonomic mode, and year of discovery/description, to test the hypothesis that the distribution of extinct taxa in dinosaurs is biased by preservation potential. We find a direct correlation between taxon size and known skeletal completeness (r=0.90, p<0.001). In particular, there is a clear dichotomy in which taxa <60 kg are significantly less complete (mean completeness ~ 8%) than those ≥60 kg (~78%). There is also a strong association of body-size and taphonomic mode, with small taxa known largely from isolated and occasionally associated remains, and large taxa known mainly from articulated skeletons. All correlations are consistent both within and between taxonomic groups (e.g., Dinosauria, Ornithischia, Theropoda, Ornithopoda, etc.). A significant correlation is also noted between body mass and the date of discovery and description, with taxa ≥60 kg taking an average of ~60 and ~75 years to discover and describe, respectively, compared to ~30 and ~36 years for taxa <60 kg. The rates of both accumulative discovery and description for large taxa are best described by a logarithmic curve nearing an asymptote, while small taxa show either a linear or power law increase through time. This suggests our current knowledge of the large-bodied dinosaur assemblage is representative of the true biological fauna with few discoveries likely to be made in the future, while the diversity and abundance of small taxa are greatly underestimated, with more discoveries to be made. Our results indicate that the interpretation of the paleoecology of the DPF requires recognition of this taphonomic bias, which greatly reduces its compositional fidelity for small-bodied forms. Given that (1) the sedimentary deposits and fossil assemblages of the DPF represent one of the best studied examples of a Mesozoic alluvial-parasitic (terrestrial) “paleoecosystem,” and (2) similar patterns have been suggested (but not documented) for other Mesozoic terrestrial ecosystems in the Western Interior of North America, we suggest this pattern of taphonomic size bias may typify vertebrate fossil assemblages in Mesozoic systems. If so, such biases must be considered before patterns of diversity in dinosaur communities through time can be accurately reconstructed, or used to compare and interpret Mesozoic paleoecosystems.
encountered in paleontology laboratories, including preparation, conservation, molding, and casting, exposure to a range of tools and techniques, as well as an introduction to the relevant literature. The syllabus can be easily modified and adopted by other institutions and ensures that students are grounded in the basics of good preparation. The syllabus was also designed to be scalable in the amount of content (e.g., modules) that can be individually expanded to constitute a short workshop or fill an entire semester. This framework can then function as a broader curriculum for formal or informal training in paleontological preparation.

Discussions during the workshop highlighted the need for continuing work toward training programs and standards in preparation. These competencies will provide a foundation for this continuing discussion of standards and best practices in vertebrate paleontological preparation. The core competencies and syllabus may eventually be useful as a basis for certification of vertebrate fossil preparators, as well as provide guidance for hiring officials when writing job descriptions or evaluating applicants for preparation positions.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleocology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 10-15 am)

THERIOPOD DINOSAURS FROM THE LATE CRETACEOUS OF EASTERN NORTH AMERICA: ANATOMY, SYSTEMATICS, BIOGEOGRAPHY AND NEW INFORMATION FROM HISTORIC SPECIMENS

BRUSATTE, Stephen L., American Museum of Natural History, New York, NY, United States; CHOINIERE, Jonah N., American Museum of Natural History, New York, NY, United States; BENSON, Roger B., University College London, London, United Kingdom; CARR, Thomas D., Carriage College, Kenosha, WI, United States; NORELL, Mark A., American Museum of Natural History, New York, NY, United States

During the latest Cretaceous (Campanian-Maastrichtian), when North America was bisected by the Western Interior Seaway, a diverse fauna of carnivorous theropods occurred across the western half of the continent (Laramidia). Some of these taxa, such as Tyrannosaurus and Dromeosaurus, are among the most familiar dinosaurian carnivores of the Mesozoic. Considerably less is known about the theropods that lived in eastern North America (Appalachia) at this time. Their sparse fossil record has frustrated scientists since the first discoveries of theropods in New Jersey and surrounding states by Cope, Leidy, and colleagues in the mid-1880s. Over the past decade, new fossil discoveries and reinterpretations of historic specimens, studied in the context of an ever-growing phylogenetic understanding of theropods, have shed new light on Appalachian theropod faunas. Reasonably complete and diagnostic specimens are rare, but the inventory of Appalachian Late Cretaceous theropods in major museum collections includes specimens of at least three diagnosable taxa: two tyrannosaurids (Appalachiosaurus montgomeriensis, Dryptosaurus aquilunguis) and an ornithomimosaur ("Ornithomimus" antiques), as well as additional material in other theropod theropod genera. These taxa are represented by two highly derived new species of these three taxa based on shared derived characters. A. montgomeriensis, from the mid-Campanian Dernomic Formation of Alabama, and D. aquilunguis, from the Maastrichtian New Egypt Formation of New Jersey, are both known from holotypes that preserve several cranial and postcranial bones. A recent phylogeny of Tyrannosauroides shows that both A. montgomeriensis and D. aquilunguis are "intermediate" tyrannosaurids, nested between basal taxa such as Guanlong and Dilong and the derived, large-bodied Tyrannosaurus, the clade consisting of Albertosaurus, Tyrannosaurus, and kin that were apex predators in western North America and Asia during the latest Cretaceous. Therefore, the eastern North American taxa are considerably more basal than their western contemporaries, suggesting that Late Cretaceous Appalachian may have been a refuge for refugial species. The long-mysterious "O." antiques is represented by two specimens from the Maastrichtian of New Jersey originally described by Leidy. It can be referred to Ornithomimosauria based on the gracile, arctometatarsalian pes that lacks a deep notch proximally on metatarsal II, and is diagnosed as a distinct taxon by an autapomorphic bulbous medial condyle on the tibia.

Phylogenetic analysis suggests that it is a relatively derived ornithomimosaur, closely related to Ornithomimus and Gallimimus. There is no evidence that "O." antiques was a primitive taxon ancestral to Laramidian ornithomimosaurians, as has been argued.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

SOMITE - LATERAL PLATE INTERACTION AS A DEVELOPMENTAL CONTROL ON EVOLUTION OF TETRAPOD AXIAL MORPHOLOGY

BUCHHOLTZ, Emily A., Wellesley College, Wellesley, MA, United States

Morphology is understood as the product of natural selection acting on variants generated randomly by the developmental process. If the generation of variation is not random, any bias may limit the possible morphologies that natural selection can elicit. Here annulate axial morphology is examined to ask if the distribution of its variation reflects the existence of bias imposed by the early embryonic interaction of somites (SM) and lateral plate mesoderm (LPM) cells. Mutations in SM and LPM cause somites, premyocytes at isolated anterioposterior somite levels (hypoglossal, limb, diaphragm, and cloacal locations) delaminate from the dermatomyotome, migrate along routes established by chemical signaling, and then invade and muscularize structures of lateral plate origin. Major transitions in vertebrate axial patterning occur at these same locations. For example, the axial cervicodorsal and dorsocaudal transitions occur at axial locations where somitic cells migrate into the lateral plate limits. Multiple lines of evidence also suggest that both internal differentiation within the cervical region and the thoracolumbar transition of mammals are tied to the migration of cells from the cervical somites to the lateral plate diaphragm. This study asks whether SM-LPM interaction is also associated with limitations in the meristic variation of the column. Using a database of vertebral anatomy in living and fossil tetrapods assembled from museum collections and from the literature, it concludes that greater SM-LPM interaction is associated with both column subdivision and progressive restriction in meristic flexibility, with mammals being the clade with greatest SM-LPM interaction, regionalization of the column, and meristic constraint. The hypothesis of a causal tie is supported by examples of evolutionary loss of SM-LPM interaction that are associated with the appearance of meristic flexibility. This is most vividly demonstrated by terrestrial taxa that have undergone limb loss during re-invasion of marine habitats. These results emphasize the important role that developmental mechanisms may play in influencing and limiting macroevolutionary trends.

Technical Session I (Wednesday, October 17, 9:30 am)

EVIDENCE OF THE FORELIMB MUSCULATURE IN TYRANNOSAURIDEA (DINOSAURIA: THEROPODA)

BURCH, Sara H., Stony Brook University, Stony Brook, NY, United States

The highly reduced forelimbs of tyrannosaurid theropods have sparked many hypotheses about their function. Although the musculature and its function in the charismatic taxon Tyrannosaurus has been studied, the myology of other tyrannosaurids has largely been ignored. This study provides the first look at the forelimb musculature across the entire clade and examines what the major morphological shifts reveal about the evolution of reduced forelimb function. Osteological correlates of muscle attachment were identified on pectoral girdle and forelimb material in 11 tyrannosaurid and several outgroup taxa. Morphological features were coded as characters and optimized onto a recent tyrannosaurid phylogeny to trace character transformations. Most major shifts in the forelimb musculature occur at the base of Tyrannosauroidea, though a few appear earlier among tyrannosaurids. The scapula and humerus show an enlargement of the available area for attachment of deltoideus musculature in tyrannosaurids, which is primarily responsible for humeral abduction as well as some protraction and retraction. Expansion of the internal tuberosity is retained in most tyrannosaurids and reduced or lost in non-tyrannosaurid neotheropods. In tyrannosaurids, the humerus possesses a deep insertion area and shorter lever arms for much of the adductor musculature of the humerus. Supinator became primarily a flexor of the forearm early in the tyrannosaurid lineage as shown by the excision of its origin proximal to the euctepicondyle and a shift of its insertion from the lateral to the anterior surface of the radius. Inability to pronate or supinate may also be indicated by scars for the interosseous membrane on the radius in some tyrannosaurids. The proximal migration of the triceps brachii insertion from the tip of the olecranon also characterizes tyrannosaurids, extending the lever arm without requiring expansion of the olecranon process. In the manus, reduction of the medial tubercle on metacarpal I in tyrannosaurids results in a shorter lever arm for extensor carpi radialis brevis, which is responsible in part for abduction of digit I. Accompanying this reduction, however, is development of a medial tubercle on the proximal ventral surface of F-1 near the abductor digit I insertion, indicating a shift of major abduction responsibility to the intrinsic manus musculature. These and other myological characters of tyrannosaurid forelimbs show a mosaic pattern of reduction and enlargement with retention of robust musculature for some functional units (e.g., flexors, extensors) even as others (e.g., adductors) have become diminished. Substantial differences in the morphology of even closely related taxa suggest that a single functional hypothesis does not apply to all reduced forelimbs.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

USING GIS SLOPE AND ASPECT DATA AS PREDICTORS OF SURFACE FOSSIL ABUNDANCE IN THE UINTA BASIN, UTAH

BURK, Daniel A., Intermountain Paleo-Consulting, Draper, UT, United States

A variety of factors contribute to slope degree and aspect in a primarily erosional modern environment such as that found in the Uinta Basin (Wagonhound) Member of the Uinta Formation in Uintah Co., Utah, USA. These factors include but are not limited to: the freeze-thaw cycle, vegetation, insolation, presence of water, and regolith development. These factors combine to determine the types of slopes and aspects upon which fossils will be found at the surface. Data regarding fossils found in a sample PLSS section was collected through paleontological reconnaissance surveys. Slope and aspect data were obtained from a 5m resolution DEM. Using a GIS, slope angle and aspect data were combined with fossil data and analyzed. Slopes were classified into two nominal categories: low angle (angles between 0° and 10°) and high angle (angles > 10°). Aspects were combined with fossil data and analyzed. Slopes were classified into two nominal categories: southerly (angles between 120° and 180°) and northerly (all other aspects). These categories were combined to create four nominal categories for all fossils: North Low, North High, South Low, and South High. Assuming a random, unbiased distribution of fossils in the subsurface, analysis showed that, with 99.5% confidence, fossils are not distributed equally on all surface types. Fossils were 81.3% to 87.1% more likely to be found on surfaces in the South Low category than on any other single surface category. Surfaces with southern aspects tend to have less available water allowing them to support less vegetation and contributing to more poorly developed regolith. Regolith is more developed on northern facing surfaces and can obscure or destroy existing fossils. Additionally, surfaces with higher angle slopes have less available surface area with which to expose fossils. Therefore, the combination of low angle slopes and southern aspects allows for fossils to be found on the ground surface more readily. Other factors possibly influencing discovery of fossils not considered in this study include rock type, degree of weathering, time of day or year and local weather conditions during which reconnaissance surveys were conducted, and attitude and skill of surveyors.
**PLESIOSAURS HAD A TASTE FOR BIRDS**

BURNHAM, David A., University of Kansas Biodiversity Institute, Lawrence, KS, United States; MARTIN, Larry D., University of Kansas Biodiversity Institute, Lawrence, KS, United States; ROTHSCILD, Bruce M., University of Kansas Biodiversity Institute, Lawrence, KS, United States

Presence of unhealed bite marks or stomach contents suggests the possibility of predation, but could also represent scavenging. Healed bite marks witness failed predation and potentially allow identification of both prey and predator. Avian predator-prey interactions are difficult to document because of the fragility of the avian skeleton. Partially digested hesperornithiform bones have previously been reported in stomach contents of the mosasaur Tylosaurus and eantiornithine bird bones, in the abdominal cavities of an ichthyosaur and the dromaeosaur, Microaptor. We present evidence that the Late Cretaceous ornithurine, Hesperornis, was a prey item for plesiosaurs, in a manner analogous to the relationship between contemporary penguins and killer whales. Conical depressions were macroscopically and radiologically examined on the left leg of a Hesperornis (YPMUP 17208) and compared to the tooth character and spacing of dentition in mosasaurs and plesiosaurs. The tibiotarsis had a series of rounded 4.4 mm depressions at 11.9 mm intervals, with inwardly pressed bone fragments. The size and separation of the depressions matched that of a small polycotylid plesiosaur. Radiologic examination of the distal tibiotarsus revealed an irregular moth-eaten radiolucent area, documenting osteomyelitis complicating the bite trauma.

The Hesperornis appears to have been attacked by a polycotylid plesiosaur that was unable to maintain its grip and the Hesperornis was able to escape. While there is evidence of plesiosaur predation on fish and cephalopods, there is limited evidence that they targeted tetrapods. To examples of plesiosaur predation, a pliosaur and an embryonic ichthyosaur, is now added Hesperornis.

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**SYSTEMATIC AND ANATOMICAL RE-EVALUATION OF BASAL PHYTOSAURS FROM THE LATE TRIASSIC OF CENTRAL EUROPE, WITH IMPLICATIONS FOR LATE TRIASSIC BIOTRATIGRAPHY**

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Phytosaurs are a diverse and morphologically distinctive clade of superficially crocodile-like archosauriforms that had a near global distribution during the Late Triassic. Because their remains are among the most abundant vertebrate remains recovered in many Late Triassic terrestrial formations, phytosaurs are used extensively in long-range biotratigraphic correlations. The stratigraphically oldest and most basal known phytosaurs include an array of small species from the early Late Triassic of North America, central Europe, Morocco, and India that have been synonymized within the genus Paleorhinus, and subsequently used to define a global “Paleorhinus biochron”. However, recent phylogenetic work suggested that the North American species previously referred to Paleorhinus are paraphyletic. Here, we reassess the systematics and anatomy of putative Paleorhinus specimens from Germany and Austria. Two well-preserved basal phytosaur skulls from the Blasenlandstein (Carnian) of Bavaria form the holotypes of Francosuchus angustifrons and Ebrachosuchus nekani, both of which were synonymized with Paleorhinus by previous workers. We demonstrate that Francosuchus angustifrons shares unique synapomorphies with Paleorhinus bransoni from the Late Triassic of Texas and Wyoming, and thus refer the species to Paleorhinus. By contrast, the longirostrine Ebrachosuchus is highly distinctive in morphology, and a new cladistic analysis of Phytosauria demonstrates that it represents a valid taxon that is more closely related to Phytosauria than to Paleorhinus. CT scan data allows virtual reconstruction of the crocodylian-like endocranial anatomy as well as examination of the cranial sinuses, including a remarkable and extensive pneumatic sinus system, providing new insights into basal phytosaur paleobiology. Our work provides the first autapomorphy-based support for a monophyletic but restricted Paleorhinus (supported by a nodal row on the jugal, and low paired ridges on the squamosal) and confirms that previous broader conceptions of Paleorhinus are likely to be paraphyletic. A putative specimen of Paleorhinus (“Francosuchus”) from marginal marine beds from the Late Triassic of Austria has previously been used to correlate the “Paleorhinus biochron” to marine stages. We demonstrate on the basis of micro-CT data that “Francosuchus” trauthi differs in numerous and substantial features from basal phytosaurs, and instead likely represents a non-phytosaurian sauuran clade. Therefore, precise correlation of Late Triassic terrestrial units bearing Paleorhinus to the global marine timescale cannot continue using that taxon.
CONTINUOUS CHARACTER STATES AND THEIR IMPACT ON THE PHYLOGENY OF THE PTEROSAURIA

BUTTON, David J., University of Bristol, Bristol, United Kingdom; UNWIN, David M., University of Leicester, Leicester, United Kingdom; PURNELL, Mark A., University of Leicester, Leicester, United Kingdom

The use of continuous characters in phylogenetic analysis is controversial, primarily because there is no consensus method for coding them into discrete states, which can result in conflict owing to inconsistencies in delimitation of states between different analyses. Such problems may be especially marked in vertebrate paleontology as analyses of fossil vertebrates often include a relatively high proportion of continuous characters. The pterosaurs are a notable example of such a group, with recent analyses containing 20-25% continuous characters. Difficulties with state delimitation may hence be contributing to the current lack of consensus in pterosaur phylogeny. To test this possibility two recent contrasting analyses of pterosaurs were reanalysed employing an additive treatment using TNT. This approach is capable of handling continuous character data directly, avoiding the need to delimit discrete states. Experimentation with inclusion and exclusion of continuous characters showed that whilst they do convey some phylogenetic signal, many such characters, and the majority of character states, are flawed. Critically, however, varying the treatment of continuous characters failed to detect any significant role for them in the conflict between pterosaur phylogenies which, in this case, appears to be related to fundamental differences in general character selection and coding, with certain problematic taxa (such as Germanodactylus) coded differently for identical characters between matrices. Additionally, a basalmost position of the Anurognathidae and, more tentatively, paralogy of the Ctenochasmatidae are supported. Some theoretical and practical issues with continuous characters, especially for groups with small sample sizes as is typical for fossil vertebrates, prevent their use from being generally recommended. However, as they do show some phylogenetic signal, they should not be outright excluded. Rather than ruling out entire classes of data based on presumed weaknesses it would seem more prudent to critically evaluate all characters on the grounds of the hypotheses of homology they present. In the case of pterosaurs it is clear that movement toward a consensus regarding their phylogenetic relationships will require a transparent and thorough reappraisal of character selection and coding.

Technical Session IV (Wednesday, October 17, 2:45 pm)

ONTOGENETIC STATE OF A JUVENILE POLYCOTYLID PLESIOSAUR

BYRD, Christina J., Marshall University, Huntington, WV, United States

Intraspecifically different suggesting that very disparate morphologies were key to survival often occurring closer to coastal environments than centrosaurines. Shifts in morphological ontogeny can be useful in understanding allometric differences among genera of these animal. It may also be used to shed light on the mammal-like life history and reproductive nature of plesiosaurs. In this study, we analyze a plesiosaur specimen from the University of Nebraska State Museum (UNSM 55810), a post-natal juvenile polycotylid plesiosaur from the Pierre Shale (99-65 Ma) of Nebraska. It is a partial skeleton possessing a partial skull, both the pectoral and pelvic girdles, the left humerus, both femora and an assortment of phalanges. Previous qualitative research using UNSM 55810 was conducted with other plesiosaurs, but no formal description has been produced. UNSM 55810 is probably referable to the plesiosaur genus Dolichorhynchops based on several cranial characteristics. In order to understand the ontogenetic changes in morphology of plesiosaurs, metric data was collected from UNSM 55810 and compared among related plesiosaurs to address allometric variation. The pectoral and pelvic girdles exhibit a significant amount of allometric growth along the anterior and posterior edges. The scapulae exhibit extreme positive allometric growth along the ventral ramus, which extends anteromedially, and the dorsal process, which extends posterolaterally. The coracoids grow longer and wider posteriorly, forming a symphysis at the midline. The pubes grow the most conservatively, with only slight allometric growth anteriorly. The isidia demonstrate the greatest amount of allometric growth extending greatly in length posteriorly. The clavicles grow larger in size while maintaining their morphology during ontogeny. This relative morphological conservatism may be linked to the dermal origin of the clavicle as opposed to the endochondral ossification of the other girdle elements. In addition, the lack of ossification along the edges of the girdle elements of the juvenile suggests that cartilage may have been present, which could provide support to the girdles at the time of birth prior to complete ossification, particularly at the glenoid and acetabulum. The overall morphology of the juvenile girdle elements tend to resemble the morphology of more basal sauropterygians such as nothosaurs, pithosaurs, and basal plesiosaurs. Understanding morphological variation during polycotylid ontogeny will provide information for better identification of subadult specimens, as well as give insight to the evolutionary and developmental changes that occurred during plesiosaur evolution.

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 8:30 am)

FIVE NEW PLOMEDUSOIDES FROM THE MIDDLE-LATE PALEOCENE OF COLOMBIA: THE FIRST CENOZOIC GIANT FRESHWATER TURTLE AND AN UNUSUALLY CIRCULAR TURTLE SHELL

CADERNA, Edwin, North Carolina State University, Raleigh, NC, United States; KSEPKA, Daniel T., North Carolina State University, Raleigh, NC, United States; BLOCH, Jonathan I., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

The first Cenozoic fossil turtles of Colombia are reported here from the Middle-Late Paleocene, Cerrejón Formation, Guajira Peninsula, Colombia. Two species correspond to new genera of Podocnemididae and Bothremydidae, and the other two are attributed as Plomedusoides incertae sedis. Four new taxa of Plomedusoides are reported here from the Middle-Late Paleocene, Cerrejón Formation, Guajira Peninsula, Colombia. Two species correspond to new genera of Podocnemididae and Bothremydidae, and the other two are attributed as Plomedusoides incertae sedis. The new podocnemid genus is based on a nearly complete skull that differs from all other podocnemid genera: (1) a prefrontal-postorbital contact that excludes the frontals from the orbital margin, (2) a reduced basisphenoid with very short medial incursion between the pterygoids, and (3) a posteriorly wide snout which becomes abruptly narrow anteriorly, particularly at the premaxillary region. Phylogenetic analyses place this new podocnemid inside the clade Erymnochelyidae, and outside the crown Podocnemididae when morphological and molecular data is combined. With a total skull length of 22 cm, this specimen constitutes the first giant representative of Cenozoic podocnemids.

Bothremydids are shown to be part of the Paleocene South American tropical herpetofauna by new material referable to Bothremydidae. A new genus is based on cranial material and dozens of shells, differing from all other bothremydids by: (1) pectoral scales shorter than humeral scale, (2) abdominal and femoral scales at midline of the plastron, (3) small and very shallow medial notch at the anterior margin of the nuchal, (4) vertebral 1 much wider than the others, (5) axillary scar oriented greater than 60° with respect to the posterior margin of costal 1, and (6) short, wide, and rounded prezygapophyses on the first thoracic vertebrae. Based on phylogenetic analysis this new taxon is closely related to the Foxemydidae group. The data bothremydidae also exhibits the most circular carapace yet observed among Pelomedusoides, which we hypothesize could have deterred predators, particularly large snakes as Titanoboa, by making the turtle more difficult to ingest. A third new taxon is based on a single large shell (170 cm) resembling Stupendomys in many carapace and carapace-plastron proportions and referred to Pelomedusoides incertae sedis. A fourth new taxon, is represented by specimens that are relatively small compared to all other pelomedusoides from Cerrejón (<35 cm along the midline of carapace). Theor shells lack a cervical scale and show the earliest evidence for a complete absence of the neural series in Pelomedusoides. Cerrejón fossil turtles show that the earliest tropical rain forests of South America after the K-Pg event were linked to the emergence of turtle diversity, large body size, and body plans innovations, with implications for the assembly of extant South American turtle faunas.

TURTLE AND AN UNUSUALLY CIRCULAR TURTLE SHELL

BYRD, Christina J., Marshall University, Huntington, WV, United States

Ontogenetic variation within plesiosaurs of the family Polycotylidae, short-necked marine reptiles from the Cretaceous period, can be useful in understanding allometric differences
ON THE CRISTA CIRCUMFENESTRALIS OF SNAKES: COMPARATIVE ANATOMY, SIMILARITY, FUNCTION AND THE FOSSIL SNAKES DINILYSIA AND NAJAISH

Caldwell, Michael W., University of Alberta, Edmonton, AB, Canada; Palci, Alessandro, University of Alberta, Edmonton, AB, Canada

Despite more than two centuries of discussion, the origin and evolution of snakes remains a much debated, and highly controversial problem. The principal barrier to achieving reasoned consensus on snake phylogeny resides in the inaccurate language of squamate comparative anatomy as applied to snakes and in contrast to lizards. Anatomical nomenclature underpins empirical statements that are used as transformed metadata statements as characters and states; these statements are then tested via congruence to hypothesize synapomorphies that support sister-group relationships and thus the constitution of clades. A characteristic anatomical feature of snakes, not observed in lizards, is the crista circumfenestralis (CCF), a system of bony crests that surrounds the fenestra ovalis and the lateral aperture of the recessus scalaris tympani, the latter of which is common to both snakes and lizards. Because the characteristics of the CCF are poorly defined in extant snakes, this morphology is problematic in the phylogenetically important Upper Cretaceous fossil snakes Dinilysia patagonica and Najaish rionegrina. In order to effectively qualify the morpho-concept of the CCF, we use the test of topology to clarify the anatomical features for empirical assessment of the presence/absence of the CCF. We conclude that the appearance of a CCF is preceded by the enclosure of the ventral margin of the juxtapatap彼此 归并 后 残余 骨 部 分 的 角 状 片 的 形 状 对 比 分 析 是 进 行 多 指 标 比 较 的 有 效 方 法。此 外，不 同 纵 向 坐 标 的 林 茂 类 型 手 工 修 削 曲 线 过 程 中，基 本 上 保 持 了 原 来 的 形 态 特 征，但 个 别 地 方 有 所 改 变，例 如，分 枝 部 分 可 能 会 更 加 水 平。因 此，对 于 不 同 坐 标 纵 向 类 型，可 以 考 虑 采 用 不 同 的 层 次 来 进 行 比 较 分 析。这 为 后 续 的 研 究 提 供 了 一 些 可 能 的 视 角。
Outliers may have a disproportionately large effect on scaling coefficients, especially in more distantly related stem taxa (e.g., non-avian dinosaurs and non-mammalian reptiles). Excluding unrepresentative taxa is a common practice, but some researchers contend that this approach may inappropriately distort scaling relationships. For example, including an extinct stem taxa, *Diploptamus lakustai*, or a more basal therian, *Eoboreus larus*, will affect body mass scaling relationships of living mammals. Although scaling relationships between living taxa are well-documented, scaling relationships of extinct taxa are less well-defined. This is because biases in sampling and the historical context of extinct taxa may produce unrepresentative scaling relationships. The biases may be the result of sample sizes, taxonomic diversity, or the accumulation of fossils over time. As a result, scaling relationships between living and extinct taxa may be inconsistent and require careful consideration. Future research should focus on the inclusion of unrepresented taxa, and the correction of scaling relationships for biases in sampling and the historical context of extinct taxa.
Forest. Small fish bones are often in sorted, partially digested, apparently disgorged masses, about 30mm in diameter, indicating lack of current and modest depth. Large predatory fishes are rare, but isolated bones of 70 cm muskellunge (Esox) and 30 cm Pikeminnows (Ptychocheilus) have been found with mammals in fluvial environments, peripheral to the leaf-bearing siltstone.

Technical Session I (Wednesday, October 17, 9:15 am)
ONTOGENY AND PHYLOGENY OF CEPHALIC ORNAMENTATION IN TYRANNOSAURIDEA (DINOSAURIA, COELUROSAURIA)
CARR, Thomas D., Carthage College, Kenosha, WI, United States; LACOV ARA, Kenneth J., Drexel University, Philadelphia, PA, United States; SCHROETER, Elena R., Drexel University, Philadelphia, PA, United States

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
A JUVENILE HYPOSURAS ROGERSII SKULL FROM THE HORNERSTOWN FORMATION OF NEW JERSEY
CARTER, Aja M., Drexel University, Philadelphia, PA, United States; BOLES, Zachary, Drexel University, Philadelphia, PA, United States; SCHROETER, Elena R., Drexel University, Philadelphia, PA, United States; LACOV ARA, Kenneth J., Drexel University, Philadelphia, PA, United States

Recent excavation in the Hornerstown Formation of Manta Township, Gloucester County, New Jersey, has yielded a plethora of marine vertebrates, including a partial skull consisting of a complete braincase, associated fragments, and two teeth. We assigned the material to Hyposurus rogersii based on the following characteristics: 1) braincase exhibits a flat ventral margin of the magnum foramen, resulting in a shunted occipital condyle that is very short; 2) the quadrate curves ventrally relative to the dorsal margin of the brain case; 3) tubercules appear on the dorsal-most lateral line on the supraoccipital and 4) a flattened parialtal-frontal complex. The combination of these characteristics are diagnostic of Hyposurus. The lack of fused skull joints, indicates this specimen to be a juvenile H. rogersii. This material represents an individual of intermediate size, relative to three previously reported specimens, and provides insight into ontological changes in the skull of H. rogersii through ontogeny.

Technical Session VIII (Thursday, October 18, 3:30 pm)
PATTERNS AS PRETTY AS CAN BE: THE RANGE AND EXTENT OF THE VALLESIAN CRISIS (LATE MIocene) IN THE VALLES-Penedès BASIN (Catalonia, Spain)
CASANOVA-VILAR, Isaac, Instituto Catalá de Paleontologia Miquel Crusafont, Cerdanyola del Vallés, Spain; VAN DEN HOEK OSTESENDE, Lars W., Netherlands Centre for Biodiversity, Leiden, Netherlands; PURIO, Marc, Institut Catalá de Paleontologia Miquel Crusafont, Cerdanyola del Vallés, Spain; MADEURN, Anneke, Netherlands Centre for Biodiversity, Leiden, Netherlands

In analyses of patterns and trends in past diversity, undesirably biased associations with the fossil record must be taken into account. Sampling of the record is uneven, with variation in both the temporal spacing of the fossil-bearing sites and their quality of preservation. Often the richest or better sampled sites (or time intervals) show a greater diversity than less well known ones simply because many more rare taxa are recovered. Therefore, a single peak in the quality of the record would exaggerate the recorded diversity as well as origin and extinction rates. Robust diversity estimates must assess such biases either by excluding those taxa known from just one single site or time interval which is supposed to be better sampled, or by taking into account the sample size recovered in each locality and the probability of sampling a particular taxon in subsequent localities. Here we analyze the effects of the quality of the small mammal record in our understanding of the Vallesian Crisis, an important turnover event said to have affected European mammal faunas by the beginning of the late Miocene. The Vallesian Crisis was initially recognized as a local event that implied the extinction of certain rodent and artiodactyl genera coinciding with the early/late Vallesian boundary (at 9.7 Ma). Subsequent studies increased the range and extent of this event to encompass all Europe and involved a great number of mammal taxa. Here we focus on the Vallesian rodent and insectivore record of the Vallé-Penedès basin (Catalonia, Spain), where the crisis was first recognized. We show that the quality of the record before the crisis is comparatively much better than afterwards so diversity appears inflated and extinction rates are overemphasized. Accordingly, we used the probability of sampling a given taxon as well as rarefaction to calculate new diversity measures independent of sample size. These measures virtually eliminate the Vallesian Crisis, showing that diversity somehow decreased during the earliest late Vallesian and soon recovered afterwards. This is because several rare taxa, customarily said to have disappeared during the crisis, are in fact present. Amongst the rodents and insectivores these taxa include genera that are generally rare and show a discontinuous record during the early Vallesian. These presumed specialists suggest that we have thought about humid forested environments such as flying squirrels, beavers, or certain dormice, most of them recorded only when the sample size is large enough. Some of them are in de facto present in a few late Vallesian sites, thus supporting our interpretation. Alternatively, these genera may have been associated with very specific habitats that, for unknown reasons, were not sampled during the late Vallesian. Our results cast serious doubts on the very existence of the Vallesian Crisis suggesting that rather than an abrupt event, a series of extinctions occurred during a longer time span. While it has not been evaluated whether the same pattern will be observed in large mammals or faunas in other areas, previous approaches have generally omitted the bias introduced by the quality of the record and, as shown here, they may importantly affect diversity calculations.

Technical Session II (Wednesday, October 17, 12:00 pm)
DIVERSITY, ABUNDANCE AND TURNOVER IN THE ANTARCTIC MARINE FAUNA DURING THE EOCENE IN RESPONSE TO CLIMATE CHANGE
CASE, Judd A., Eastern Washington University, Cheney, WA, United States

The La Meseta Formation crops out on the northern end of Seymour Island, northeastern Antarctic Peninsula and its deposits have been dated by 87Sr/86Sr ratios to range from 54.2 Ma to 34.2 Ma, thus encompassing nearly the entire Eocene. The La Meseta Formation spans an 18 million year time frame and exhibits an 8°C drop in ocean temperature from 11°C to 3°C. The La Meseta Fm is divided in seven stratigraphic units (Telm 1-7); in units Telm 3-5, spanning from 54.2 Ma to 45.2 Ma, the diversity index of neoselachian sharks is very high (H= 1.814), nearly equaling the shark diversity values (H= 1.920) in the modern tropics today, with high levels of abundance as well. Penguin diversity is high (H= 1.619), with low levels of abundance (10% of marine vertebrate fauna), while cetacean diversity (1 species) and abundance are low. In units Telm 6 and 7 (41.0 Ma to 34.2 Ma), a significant portion of the crustacean fauna is retained, and skeletal changes in vertibrate diversity are seen. Sharks are now extremely rare in the two upper units, penguin diversity remains high but abundances dramatically increase (90% of marine vertebrate fauna). The cetacean fauna shows only a slight increase in diversity, however cetacean abundance shows a substantial increase. The drop in ocean temperature and the changes in marine vertebrate diversity and abundance seem to coincide with a deep water opening of the Drake Passage around 41 Ma.

Technical Session X (Friday, October 19, 8:15 am)
A NEW TATARIAN DICYDOND FROM MOZAMBIQUE
CASTANHINHA, Rui, Instituto Gulbenkian de Ciencia and Museu da Lourinhã, Lisbon, Portugal; ARAÚJO, Ricardo, Southern Methodist University and Museu da Lourinhã, Dallas, TX, United States; COSTA JÚNIOR, Luis, Museu Nacional de Geologia, Maputo, Mozambique; ANGIECZYK, Kenneth D., Field Museum of Natural History, Chicago, IL, United States; MARTINS, Rui, Instituto Tecnológico e Nuclear and Museu da Lourinhã, Lisbon, Portugal

A nearly complete three-dimensionally preserved skull and mandible, with a series of 19 articulated dorsal, sacral and tail vertebrae, ribs, ilia, partial pubis and femur (ML1620) was collected from the Late Permian Karoo sediments, Metangula Graben, northern Mozambique (Niasa Province), Cáodzi Formation. The specimen can be distinguished by the following four autapomorphies: radiating pattern of vascular foramina plus grooves and ridges on a dorsal surface of the frontal, weakly scalloped ridge on the dorso-lateral surface of the prearticular, shoe-shaped profile of the articular surface of the quadrate in posterior view and...
a waterfall-shaped interpterygoid vacuity. Micro-CT visualization of the internal cranial bones combined with a phylogenetic analysis demonstrate a set of characters shared with Euamantellidae (namely, the interparietals contribute to the intertemporal skull roof and lateral denta1y shelf present and well developed) and Emydopoidea (namely, palatal surface of premaxilla with groove-like depressions that have straight sides and a rounded anterior end). However, the absence of both caniniform depression and keel-like extension of the palatal rim posterior to the caniniform process plus symphyseal region of lower jaw with an upturned margin that is raised above the level of the dorsal surface of the jaw rami with a scooped-out depression on its posterior surface is distinct from Emydopoidea. Moreover, the possession of 6 maxillary tooth positions and 11 denta1y teeth is also distinct from emydopoids, none of which possess non-caniniform teeth. On the other hand, the presence of the lateral palatal foramen at the level of the anterior, expanded palatal exposure of the palatines is distinct from Euamantellidae.

This specimen was collect as a result of an annual expedition that started in July 2009. Since then, important fossil sites have been discovered. The sediments are Tatarian in age which is equivalent to the Beaufort Group, possibly correlable to the Cistecephalus Assemblage Zone from South Africa. Mozambique offers a new window of unstudied sites suggesting that a complete faunal list from the East African Late Permian is still far from being accomplished.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
THE FIRST RECORD OF AN APATEMYID FROM OREGON: SINCLAIRELLA DAKOTENSIS FROM THE TURTLE COVE MEMBER OF THE JOHN DAY FORMATION
CAVIN, Jennifer L., John Day Fossil Beds National Monument, Kimberly, OR, United States; SAMUELS, Joshua X., John Day Fossil Beds National Monument, Kimberly, OR, United States
Sinclairella dakotensis is a rare and unusual species belonging to the family Apatemyidae, a group of archaic insectivorou1 mammals of uncertain phylogenetic affinities. Here we report a new occurrence of S. dakotensis from the Arikareean aged Turtle Cove Member of the John Day Formation, Oregon. Two isolated teeth, a lower first incisor and an upper second molar, were found at two separate sites. Both were located in Unit C of the Turtle Cove Member in the Blue Basin area of John Day Fossil Beds National Monument. Because of the well-studied stratigraphy with persistent, traceable ash layers found in the Turtle Cove Member of the John Day Formation, these finds can be dated to between 29.75 and 28.8 Ma. The distinctively enlarged lower incisor, and morphology and measurements of the M2 were consistent with published descriptions of S. dakotensis from the Great Plains region. S. dakotensis has previously been found in Chadronian to early Arikareean aged deposits from South Dakota, North Dakota, Colorado, Nebraska, and Saskatchewan. This find represents the first occurrence of the taxon west of the Rocky Mountains and possibly the youngest dated occurrence to date. Due to the hypertrophied, procumbent incisors and elongate digits on the manus, apatemyids are thought to have ecologically similar to extant "wood-land" species and may have occupied a similar niche in their environment.

Poster Session II (Saturday, October 20, 4:15 - 6:15 pm)
REVIEW OF A MIOCENE CARASSUS-LIKE CYPRINID LUCYPINUS (TELEOSTEI, PISCES) FROM EAST CHINA AND ITS BEARING ON FRESHWATER FAUNAL EXCHANGE BETWEEN EUROPE AND ASIA
CHANG, Mee-Mann, JVP, Beijing, China; CHEN, Gengjiao, Natural History Museum of Guangxi Zhuang Autonomous Region, Nanning, China; LIU, Huanzhang, Institute of Hydrobiology, Wuhan, China
Fossil cyprinids from the late early Miocene of Shanwang diatomite quarry, Shandong, East China were first studied by Young and Tchang, who referred some to the genus Cyprinus. Fossil cyprinids from the late early Miocene of Shanwang diatomite quarry, Shandong, East China were first studied by Young and Tchang, who referred some to the genus Cyprinus. Compared with living Cyprinus and Carassius, its dorsal fin is comparatively short and slightly backwardly situated. Similar fossils, i.e., several species of Plaurocorax, have been found from Europe and Middle Asia from the early Miocene onward. The Carassius-like forms from Europe and Asia are more similar to each other than to their Recent kin. This implies that there must have been faunal exchanges between the two regions after disappearance of the Turgai Strait, and subsequent divergent evolution of the Carassius-like forms in each region.

POSTER SESSION II (Thursday, October 18, 4:15 - 6:15 pm)
The Anat0my and Phylogenetic Placement of the Cretaceous Stem Turtle Naomichelys Speciosa
CHAPMAN, Sandra D., Natural History Museum, London, United Kingdom; STERLI, Juliana, CONCET-Museo Egido Ferguio, Trelew, Argentina; LYSON, Tyler R., Yale University, New Haven, CT, United States; JOYCE, Walter G., University of Tubingen, Tubingen, Germany
Naomichelys speciosa is a highly unusual turtle from the Cretaceous of North America. The type specimen consists of an isolated entochephalon that was discovered in Aptian/Aptian sediments in Montana more than 100 years ago and that was diagnosed as a new species of turtle by its unusual surface sculpturing consisting of raised tubercles. A small number of additional fragments have since extended the temporal range to the Campanian and the spatial range to Alberta, Maryland, Oklahoma, Texas, Utah, and Wyoming, but these specimens add little to help understanding the anatomy or phylogenetic position of this enigmatic taxon. The unique surface sculpture of the shell, how sculptural modification and the presence of tubercles are organized relatively recently as well as the fact that the fossil turtle is known from discovered in Europe turtles of the clade Selyemidae and N. speciosa is now generally recognized as a representative of that clade.

Field crews of the Field Museum of Natural History discovered an unusually well-preserved, near complete skeleton of Naomichelys speciosa in the Aptian/Aptian Trinity Sands of Texas in the 1950s, but the specimen was never described in any detail, likely because the braincase is only partially preserved. A phylogenetic analysis places N. speciosa as sister to the solenmydid taxon Helochelydra nobispalai from the Early Cretaceous of England and Solemys vermuculata from the Late Cretaceous of Spain based on the complete lack of an ossified processus interfrontalis, formation of a secondary pair of "basioctipical tubercules" by the pterygoids, and based on the presence of V-shaped anterior peripherals, a supernumerary entoplastral scute, and the unique surface ornamentation. Among others, the presence of a secondary intertubercular fossa, extension of the upper temporal roofing posterior to the level of the basioctipical condyle, and primitive cervical vertebrae with a biconvex fourth cervical place N. speciosa within the clade Meloanomidae. Meloanomidae is therefore known to have had a near global distribution in the Cretaceous, a pattern best explained by vicariance. The presence of large nasals, confluent external nares, a single vomer, eleven premaxillae, 5 peripheral vertebrae, 8 maxillae, 3 scapulae, 4 clavicles, and the absence of lacrimal, supratemporal, temporal emarginations, palatal teeth, and supramarginals support placement of N. speciosa just outside of crown Testudines. The presence of limb osteoderms and short digits support the hypothesis that N. speciosa was a terrestrial turtle.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
MEASURING THE PENGUIN HUMERUS: THE IMPACT OF INTRASPECIFIC VARIATION ON QUANTITATIVE CHARACTERS
CHAVEZ-HOFFMEISTER, Martin F., School of Earth Sciences, University of Bristol, Bristol, United Kingdom
Isolated skeletal elements are often used as type specimens in vertebrate paleontology. In the case of fossil penguins, the humerus has been one of the most widely used elements, but its reliability for taxonomic treatment has only been recently studied. It has been suggested that angular measures are useful for discrimination of taxa at different levels; however these results have been based on the use of average values for the studied species. This study aimed to evaluate the impact of intraspecific variability on our ability to use metric characters for taxonomic treatment. Through the expansion of published sets of linear and angular measurements, the distributions of data for four species of extant penguins are analysed through the construction of modified logarithmic differences diagrams. This modification consists of the use of box plots instead of linear graphics to show the distribution of data in each measure analyzed. The results show that: 1) the use of average values for the evaluation of measures is inadequate; 2) the proportions between measures vary for each individual; 3) each measure has different ranges of variation; and 4) the angular measurements have wide ranges of variation. Comparing the three species of the genus Pygoscelis to each other, only four of the 12 measures evaluated are reliable for all three species and none of the measures allows their discrimination. This exemplifies the difficulties of using isolated elements for taxonomic purposes and the importance of considering intraspecific variability of each character to identify which of them can be useful for taxonomy.
AN EARLY SPADEFOOT TOAD (ANURA: PELOBATIDAE) FROM THE LATE PALEOCENE - EARLY EOCENE OF TSAGAN KHUSHUU, MONGOLIA, AND ITS IMPLICATION FOR THE PHYLOGENY AND BIOGEOGRAPHY OF THE PELOBATIDAE

CHEN, Jianye, American Museum of Natural History, New York, NY, United States; NORELL, Mark A., American Museum of Natural History, New York, NY, United States

Here we report a new spadefoot toad (Anura: Pelobatidae) from Tsagan Khushuu, Mongolia, based on a nearly complete skeleton. The age of the fossil is late Paleocene-Eocene, slightly older than the earliest *Epodelobates* from Europe. Skeletal features uniting this fossil with living spadefoot toads include the presence of metatarsal spade, prococelous centra, absence of ribs, dilated sacral diaphysis and monocoelar sacrum-urostyle articulation. Notably it documents the earliest record of spadefoot toads that have a bony spade in foot adapted for burrowing. Two phylogenetic analyses are performed to determine the relationships of the new fossil, one using a croacobatrachid phylogeny (29 taxa/65 characters) and one within the Pelobatidae (17 taxa/37 characters). The results show that the new taxon represents the most basal member of the Pelobatidae. Interestingly, it also suggests that, within the Pelobatidae, neither African fossil taxa nor the two extant North American genera (*Spea* and *Scaphiopus*) are monophyletic. Therefore, we conducted an empirical biogeographic analysis. A Bayesian MCMC process with a widespread root is performed based on the Pelobatoidea phylogeny. Excluding very fragmentary records from the Mesozoic, the results indicate that spadefoot toads are likely to have an East Asian origin, with dispersal to North America during the Early Eocene, a succeeding dispersal from North America to Europe right after, and a dispersal from North America back to East Asia sometime between Early Eocene and Early Oligocene.

Technical Session X (Friday, October 19, 11:15 am)

LOCOMOTOR INFERENCE OF FOSSIL MAMMALS BASED ON QUANTITATIVE MORPHOMETRIC ANALYSIS OF THE POSTCRANIAL SKELETON OF SMALL-BODIED EXTANT TAXA

CHEN, Meng, University of Washington, Seattle, WA, United States

Recent studies of fossil mammal skeletons from the Jehol Group of western Liaoning, China, which is known for its well-preserved Mesozoic vertebrate fossils, have revealed a much greater diversity of locomotor adaptations of Mesozoic mammals than previously known. These Mesozoic taxa provide a unique opportunity to study their paleoecology. Instead of the traditional perception that Mesozoic mammals were generalized terrestrial animals excluded by the dinosaurs from more specialized ecological niches, these discoveries indicate that mammals of the Jehol Group likely occupied a breadth of ecological niches, possibly approaching the ecological diversity of extant mammals.

To develop a method to quantify the range of locomotor morphotypes among Mesozoic mammals, I conducted a morphometric analysis of the entire postcranial skeleton of 51 small-bodied extant mammals of 13 orders, including Aves, Carnivora, Chiroptera, Didelphimorphia, Dasyuromorphia, Diprotodontia, Erinaceomorpha, Monotremata, Peramelemorphia, Primates, Rodentia, Scandentia, and Soricomorpha. Eight locomotor categories were used: arboreal, gliding, scanorial, terrestrial, fossorial, semi-fossorial, semi-aquatic, and salterial. Twenty-four osteological indices were derived from 54 linear measurements of the entire postcranial skeleton in contrast to the indices of individual elements applied in previous studies. Linear Discriminant Analysis of those indices shows statistically significant differences among the diverse locomotor categories. In the plots of Linear Discriminant Analysis, fossorial and salterial mammals have particularly distinctive postcranial skeletons, whereas arboreal, scanorial, and terrestrial mammals show some overlap suggesting that similar morphological features may respond to different locomotor adaptations. Two fossil representatives, *Lioconodon* and *Fructisaurus* are shown by principle Component Analysis to plot among generalized terrestrial and specialized fossorial mammals, respectively. This preliminary study suggests that this quantitative morphometric analysis of the entire postcranial skeleton supports the conclusions drawn from previous qualitative studies of individual features of limb skeletons. Moreover, this method helps identify the critical indices derived from the entire postcranial skeleton for distinguishing locomotor categories and with just several simple measurements estimates the locomotor adaptation of fossil mammals more accurately and effectively than previous qualitative methods.

Technical Session XVI (Saturday, October 20, 11:00 am)

ISOTOPE ANALYSES SUPPORT USE OF CT SCANS FOR IDENTIFYING ANNUAL INCREMENTS IN SNOWMASS MASTODON MANDIBULAR TUSKS

CHERNEY, Michael D., University of Michigan, Ann Arbor, MI, United States; FISHER, Daniel C., University of Michigan, Ann Arbor, MI, United States; ROUNTREY, Adam N., University of Western Australia, Perth, Australia; CALAMARI, Zachary T., University of Michigan, Ann Arbor, MI, United States

At an altitude of almost 3km in the Colorado Rockies, the Snowmass site gives a rare look at a high-elevation ecosystem from the late Pleistocene of North America. Recent studies have shown that the roughly 4000 *Mammut americanum* bones recovered from the site include tusks of about 35 individuals ranging from calves to senescent adults. The assemblage may represent the combination of many independent single-death events, but it has also been proposed that semicircular induced liquefaction of sediments on the shoreline might have trapped entire groups of mastodonts. We aim to evaluate the nature of the assemblage by analyzing tusks to compare the timing of death for many individuals. Mastodont tusks grew throughout life and are marked by annual, fortnightly, and daily growth increments that enable fairly precise season-of-death determinations. Furthermore, many studies have shown consistent seasonal patterns in the stable isotope composition of tusk dentin. Multi-year comparisons will be used to determine if animals that died in the same season actually died simultaneously, in the same year.

Mastodon mandibular tusks are numerous at the site and convenient for censusing, but their annual growth increments are often obscure. However, X-ray computed tomographic (CT) scans of mandibular tusks reveal cyclic features in dentin density that appear to correspond to annual growth increments. Previously reported oxygen isotope (δ18O) data from one tusk support this interpretation of the CT data. Additional serial isotope analyses combined with increment thickness profiles now further reinforce this interpretation. The δ18O and nitrogen isotope (δ15N) series from the Snowmass tusks consistently show elevated values during periods of winter growth and work to correspond to winter. Periodic peaks in δ15N probably result from winter nutritional stress. However, the simultaneous high δ18O values are contrary to expectations for mid-latitude temperate regions, where meteoric water δ18O tends to display higher values in summer and lower values in winter. Explaining this “inverted” δ18O signal in Snowmass mastodon tusks requires invoking either a seasonal pattern of water source variation shared by individuals at the site or a mechanism for enrichment of δ18O in the local water source during the winter months. Enrichment in δ18O of snow pack due to sublimation during the cold, dry, high-altitude winters may explain the anomalous oxygen values. Isotopic patterns from Snowmass mastodon tusks are consistent among individuals, present a first look at seasonal variation in a high-altitude population of mastodonts, and support the interpretation of annual increments in CT data.
angustis, Didactylornis jii, and Shenshiornis primita—whose validity has yet to be critically assessed. We present the results of a qualitative and quantitative analysis of twelve specimens, including the aforementioned holotypes and new specimens. The regression models reveal that the observed limb elements are more closely related than currently thought.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
MORPHOMETRICS OF RATITE FEMORA AND IMPLICATIONS FOR SEXUAL DIMORPHISM IN DINOSAURS
CHIBA, Kentaro, Natural History Sciences, Hokkaido University, Sapporo, Hokkaido, Japan; BRINK, Kirstin S., University of Toronto Mississauga, Mississauga, ON, Canada; KOBAYASHI, Yoshitugu, Hokkaido University Museum, Hokkaido University, Sapporo, Hokkaido, Japan; SUZUKI, Daisuke, Sapporo Medical University, Sapporo, Hokkaido, Japan

Sexual dimorphism in non-avian dinosaurs has traditionally been studied based on cranial material, especially in taxa with ornamental display structures (e.g., ceratopsians and hadrosaurids). However, with the exception of a rigorous morphometric study of Kentrosaurus, few studies have focused on assessing sexual dimorphism in postcraniomandibular or postcranial skeleton. This may be due to the fact that sexual dimorphism was studied in postcranial skeleton and in the skeletons of exant analogues, such as Alligator mississippiensis, is poorly known. Here, we test for sexual dimorphism in the femur of the ratites (Struthio camelus and Dromaius novaehollandiae), which are basal members of modern birds. As these ratites show a sexual size dimorphism, they are ideal to test whether morphological sexual dimorphism independent of size can be detected in the skeleton. We performed a principal components analysis (PCA) on geometric morphometric data of the femur of males and females at a variety of growth stages. The bones were analyzed from photographs in proximal, distal, anterior, and posterior view, using landmarks and semilandmarks. In the ostriches, three distinct groups are detected: juveniles, adult females, and adult males. The adult groups are separated from the juvenile group by the morphology of the proximal end of the femur and the proportions of the lateral condyle. Adults of both sexes differ from juveniles by having a thicker neck of the head of the femur and a longer and more medially placed condyle. Parallel group. Adult females differ from males by having an anterolaterally-rotated head of the femur and an expanded proximolateral margin of the trochanter. Interestingly, the morphological differences of the trochanter are also dimorphic in Kentrosaurus. On the other hand, there are no significant morphological differences between sexes in the emus, but the adults are distinguished from juveniles by the robustness of the neck of the head of the femur, as seen in the ostriches. This suggests that the dimorphism in emus is only size-related and not morphological. Our study demonstrates that the presence of morphological sexual dimorphism is variable, even in closely related taxa. When morphological sexual dimorphism is present, it may be detected in the femur using geometric morphometrics. An understanding of the sexual dimorphism in ratites has implications for the interpretation of sexual morphological dimorphism in dinosaurs, as dinosaurs may exhibit both sexual size dimorphism and morphological sexual dimorphism.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)
NEW INFORMATION ON QWEBASARUS THWAZI, A COELUROSAURIAN THEROPOD FROM THE EARLY CRETACEOUS (HAUTERIVIENIAN?) KIRKWOOD FORMATION IN SOUTH AFRICA
CHONIERE, Jacon N., Bernard Price Institute, University of the Witwatersrand, Johannesburg, South Africa; FORSTER, Catherine A., George Washington University, Washington, DC, United States; DE KLERK, William J., Albany Museum, Rhodes University, Grahamstown, South Africa

We performed additional preparation on the holotype skeleton of Qwebasaurus thwazi and discovered new material from the holotype. We describe this material, which includes a maxilla with small, conical, un serrated teeth and bones of the braincase, as well as parts of the holotype postcranial anatomy that were previously poorly documented. We incorporate this new anatomical information into a broadly sampled matrix designed to test theropod relationships. Our phylogenetic results hypothesize that Qwebasaurus is the basalmost ornithomimosaur, and we recover numerous characters supporting this relationship, including features of the maxilla, frontal, dentition, axial skeleton, forelimb and hindlimb. Qwebasaurus is the first African ornithomimosaur and the first Gondwanan member of this group known from articulated skeletal material, supporting the hypothesis that coelurosaurian groups were cosmopolitan during their early evolutionary history. The presence of reduced dentition and a gastral mil in Qwebasaurus strongly suggest that this taxon was herbivorous. Additionally, some features of the anatomy suggest alvarezsaurid affinities, strengthening the possibility that alvarezsaurids and ornithomimosaurids are more closely related than currently thought.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)
BODY SIZE RECONSTRUCTION FOR FOSSIL NORTH PACIFIC PINNIPEDIA (MAMMALIA: CARNIVORA): PROBLEMS AND IMPLICATIONS
CHURCHILL, Morgan, University of Wyoming, Laramie, WY, United States; CLEMENTZ, Mark T., University of Wyoming, Laramie, WY, United States; KOHNO, Naoki, National Museum of Nature and Science, Tokyo, Japan

Animal body size is strongly correlated with a variety of ecological variables, including trophic position, diversity of prey, and species range size. However, body size can be difficult to quantify for fossil taxa, as whole skeletal material is rare. To produce estimates of body size for fossil pinnipeds (seals, sea lions, and walruses), we regressed the log of 14 cranial measurements against log body weight and total length. Cranial measurements were selected based on their frequency of preservation within fossil taxa, ease of measurement, and presence of the measured feature across different pinniped families. Over 400 adult specimens of both genera, representing all 33 extant species, were examined. Two different sets of equations were created: 1) a set based on measurements from specimens of known size increase and the appearance of dentitions capable of the shearing forces required for the breakup of tough plant matter. The timing and nature of this transition has not yet been evaluated, however, multituberculates radiated in size and, presumably, function just prior to the K/T extinction, but the degree to which the placental mammals that replaced them were ecologically similar is unknown. Changes in mammalian diet in the Paleocene were investigated using molar shearing crest length in series with low-magnification microwear techniques, which together allow for the evaluation of an animal’s dietary niche (insectivore, carnivore, grazer, browser, hard-object feeder) more precisely than is usually possible by analyzing either tooth shape or microwear alone. There was an initial transition from predominantly insectivorous communities in the Judithian to a more dietarily diverse mammalian fauna in the Maastrichtian, in which some multituberculates adapted to a high-fiber (leaves/brows) diet. These larger and more herbivorous forms disappeared at the boundary; the Puerkan communities that immediately followed were dominated by insectivory and hard-object feeding/micromorphology. Hard-object feeding remained dominant among mammalian faunas through the Paleocene even as both taxonomic and size diversity increased. Evidence of predominant high-fiber diets does not re-appear in any taxa until the late Paleocene, when a general increase in insectivory and hard-object feeding occurred. The shift to a high-fiber diet in the Paleocene is supported by geological and paleontological evidence. The delay in the appearance of high-fiber diets for several million years is remarkable and may reflect both intrinsic biological factors, such as the need to re-evolve the herbivore gut flora, and extrinsic factors, such as the potential abundance of fruit fall in the Paleocene forests of the western interior before regional drying led to more open environments.
ESLASMOBRANCH AND OSTEOCHITINIAN DIVERSITY FROM TWO LATE CREATACEOUS (LATE CAMPANIAN) TRANSgressive LAG DeposITS ALONG THE NEW JERSEY RIVER, LOEN COUNTY, NORTH CAROLINA

CIAMPAGLIO, Charles N., Wright State University, Celina, OH, United States; CIUMBURU, David J., South Carolina State Museum, Columbia, SC, United States

Along the Neuse River in western and central Lenoir County, NC, two transgressive lag deposits expose copious amounts of vertebrate material, including chimaerid jaw plates, elasmobranch teeth and denticles, and bony fish remains. The first site, commonly referred to as Auger Hole Landing, is located at the junction of the Neuse River and the Wayne/Lenoir county line, and consists of the basal Bladen Formation. The lithology consists of three distinct horizons, including a basal arenaceous shell bed, a calcareous sandstone that contains a diverse assemblage of well-preserved mollusks, and an upper greenish-gray, clayey, glauconitic sand. All three horizons contain well preserved elasmobranch and osteichthyan remains.

The upper horizon at Auger Hole Landing has been extensively sampled and investigated. This horizon can be divided into a lower and upper unit, each of which is composed of glauconitic clays overlain by poorly sorted quartz sands and clays. Both units contain abundant elasmobranch remains, including, but not limited to the following species: Brachyacanthus wickiena, Rhombodus laevis, Bororidinopsis schwimmeri, Cantiscyllum sp., C. mayeri, Chiloscyllium sp., Pilacitoscyllium minutum, Ischyrysa mira (Orla), Ptychotrygon cuipidata, Ptychotrygon vermiculata, Squilariscus kaupi, Squatinus hasselii. Bony fish include Enchodus petrurus and Anomoaedes latidens. The second site is exposed just upstream of the US 70 bridge. Here, the lithology is composed of a basal, thinly laminated sand and clay, overlain by glauconitic sand that contains quartz gravel, phosphatic pebbles, and copious elasmobranch and bony fish remains. The exposure is sp. by an approximately four-inch thick lens of arenaceous limestone containing phosphate pebbles and vertebrate remains. Although this transgressive lag most likely represents the basal Donoho Creek Formation, the chondrichthyan fauna is associated with the Bladen Formation. The chondrichthyan fauna includes, but is not limited to: Ischyodus bifyratus, Chiloscyllium sp., Odontaspis aculeata, Serratolamanna serrata, Scapanorhynchus texanus, Bororidinopsis schwimmeri. Bony fish include Pachyrhizodus sp., and Plethodon sp.

Both sites expose well preserved abundant and diverse chondrichthyan and bony fish faunal elements. Taken together, the two sites preserve the vertebrate biota of the upper and lower boundaries of the Bladen Formation exposed within the coastal plain of North Carolina.
CHALLENGE AND MOLECULAR CHARACTERIZATION OF ENDODGENOUS PROTEINS FROM THE BLOOD VESSELS OF BRACHYLOPHOSAURUS CANADENSIS AND TYRANNOSAURUS REX CORTICAL BONE
CLELAND, Timothy P., North Carolina State University, Raleigh, NC, United States

Vessel-like structures (referred to herein as vessels for brevity and clarity) have been observed after demineralization of extant and fossil bone from the Recent to the Cretaceous; however two competing hypotheses have been suggested as the source of these structures: they are endogenous, representing original blood vessels; or they are the result of recent invasion and colonization of biofilm-producing bacteria. We hypothesized that if original, the structures would exhibit proteins in common with comparable vertebrate material that are not expressed by bacteria. Vessels from a specimen of Brachylophosaurus canadensis (MOR 2598) and Tyrannosaurus rex (MOR 1125) were collected after cortical bone fragments were demineralized with ethylenediaminetetraacetic acid (EDTA) using aspetic techniques in a laboratory dedicated solely to fossil analyses to avoid contamination. Antibodies against several vascular proteins differentially bind these dinosaur soft tissues in multiple assays, supporting the hypothesis of endogeneity. The same antibodies do not bind to bacterial biofilm. High-resolution mass spectrometry also supports an endogenous source, as peptides from myosin, tubulin, actin, and tropomyosin have been detected from the B. canadensis specimen and peptides from myosin and actin have been detected from the T. rex specimen. Myosin and tropomyosin are only found in metazoan taxa, and tubulin is only found in eukaryotic taxa; these proteins are not common lab contaminants. Purgatorid vessels are remnants of original dinosaur vasculature.

PATTERN OF IMMIGRATION OF PURGATORIIDS AND OTHER EUTHERIANS INTO THE NORTHERN NORTH AMERICAN WESTERN INTERIOR
CLEMENS, William A., University of California Museum of Paleontology, Berkeley, CA, United States; WILSON, Gregory P., University of Washington, Seattle, WA, United States

Immigration played a major role in reconstitution of mammalian faunas of the northern North American Western Interior after the extinctions marking the Cretaceous/Paleogene boundary. Plesiadapiforms and multituberculates were among these immigrants. Large samples of vertebrate local faunas of Lancer and Puercan (Puercan 1 and probably Puercan 3 Interval Zones) North American Land Mammal Ages have been recovered from the Hell Creek and Tullock formations of northeastern Montana. In the collections of the University of California Museum of Paleontology from probable Puercan 3 local faunas found in the Garbani Channel, approximately 18 percent of over 7,300 currently cataloged mammalian specimens were identified as Purgatorius. Additional material has been identified in local faunas from the Puercan 1 interval, and was not found in large samples of Lancerian or Puercan 1 local faunas. For example, two thoroughly studied Puercan 1 local faunas documented by over 1,700 mammalian specimens lack any records of purgatoroids. Similarly they are unknown in any Lancian local fauna. Here we report discovery of a purgatoriid in the Puercan 1 local fauna found at the McKeever Ranch, Harley’s Point, locality. Lithostratigraphic correlations with magnetostatigraphic sections indicate that this local fauna lived during the more recent part of C29R. Continuing sampling of the locality has resulted in discovery of five isolated teeth, approximately three percent of the available sample, documenting the presence of a purgatoriid. Additional material will be needed to determine if it is referable to a currently recognized species of Purgatorius. This occurrence of a purgatoriid in Montana is approximately contemporaneous with or possibly slightly older than the recently reported first occurrence of Purgatorius, P. coracis, in Canada. Together they indicate that the immigration of purgatoriods into the northern Western Interior occurred soon after the immigration of the ecumodontid multituberculate Stygymys and the “archaic ungulates,” Oxyprinus, Protangulatum, Mimuta, and Basiconodon.

ONTOGENETIC VARIATION IN DENTAL STABLE ISOTOPE VALUES OF TWO SPECIES OF BASILOSAURIDS (ZYGORHIZA KOCHI AND DORUDON ATROX)
CLEMENTZ, Mark T., University of Wyoming, Laramie, WY, United States; UHREN, Mark D., George Mason University, Fairfax, VA, United States

Basilosauridae represent the most derived of the Eocene archaeocete cetaceans, and yet they lacks a detailed description. We describe numerous new remains of ‘Zygorythiza’ pigotti (Brasfield’s Crocodile) a poorly known and relatively small (approximately 2.5 m long), early Miocene crocodylid from Rusinga Island, Lake Victoria, Kenya. We report on previously unknown parts of the anatomy and provide an updated phylogenetic analysis. Known only from one relatively complete skull and limited, fragmentary, referred material, ‘Crocodile’ pigotti lacks a detailed description. We describe numerous new remains of ‘Crocodile’ pigotti recovered from a locality within the Fossil Bed Member of the Hiwgei Formation at Kasongwa Point, Rusinga Island. The new material includes parts of at least a dozen skulls, cervical, dorsal, and caudal vertebrae, scapulocoracoids, humeri, ulnae, parts of the manus, an ilium, an ischium, femora, and tibiae. The postcranial skeleton reveals a robust crocodylid with a ‘generalist’ skull. ‘Crocodile’ pigotti was originally compared to the Crocodylus niloticus morphotype and allied with it phylogenetically. However, recent phylogenetic analyses have shown ‘Crocodile’ pigotti to be an osteolaemine crocodylid, a result further supported by our own analyses. Even so, the gestalt of the relatively long and slender ‘Crocodile’ pigotti is more that of a subadult Crocodylus niloticus than the relatively shorter-faced Osteolaemus. This lends credence to the early suggestion that ‘Crocodile’ pigotti might have been ecologically similar to small or subadult generalist predator Crocodylus niloticus. An unnamed Miocene fossil from Lothagam Kenya probably represents another new Miocene osteolaemine similar to ‘Crocodile’ pigotti. Over its history, osteolaemine diversity has mirrored that of crocodyliforms—a fact not immediately apparent based on the two extant relictual species. Ranging from two to five-plus meters

PREPARATORS’ SESSION (THURSDAY, OCTOBER 18, 9:45 AM)
THE USE OF HIGH-RESOLUTION XRAY CT TO INTERPRET MATRIX VARIABILITY AND GUIDE FOSSIL PREPARATION
COLEBART, Matthew W., The University of Texas at Austin, Austin, TX, United States; BROWN, Matthew A., Vertebrate Paleontology Laboratory, The University of Texas at Austin, Austin, TX, United States

The process of fossilization is complicated and can be influenced by a multitude of geological, biological, and chemical factors. Because of this, variable patterns of sediment sorting, mineralization, and cementation are often found at the scale of an individual specimen. Such variations potentially complicates mechanical and/or chemical preparation, and may require different techniques to be applied to different regions of a fossil. The differences in preservation may also have taphonomic significance (e.g., evidence of bioturbation, preserved soft tissues), the context of which—or even the information in its entirety—is lost during conventional preparation. Commonly used for visualization of anatomical structures, CT scanning is a powerful tool that can often reveal variations in sedimentary sorting, cementation, and mineralization, in addition to physical damage to specimens, and thus serves as a useful guide during preparation. Here we present CT data showcasing the convoluted taphonomic histories of a variety of specimens ranging from the Paleozoic to the Quaternary. While these data illustrate a spectrum of preservational situations, they also demonstrate some commonalities in the fossilization process (e.g., predictable loci for cementation, and predictable patterns of sediment dispersal) that can inform specimen preparation. These data also serve as a caution against over-preparation, as there may be valuable information preserved in the matrix encasing a fossil. CT technology can be effectively used to develop a preparation or conservation strategy for a specimen that increases efficiency and minimizes information loss.

NEW SPECIMENS OF ‘CROCODYLUS’ PIGOTTI (CROCODILIDAE) FROM RUSINGA ISLAND, KENYA, AND A REFINED UNDERSTANDING OF THE SPECIES
CONRAD, Jack L., New York College of Osteopathic Medicine, Old Westbury, NY, United States; JENKINS, Kirsten, University of Minnesota, Minneapolis, MN, United States; DUNSWORTH, Holly M., University of Rhode Island, Kingston, RI, United States; HARCOURT-SMITH, William E., Lehman College, Bronx, NY, United States; MCNULTY, Kieran P., University of Minnesota, Minneapolis, MN, United States

During June and July of 2011, we recovered parts of more than a dozen ‘Crocodile’ pigotti (Brasfield’s Crocodile) a poorly known and relatively small (approximately 2.5 m long), early Miocene crocodylid from Rusinga Island, Lake Victoria, Kenya. We report on previously unknown parts of the anatomy and provide an updated phylogenetic analysis. Known only from one relatively complete skull and limited, fragmentary, referred material, ‘Crocodile’ pigotti lacked a detailed description. We describe numerous new remains of ‘Crocodile’ pigotti recovered from a locality within the Fossil Bed Member of the Hiwgei Formation at Kasongwa Point, Rusinga Island. The new material includes parts of at least a dozen skulls, cervical, dorsal, and caudal vertebrae, scapulocoracoids, humeri, ulnae, parts of the manus, an ilium, an ischium, femora, and tibiae. The postcranial skeleton reveals a robust crocodylid with a ‘generalist’ skull. ‘Crocodile’ pigotti was originally compared to the Crocodylus niloticus morphotype and allied with it phylogenetically. However, recent phylogenetic analyses have shown ‘Crocodile’ pigotti to be an osteolaemine crocodylid, a result further supported by our own analyses. Even so, the gestalt of the relatively long and slender ‘Crocodile’ pigotti is more that of a subadult Crocodylus niloticus than the relatively shorter-faced Osteolaemus. This lends credence to the early suggestion that ‘Crocodile’ pigotti might have been ecologically similar to small or subadult generalist predator Crocodylus niloticus. An unnamed Miocene fossil from Lothagam Kenya probably represents another new Miocene osteolaemine similar to ‘Crocodile’ pigotti. Over its history, osteolaemine diversity has mirrored that of crocodyliforms—a fact not immediately apparent based on the two extant relictual species. Ranging from two to five-plus meters
and with a variety of stout and tooth types. Osteolaeminae includes generalist dwarfs, presumably piscivorous giants, and a variety of forms between. Osteolaemines were a significant part of the Miocene freshwater fauna in Kenya.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

RECONSTRUCTION OF SUBFOSSIL LEMUR BITE FORCES USING DENTAL FRACTURE MECHANICS

CONSTANTINO, Paul J., Marshall University, Huntington, WV, United States; GODFREY, Laurie R., University of Massachusetts, Amherst, MA, United States; MEADOR, Lindsay R., University of Massachusetts, Amherst, MA, United States; SCHWARTZ, Gary T., Arizona State University, Tempe, AZ, United States

Nearly 20 species of now-extinct lemurs inhabited the island of Madagascar only a few thousand years ago. Each of these species was larger in body size than the largest of living lemurs, and some at least appear to have occupied niches that have not been refilled by surviving lemur species. To better understand lost niche space, we seek to reconstruct the maximum bite forces these lemurs could have exerted by using information on the fracture resistance of their teeth. Tooth enamel is a hard substance that does not deform easily under load. However, it is also brittle and highly susceptible to fracture. Previous work has shown that such fractures can be used as a diagnostic tool for reconstructing bite force in mammals with bunodont dentitions. Through simulated biting experiments on model tooth structures and extracted human molars, two principal fracture modes in enamel – longitudinal cracks and chipping – have been identified. Fracture mechanics theory from materials engineering allows one to derive explicit relations for quantifying critical bite forces from each crack type in terms of characteristic tooth size and enamel thickness. We determined values for these variables using whole teeth and sections of teeth in a number of subfossil lemurs. We then used these data to calculate and compare bite forces among these primates. Such a comparative study of bite forces can reveal important dietary differences among extinct species and can narrow the range of foods to which these creatures would have had access.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

FUNCTIONAL MORPHOLOGY OF ELONGATED VERTEBRAE IN BASILOSAURUS TO INTERPRET AQUATIC LOCOMOTION PATTERNS

CORMIE, Joshua E., Marshall University, Huntington, WV, United States

The elongated vertebral column unique to the archaeocete Basilosaurus is a highlight in the evolutionary transition within Cetacea from a semi-aquatic lifestyle to the fully aquatic lifestyle typical of modern whales. Because whales swim by dorsoventral flexion of the vertebral column, swimming speed and maneuverability are influenced by dimensional variations in the vertebral column. In this study, vertebral from the posterior thoracic, lumbar, and caudal regions were analyzed from fossil specimens of Basilosaurus. Analyses of vertebral characteristics included dimensions of centra, length and orientation of processes, and description of the enpyphyses. Results were compared to analyses of vertebrae from other archaeocetes to depict changes in vertebral morphology during the Eocene land-sea transition, and the coinciding evolution of aquatic locomotion. In addition, extant Odontoceti and Mysticeti specimens were used, providing examples of highly derived modern taxa to assess the morphological change from mid-Eocene basilosaurids (36-40 Ma) to modern Cetacea. Furthermore, vertebral dimensions (centrum length, width, and height) were used to compute the Vertebral Length Index (VLI) to show variations in centrum length across the vertebral column. The VLI included cervical vertebrae to observe foreshortening as aquatic competency increased during the land-sea transition. Vertebral characteristics observed in Basilosaurus indicate a high degree of flexibility, leading to an interpretation of a derived aquatic locomotion pattern combining dorsoventral and laterally oriented anguilliform swimming patterns with fluke generated propulsion. Furthermore, the high level of flexibility of the vertebral column in Basilosaurus probably allowed high maneuverability, but relatively low speed. The VLIs in Basilosaurus increase rapidly, beginning in the posterior thoraces and reaching values of ~225. Values remained just below 200 through the lumbars and ~175 in the anterior caudals before rapidly decreasing in the mid-caudal region. Rapid increase and sustaining of high VLIs indicates extreme elongation of centrum length.

In the early 1980s the noted fossil collector S. P. Wood discovered a pair of exceptionally intact specimens of Basilosaurus in a ca. 10 cm thick bonebed at the top of the Bladen Formation of the Black Creek Group. The bonebed, overlain by Cenozoic terrace deposits, is exposed at the new site, approximately 6 km from Phoebus Landing. The Elizabethtown site has yielded a greater abundance and diversity of vertebrate material than Phoebus Landing, thus permitting a more detailed understanding of the regional paleoecology. Bulk samples from the bonebed have yielded a diverse assemblage of fresh water, brackish water, and terrestrial organisms representing at least 44 taxa, including 22 species of selachians, seven species of osteichthyans, as well as crocodylomorphs, mosasaurs, freshwater and saltwater turtles, plesiosaurs, four dinosaur taxa, one genus of Mammalia, and one genus of Amphibia. Of particular note are the occurrence of Cimolomys sp., Albanerpeton sp., Deinosuchus ruggosus, Ornithosuchus sp., Dromaeosauridae gen. and sp. indet., Tyrannosauridae gen. and sp. indet., Hadasauridae gen. and sp. indet., and Bordinosaurus sp.

DELTOPTYCHIUS: CRANIAL CHARACTERS AND RETHINKING EARLY HOLOCOPHALAN PHYLOGENY

CRISEWILL, Katharine E., University of Chicago, Chicago, IL, United States; FINARELLI, John A., University College Dublin, Dublin, Ireland; FRIEDMAN, Matt, Oxford University, Oxford, United Kingdom; GARWOOD, Russell, Manchester University, Manchester, United Kingdom; COATES, Michael J., University of Chicago, Chicago, IL, United States

In the early 1980s the noted fossil collector S. P. Wood discovered a pair of exceptionally intact specimens of Deltoptychius, a Lower Carboniferous holocophalan, while excavating the fossil fish site at Beardsen, Scotland (Serapdchovian: ~326-318 Ma). We obtained a CT-scan of the most complete Deltoptychius specimen and have identified and digitally isolated parts of the skull, mandible, and pectoral girdle. Deltoptychius traditionally was diagnosed by features including a head shield made up of dermal plates and scales, supraorbital sensory line grooves on the surface of the dermal bones, presence of mandibular spines, but lack of frontal spines in the array present in the rest of its close relative, Menops. This specimen of Deltoptychius reveals numerous characters that were not previously known, including details of the braincase concealed by the dermotomarion. The orbits are separated by endocranial space: there is no interorbital septum. The quadrate is positioned anterior to the orbit and there is some evidence for a large crano-quadrate passage perforating the broad suborbital shelf. For the first time we can begin to see the internal structure of the otic capsules: these are small, as in living chimaeroids. Postcranially, the pectoral skeleton shows no synarcetal plate, consistent with absence of a dorsal fin and associated spine. It is also apparent that mineralized chondracenta are absent. These new data fill in previously-missing character state information for this taxon, and serve to falsify previous hypotheses of the evolution several functional character complexes, in particular the evolution of the paired sensory organs. Holocophalans represent an important component of the post-Devonian evolutionary radiation of modern vertebrate clades. This is a topic of
increasing interest as we begin to explore the refilling of vertebrate ecomorphospace in the recovery period following the Hangenberg extinction.

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 11:45 am)

ASYNTHESIS OF CENOZOIC NEOTROPICAL MAMMAL EVOLUTION IN SOUTH AMERICA: BIOGEOGRAPHY AND INFLUENCES FROM HIGHER LATITUDES

CROFT, Darin A., Case Western Reserve University, Cleveland, OH, United States

Fossil assemblages from the Southern Cone have long been the basis for understanding patterns of Cenozoic mammalian evolution in South America. More recent studies of assemblages from other parts of the continent have added a geographic dimension to this mainly temporal framework, revealing additional complexities. The present study synthesizes the past two decades of research on terrestrial Cenozoic mammals of tropical South America (the Neotropics). Within this region, spatial gaps in sampling and shared characteristics among faunas of each region permit the recognition of two subregions: low latitude (LL) faunas north of about 15° S and mid-latitude (ML) faunas south of 15° S.

The pre-Oligocene record of terrestrial mammals in tropical South America includes only two well characterized ML localities, Tiupampa, Bolivia and Itaborai, Brazil. The lack of unambiguously correlative and well-sampled extratropical localities during the Paleocene and early Eocene hampers biogeographic conclusions based on these sites, but circumscribed xenarthrans and microbiotherian marsupials may have originated in the tropics during this interval. New middle Eocene mammals from Contamana, Peru (LL) mostly remain undescribed but are noteworthy in including the oldest rodents in South America, suggesting a LL tropical origin for caviomorphs. Pyrotheres may also have originated in the LL tropics by the late Eocene.

The earliest interval for which detailed time-correlated comparisons of tropical and extratropical localities are possible is the late Oligocene. Such studies reveal few clear examples of suprageneric endemism in the Neotropics, but aegyptolagid and caenolestid marsupials and toluytpine armadillos may have originated in the LL tropics by this time. By the early Miocene, distributions of some suprageneric clades, such as mesotheriid notoungulates and chinchillid rodents, clearly differ among LL and ML Neotropical localities and between tropical and extratropical regions. This pattern persists into the middle Miocene with these and other groups. Primates become restricted to tropical latitudes during the middle Miocene and groups such as pangoliers may have originated in LL areas by this time. Range contractions of older lineages into the tropics and extratropical expansions of newly originating clades continues into the late Miocene and Pliocene. Mammals such as astrapotheres are last recorded in LL localities during this interval. Neotropical evidence of the earliest stages of the Great American Biotic Interchange is surprisingly scarce, but a proboscidean and artiodactyls from the LL Madre de Dios Formation have been proposed to represent its first phase in South America.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

MODELING FUNCTIONAL TRADE-OFFS OF TEETH FROM EXTINCT AND EXTANT HARD PREY CRUSHING TAXA

CROFTS, Stephanie B., University of Washington, Seattle, Seattle, WA, United States

The dense mineral composition of teeth, especially enamel and enamelled layers, means that they are commonly found in the fossil record. Because of the tight connection between tooth morphology and function, tooth shape is often used to infer the diet of organisms; and tooth morphologies are generally placed in one of three categories: cutting, piercing, and crushing. Experiments measuring the mechanics of cutting blades and puncturing devices, as well as experimental measurements of tooth performance in these two categories have found that notched blades reduce the energy needed to cut through animal flesh, and that the need to prevent tooth failure leads to a trade-off in the ability of canine teeth to puncture flesh. In this study I set out to test the relative ability of different tooth morphologies to crush prey items. I constructed four series of archetypal tooth models that graded from one morphological extreme to another, covering the range of morphologies used for durophagy. Using a tooth with a flat occlusal surface as 'tooth zero,' I varied the degree of convexity and concavity of the occlusal surface to generate two series of models. To generate the other two series, I added a conical stress concentrator to the center of the occlusal surface and changed its morphology. To vary the shape I changed two parameters: the height, or how far a force concentrator would extend above the occlusal surface of 'tooth zero,' and the radius, which determined how far the base of the force concentrator spread over the occlusal surface 'tooth zero.' By mounting these models in a materials testing system, I was able to measure the force needed by these shapes to crush morphologically and compositionally identical prey items. I compared these results to finite element models of these same tooth shapes to determine whether prey-breaking or prevention of tooth breakage plays a more important role in the evolution of crushing tooth shape. Based on these two data sets, it appears that there is a trade-off, similar to that seen in puncturing teeth, between tooth shape durability and tooth function.
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fibrolamellar tissue, near-qual spacing of lines of arrested growth (LAGs), and osteon development at outer bone margins, indicating that they were experiencing rapid growth at the time of death. However, this rate was decreasing in the largest individual, possibly indicating the onset of maturation. The two smaller individuals were determined to be two and three years of age at death, while the largest individual was determined to be four years old at the time of death. Of note is that LAGs and other histological signals remain consistent across the different hind limb elements examined within individuals. This indicates that for at least some small theropods, age at death can reliably be determined from various postcranial long bones. This has the potential to significantly increase the database available for determining growth patterns within various taxa as long as body size at the time of death can be determined.

Education and Outreach Poster Session (Posters displayed October 17 – 20)

TEEN SCIENCE SCHOLARS AT THE DENVER MUSEUM OF NATURE AND SCIENCE: NURTURING THE NEXT GENERATION OF SCIENTIFIC LEADERS


The Teen Science Scholar program (TSS) at the Denver Museum of Nature & Science involves high school youth (ages 15 to 18) in authentic scientific research in order to encourage their selection of an academic career path in science. The program began in 2007 with a focus in vertebrate paleontology and is now in its sixth year. Scholars are selected based upon academic performance, a personal objective to pursue an interest or career in science, recommendations on leadership and science interests, and the potential to be future community leaders. Special emphasis is placed on students who are underrepresented in the sciences, women and minority students, and who will be the first in their family to attend college. The program began in vertebrate paleontology and now includes additional tracks in zoology since 2009, health sciences since 2010 and archeology since 2011. Scholars in paleontology, zoology, and archaeology spend time doing field research collecting data and specimens. This is followed by six weeks of specimen preparation, identifications, and analysis in the Museum laboratories. Students in health sciences are involved in laboratory experiments and analysis. Students are paid for their work during the summer. The objective of each year’s program is to provide an authentic research experience that results in the development of new scientific knowledge and helps students understand the complete process of science. Scholars have finalized their research work through abstract publication, peer-reviewed papers including the description of new taxa, video presentations, and posters. Many of the students continue as Museum volunteers after the summer program. Students who have participated in the program are tracked to follow their educational development, careers, and interests in science. Among those that have graduated from high school over half are majoring in a science or engineering field. Of those who have graduated from college, all three are in postgraduate programs in science, one in paleontology. We anticipate that graduates in TSS will eventually become science mentors and role models for students in their communities.

LAMBEOSAURINE DINOSAURS OF THE EUROPEAN ARCHIPELAGO

DALLA Vecchia, Fabio M., Grup de Recerca del Mesozoic, Institut Català de Paleontologia Miquel Crusafont, Sabadell, Spain; PRIETO-MARQUEZ, Albert, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; GAETE, Rodrigo, Museo de la Conca Dellà, Isola, Spain; GALOBART, Angel, Grup de Recerca del Mesozoic, Institut Català de Paleontologia Miquel Crusafont, Sabadell, Spain

We document new specimens of lambeosaurine dinosaurs recovered from the upper Maastrichtian Tremp Formation (near-south Pyrenees, northeastern Spain) and re-evaluate the phylogenetic position of all European taxa, providing an assessment of the diversity and historical biogeography of these animals in the European Archipelago. Maximum parsimony analysis indicates that representatives of at least four clades of lambeosaurines lived during late Maastrichtian times in the Ibero-Armorican Island of the European Archipelago: the Aralosauridae, Tsintaosauridae, Parasaurolophidae, and Lambeosaurinae. A new taxon forms a sister relationship with Charonosaurus jiayinensis (upper Maastrichtian Yulangze Formation of northeastern China) supported by dentary teeth with a single median ridge and lacking marginal denticulation, and dentary with short (less than 20% dental length) proximal edentulous margin. Finally, Arroyerasaurus ardevoli, from the Tremp Formation, was deeply nested within helmet-crested lambeosaurines based on the possession of nasal articulation surface of the frontal shaped into an anterovesically-sloping platform, along other characters. Dispersal-vicariance analysis indicates that the most recent common ancestors of aralosaurids, tsintaosaurids, and parasaurolophids were widespread in Eurasia; their presence in the upper Maastrichtian of the Ibero-Armorican Island is most parsimoniously explained in this analysis by vicariant events taking place no later than the Santonian, early Campanian, and late Maastrichtian, respectively. Explaining the occurrence of A. ardevoli requires a dispersal event from North America to the European Archipelago or Eurasia no later than the late Campanian. However, those results are in contrast with the information yielded by the shared hadrosaurid record of Europe, and the Late Cretaceous paleogeographical reconstructions of the Northern Hemisphere and its geodynamic history. They are biased by the absence of hadrosaurid records from southwestern Asia during the Campanian-Maastrichtian.
A NEW LARGE-BODIED THEROPD Dinosaur from the UPPER MORRISON FORMATION (Late Jurassic, Tithonian) of Colorado  
DALMAN, Sebastian, Department of Geosciences, Fort Hays State University, Hays, KS, United States;  
PAULINA CARABAJAL, Ariana, CONICET-Museo Carmen Funes, Plaza Huincul, Argentina;  
CURRIE, Philip J., University of Alberta, Edmonton, Canada  
In 1953, J. T. Gregory and D. Teichert of the Yale Peabody Museum of Natural History discovered a partially preserved theropod skeleton in the Morrison Formation (late Tithonian) of Montezuma County, Colorado, U.S.A. The specimen consists of several well-preserved cranial, axial, and appendicular elements, some of which are still unprepared and embedded in hard sediment, explaining why this material lay largely unnoticed in the collections of the Museum until now. All the cranial elements, including the braincase, left premaxilla, maxilla, quadratojugal, and dentary were CT scanned so that digital 3D reconstructions could be done, allowing morphological description and comparisons. The McElmo specimen represents a large-bodied theropod, distinct from Allosaurus and Saurophaganax from the same formation. The specimen is characterized by a short and deep premaxilla (with 4 teeth), deep maxilla, and a robust quadratojugal. These cranial elements are more massive than the equivalent elements in known specimens of Allosaurus. Preliminary phylogenetic analysis, based on previous phylogenies of this clade, positions this new form within Allosauroidia, more closely related to Allosaurus, Fakuiraptor and Neovenator.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)  
MOLAR WEAR GRADIENT ANALYSIS IN EXTANT AND FOSSIL KANGAROOS (MARSUPIALIA, MACROPODOidea)  
DAMUTH, John, University of California, Santa Barbara, CA, United States; JANIS, Christine M., Brown University, Providence, RI, United States; TRAVOULLON, Kenny J., University of Queensland, Brisbane, Australia; ARCHER, Michael, University of New South Wales, Sydney, Australia; HAND, Suzanne J., University of New South Wales, Sydney, Australia  
We have developed techniques for the analysis of both relative and absolute rates of abrasive molar wear among species of kangaroos and wallabies (Macroproidea). The molars of fossil and extant macropodoids are lophodont, with relatively simple crowns dominated by large transverse ridges. These ridges wear down through a recognizable wear morphology sequence that is similar in all species. The overall rate of wear, however, appears to differ consistently among species. We assess relative wear rates for a species based on a comparison of the degree of wear among the lower molars of each individual. Since the four molars erupt in sequence from front to back, anterior molars will experience wear earlier in the animal’s lifetime than will posterior molars. Thus, for most of the adult lifetime there is a wear gradient along the molar row. The steepness of the gradient should indicate the average rate of abrasive wear, irrespective of the animal’s age.  
We tested this in a sample of 1,660 museum specimens (representing 73 species) of extant macropodoids. For each specimen, we visually scored the lower molar cusps according to a set of eight wear classes. The results confirm that steeper gradients (measured by linear least-squares slopes of wear class versus tooth position) are associated with species that are usually considered to experience higher rates of dental abrasion. For example, browsing, forest-dwelling macropodoids (Dorcopsis spp., Thylagale stigmatica) and tree kangaroos (Dendrolagus) show slopes that are approximately one-third that of those of the mixed feeding, open country Macropus robustus and the grazing M. giganteus. As expected, molar gradient slopes change little with known or apparent age (when including only those teeth still functional and in occlusion). That these gradient slopes reflect mostly differences in wear rates, rather than differences in developmental timing, is supported by measures of absolute wear rates based on molar height from known-age individuals of extant species. Browsing Dendrolagus lunolhozi shows absolute wear rates of 0.25mm/yr or less, with a simple hillshoer by a factor of four or five. Thus it is likely that these two sympatric species differed in their wear rates to at least the same degree as seen in the gradient slopes. The gradient wear technique is straightforward to apply to fossil species. Gradient slopes of Pleiostocene Macropus giganteus from Victoria Fossil Cave, South Australia are as steep as those of the extant grazing species of Macropus, whereas the short-faced kangaroo Shenurus gilli, found in the same cave deposit, has a gradient that is shallower by a factor of four or five. It is thus likely that these two sympatric species differed in their wear rates to at least the same degree as extant grazing and browsing macropodoids.

Technical Session XIX (Saturday, October 20, 2:30 pm)  
TESTING THE ACCURACY OF ECOLOGICAL NICHE MODELS USING THE LAST GLACIAL MAXIMUM FOSSIL RECORD OF MAMMALS  
DAVIS, Edward B., University of Oregon Museum of Natural and Cultural History and Department of Geological Sciences, Eugene, OR, United States; MCGUIRE, Jenny L., University of Washington School of Environmental and Forest Sciences, Seattle, WA, United States; KOO, Michelle S., University of California Museum of Vertebrate Zoology, Berkeley, CA, United States  
The geographic distributions of many species are expected to change dramatically over the next century to accommodate global climate change. Conservation biologists model these expected changes using a suite of techniques called Ecological Niche Models (ENMs). ENMs sample physical environmental parameters (temperature, precipitation, seasonality) and vegetation parameters from known modern distributions of species, creating a multidimensional model of the current realized niche of the species. This niche model can then be mapped on hypothesized future climate surfaces, producing hypotheses of future species distributions. These hypotheses have been used to plan conservation efforts, and some researchers have suggested programs of assisted migration to transition species to new optimal environments. We test the accuracy of the most commonly used ENMs by projecting models of 50 mammal species onto Last Glacial Maximum (LGM, ~18–21 Ka) paleoclimate surfaces and comparing their hindcast distributions to the LGM fossil record. Our fossil data are drawn from the FAUNMAP II database, and include sites with data from 30-10 Ka that clearly cross the LGM, ~20Ka. We tallied the number of sites both within and outside each ENM that contain and do not contain each species, allowing us to quantify the mismatch between hindcast and fossil distributions. The ENMs for many species predict distributions south of the southernmost fossil occurrences, but there is no apparent consistency in the model-data mismatch. At one extreme are species like Marmota flaviventris, which has a close match between its LGM fossil distribution and ENM. On the other end of the spectrum, Procyon lotor, Vulpes vulpes, and Ursus americanus have ENMs that reconstruct LGM distributions entirely south of all of their known LGM fossil distributions. Most surprisingly, some species, like the raccoon, appear to have robustly expanded their ENMs, suggesting the LGM conditions contained little to no analog to their current realized niches. We seek the phylogenetic and ecological controls on the mismatch between models and data, which will be valuable information to consider for future-climate ENMs. We hypothesize that observed mismatches could be caused by one or a combination of three factors: 1) niche evolution between LGM and today, 2) modern realized niche undersampling fundamental niches, or 3) problems with the LGM climate model parameterizing glacial edge effects.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)  
WHAT IS THE APPROPRIATE SPATIAL AND TEMPORAL SCALE OF FAUNMAP DATA?  
DAVS, Matt, Yale University Department of Geology and Geophysics, New Haven, CT, United States  
Paleo occurrence databases like Neotoma and FAUNMAP II are crucial to understanding morphological changes that occurred during the late Cenozoic. However, the temporal and spatial grain size appropriate for these data is unclear. Care must be taken to only interpret paleontological data at a scale where they are still accurate, especially when comparing them to modern occurrence data. Mammal occurrence data for the last 50,000 years were examined from the most densely sampled portion of the FAUNMAP II database. Simple null models based on poor sampling accurately predict patterns of taxa similarity over time and space, the continental and regional patterns, and the turnover of species. It appears that even relatively densely sampled FAUNMAP data can only be viewed at a much coarser grain size than previously utilized and that many of the patterns we see could be the results of poor sampling and taphonomy. Future research must take into account the error associated with all spatial occurrence data and the taphonomic biases inherent in the fossil record.

Technical Session XIII (Friday, October 19, 1:45 pm)  
DIVERSITY OF THE MAMMALS FROM HAININ, BELGIUM, THE OLDEST PALEOCENE MAMMAL FAUNA OF EUROPE  
DE BAST, Eric, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium  
The locality of Hainin in the Mons Basin, Belgium has yielded the only well diversified land vertebrate fauna of the Early to Middle Paleocene of Europe. Mammal specimens mainly consist of isolated teeth. A little over 250 complete and fragmentary jugal teeth have been recovered from screenswashing of the sediments. Multituberculates account for a little less than 20% of the fauna. They are represented by two species of the kogaionid genus Hainina: H. belgica and H. godfroisiani, the genus being endemic to Europe; and by the problematic Boffius splendius, known only from Hainin and whose affinities are unclear. Most eutherian taxa are very small, 75% of the specimens exhibiting an M1, M2 length comprised between 1 mm and 2 mm. The most abundant and diversified group is the adaposauridcillos, with at least four species dispersed in three genera: afrodon, Buxtorfia marandati, Buxtorfia marandatii and Prenovilliacis lupias. The microhyrid genus Microhyus, have almost no LGM territory within their ENMs, this can only be viewed at a much coarser grain size than previously utilized and that many of the patterns we see could be the results of poor sampling and taphonomy. Future research must take into account the error associated with all spatial occurrence data and the taphonomic biases inherent in the fossil record.
This probably indicates a markedly older age for Hainin than the only well-known continental deposits of Europe that are Cenay-Berru and Welbeck. Few species clearly show close phylogenetic affinities with North American or Asian taxa, even at family-level, enhancing the endemic character of the European region during roughly the first half of the Paleocene.
patterns and processes that shaped this macroevolutionary event. Underlying trends in theropod evolution were isolated so that particular phenotypic changes could be identified and their potential drivers investigated. This presentation looks at two proposed trends that have functional consequences for the origin of flight: forelimb discrete character change and appendicular length evolution. The findings demonstrate that character change in the theropod forelimb skeleton is not uniform, the node Aves is not associated with high levels of concentrated character change, and the forelimb phenotype does not evolve similar to other modules, such as the skull, axial column, or the hind limb. Although allometry does not explain the tempo and mode of forelimb quantitative changes, the general trend of body size reduction within Coelurosauria does drive the observed pattern of forelimb elongation prior to the node Aves. At Aves however, a significant decoupling of fore- and hind limb scaling from body size occurred such that early avians have distinctively different allometries in these regions compared to their non-avian antecedents. Early birds have distinctly shorter hind limbs and longer forelimbs than expected based on non-avian regressions, indicating a novel selective regime compared to similar sized feathered maniraptorans. The three main ecological scenarios proposed to explain the transformation of a theropod forelimb into a wing (tree’s down, ground up, and wing assisted incline running (WAIR)) were tested. Using an extensive dataset of extant and extinct mammalian, reptilian and avian climbers scored for 17 climbing related characters as well as individual indices correlated to asexual ability, non-avian theropods are shown to not possess the morphological adaptations required by extant arboreal taxa. The WAIR model is also challenged based on allometry and ontogenetic factors, gross morphological differences in the pectoral region between non-avian theropods and extant birds and biomechanical limitations in the theropod body plan; all of which limit its applicability, at least two. These findings, the pattern and ecology of a major evolutionary transition in a level of detail that has not previously been achieved and can create a framework to examine other major transitions.

Technical Session XIII (Friday, October 19, 3:30 pm)

A NEARLY COMPLETE FOSSIL IGUANIAN FROM THE UPPER CRETACEOUS (CAMPAIGNAN) TWO MEDICINE FORMATION OF WESTERN MONTANA

Cary J., University of Nebraska-Lincoln, Lincoln, NE, United States; VARRICCHIO, David J., Montana State University, Bozeman, MT, United States; HEAD, Jason J., University of Nebraska-Lincoln, Lincoln, NE, United States; MOORE, Jason R., Dartmouth College, Hanover, NH, United States; WILSON, Gregory P., University of Washington, Seattle, WA, United States

The Late Cretaceous was an important interval for the early diversification of many extant lizard clades, but much of what is known of Late Cretaceous lizards from North America is restricted to disarticulated and isolated remains from vertebrate microfossil localities. This bias in the fossil record made it difficult to fully understand these clades, and their diversification, and evolutionary history. Here we report on a nearly complete and mostly articulated lizard from the Egg Mountain locality of the Upper Cretaceous (Campanian) Two Medicine Formation of western Montana. The specimen was preserved in heavily bioturbated, reworked terrigenous and volcaniclastic sediments with a potential palaeoepidological overprint. The specimen was recovered as part of a vertebrate assemblage including isolated dinosaur tooth eggshell and at least two partial lizard skeletons. We performed a phylogenetic analysis of 232 taxa that were scored for 363 morphological characters. Our analysis recovered an Adams consensus topology that places the taxon among pleurodontan iguanians forming a polytomy with Corytophanidae (e.g., basilisks) and Polychrotidae (e.g., anoles). Three unambiguous synapomorphies support the node: presence of postorbitalfronto nasal rugosities on the jugal, relatively narrow parryliform recess, and clavicle with a proximal expansion. The new specimen represents the oldest record of the North Central American clade including corytophanids and polychrotids and provides important new constraints on divergence timing and biogeographic histories of these groups.
NEW INFORMATION ON THE HYPOBRANCHIAL SKELETON OF THE EARLY PERMIAN LEPPOSODYL LYSORPHID AMPHIBIAN BRACHYDECTES

DEVLIN, Kathleen R., California State University, San Bernardino, San Bernardino, CA, United States; SUMIDA, Stuart S., California State University, San Bernardino, San Bernardino, CA, United States

The Late Paleozone Lysoraphid is a small Perno-Pennsylvanian leposoptyid amphibian family comprised of only two genera, Brachydecetes and Placentops. The group is moderately well known given the frequently excellent preservation afforded by their location in aertisation burrows. The group is best known for their elongate bodies, reduced limbs, and highly fenestrated skulls and highly ossified hypobranchial skeleton.

Heretofore undescribed specimens collected by Everett C. Olson, and deposited in the UCLA Vertebrate Paleontology collections, provide additional information on the details of the hypobranchial skeleton in the North American genus Brachydecetes. UCLA VP 2946, from the Lower Permian (Leonardian) Fairmont Shale, Hennessey Group near Norman, Oklahoma includes a small partial skull, articulated anterior presacral vertebrae, and an exceptionally preserved hypobranchial apparatus. Preservation of the hypobranchial apparatus in lysoraphids is not uncommon because of the highly ossified nature of the individual elements, but they are frequently disarticulated and somewhat scattered. UCLA VP 2946 preserves a robust and well articulated hypobranchial skeleton demonstrating previously undocumented patterns of articulation of the medial-most elements.

In previous studies a midline basibranchial element was unable to be identified. The specimen described here does not show clearly any of the hyoid arch elements; however, a very small midline element is present ventral to the margin of the mandible that could be a basibranchial. The hypobranchials of the first posthyoid arch appear to be very tightly articulated with one another in the ventral midline. Further, they are also very tightly articulated with the more lateral ceratobranchials. This hypo-ceratobranchial articulation is in fact so tight as to be potentially fused. Subsequent segments do not show a hypobranchial element, but ceratobranchials 2-4 are very well developed. Ceratobranchials of the second posthyoid arch articulate very closely with one another in the ventral midline. The ceratobranchials are strongly waisted, and their expanded distal ends give them an almost hourglass shaped outline.

The hypobranchial skeleton in Brachydecetes shares certain features characteristic of juvenile amphibians on the one hand, and fully metamorphosed adults on the other hand. This mosaic of features is ascribed to the aquatic, neotenic features of an otherwise adult individual. A new reconstruction of the hypobranchial skeleton and its position relative to the ventral surface of the skull is offered.

METHODS

With asc values intermediate between A. jubatus and P. leo (statistically separable from all extinct and extant taxa), Smilodon fatalis has significantly lower epLar than A. jubatus (p<0.01) and significantly higher Tvs than both A. jubatus and P. atrox (p<0.05), suggesting that S. fatalis did not avoid bone to the extent previously suggested by SEM microwear data. Lower mean Asc and Tvs values in P. atrox and S. fatalis compared with P. leo and C. crocuta suggest that carcass utilization by the extinct carnivorans was not necessarily more complete during the Pleistocene at La Brea; thus, times were not any “tougher” than today. Perhaps instead, increased tooth breakage may have resulted from consumption of larger prey that generated higher forces during capture. Additionally, minor to no significant variation was found when comparing specimens from older (pits 77 and 91, ~30-35 Ka) to younger (pits 67, ~11.5 Ka) deposits, suggesting that declining prey resources were not a primary cause of their extinction.
FIRST STABLE ISOTOPE ANALYSES ON CROCODILES AND DINOSAURS FROM THE LATE CRETACEOUS “LO HUECO” FOSSIL SITE (CUENCA, SPAIN)

DOMINGO, Laura, Earth and Planetary Sciences Department, University of California Santa Cruz, Santa Cruz, CA, United States; BARROSO-BARCENILLA, Fernando, Grupo de Investigación IBERCRETA, Universidad de Alcalá de Henares and Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Madrid, Spain; CAMBRA-MOO, Òscar, Laboratorio de Poblaciones del Pasado, Departamento de Biología, Facultad de Ciencias, Universidad Autónoma de Madrid, Madrid, Spain

The “Lo Hueso” fossil site (Cuenca, Spain) was fortuitously discovered in 2007 while constructing the high-speed railway Madrid-Levante. More than 5,000 macrofossils were recovered and the vertebrate assemblage suggested an age of Late Campanian-Early Maastrichtian.

Preliminary stable isotope analyses were performed on crocodiles and dinosaurs from two different levels: G1 and G2, with the former being older. Diagenetic alteration has been discounted based on two lines of evidence: 1) differences in dentine and enamel δ¹⁸O values were detected, with the former showing consistently higher values, and 2) crocodiles have lower δ¹⁸O values than dinosaurs (mean δ¹⁸Ocrocodile = -19.4±1.0‰ versus mean δ¹⁸O dinosaur = -20.8±0.8‰). This result is in good agreement with the observed low latitude δ¹⁸O relationship between ectotherms and endotherms not only at present, but also in the Late Cretaceous.

Calculated total mean δ¹⁸O values and temperature values are comparable for crocodiles (δ¹⁸Olodoine = -3.2±0.7‰; temp. = 22±4.1°C) and dinosaurs (δ¹⁸Odinosaur = -3.4±0.9‰; temp. = 22±1.1°C). δ¹⁸Ovalues correspond to precipitation waters in tropical and subtropical locations, whereas temperature values are in good agreement with estimated temperatures during the Late Campanian-Early Maastrichtian for the paleolatitude of “Lo Hueso” (~31°N).

A slight increase has been observed in δ¹⁸Olodoine, δ¹⁸Oendocrane, and temperature values from G1 to G2. G1 corresponds to a proximal muddy floodplain (close to distributary channels), whereas G2 represents a distal muddy floodplain (distant from distributary channels) and thus, in this last scenario, isotopic values may be influenced by slightly drier conditions. Another possibility is that there was a shift towards warmer conditions between G1 and G2. Finally, δ¹³C values determined for dinosaurs are in the range of C3, feeders, with theropods showing a mean δ¹³C value of -10.7±0.8‰ and sauropods having a mean δ¹³C value of -11.1±0.2‰, with similar isotopic values in G1 and G2.

These preliminary isotopic results on the recently discovered “Lo Hueso” fossil site allow a first approximation to the paleoclimatic and paleoenvironmental conditions in Iberia during the Late Cretaceous.

New insights on mammal faunal dynamics from the Miocene of Spain

DOMINGO, M. S., University of Michigan, Ann Arbor, MI, United States; BADGLEY, Catherine, University of Michigan, Ann Arbor, MI, United States; AZANZA, Beatriz, Universidad de Zaragoza, Zaragoza, Spain; ALBERDI, Maria T., Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

The mammalian fossil record of Spain offers one of the best opportunities in the Eurasian Miocene to investigate patterns of faunal turnover through time due to its completeness, high taxonomical resolution and comprehensive coverage of the Miocene Epoch. We evaluated diversification in relation to environmental history for large mammals identified to the species level. Large mammal species included in the analysis belong to Artiodactyla, Perissodactyla, Hyracoidae, Proboscidea, Primates and Carnivora. We focused on the interval from 12.0 to 5.5 Ma, which contains 72 localities from 13 basins supported by paleomagnetic dating. The occurrence of localities in different basins makes it difficult to establish age correlations among them directly. We established a comprehensive chronologic sequence through maximum likelihood appearance-event ordination. Changes in mammalian diversity of Spain have been traditionally analyzed using the Mammalian Neogene (MN) biochronological framework, which has long time bins of unequal duration. Applying an ordination method permitted us to analyze diversity changes at a finer time resolution. We parsed the localities into 0.5-Myr time bins. Since observed first and last appearances underestimate the real temporal range of taxa, we calculated 80% confidence intervals on the observed duration of each lineage. We evaluated rates of origination, extinction, diversification and turnover as well as changes in faunal composition and trophic structure. Three significant turnover periods were identified. The first one, between 12.0 and 11.5 Ma, was mainly driven by originations with a substantial number of immigrations. High turnover between 9.0 and 8.0 Ma arose from a combination of appearances and disappearances. Disappearance of some browsers and appearance of mixed feeders and grazers is thought to coincide with this period of faunal turnover was related to environmental change toward more open habitats. Finally, significant faunal change occurred between 6.5 and 5.5 Ma. The extinction rate for this interval was the highest for all the intervals evaluated. At this time, the Messinian Salinity Crisis extended throughout the Mediterranean Region and the mammalian fauna experienced a major reorganization. Finer temporal resolution and standardized diversity metrics have provided more detailed insight into the timing and pattern of faunal events over time and also will facilitate comparison with other Miocene records.

TRADITIONAL CLASSROOM VISITS ARE NECESSARY WHEN EVOLUTION IS TAUGHT AS A CONTROVERSY: Broadening the impact of individual classroom visits

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Recently, the state of Tennessee passed a law that permits teachers to teach scientific topics like evolution and global warming as controversial. While much debate has ensued about this legislation, Tennessee teachers can now choose to teach science as they always have, or introduce alternative ideas or explanations. While citizens are working on changing the current state of affairs, in the meantime, scientists and paleontologists aim to ensure sound science is taught in the classroom – one classroom at a time. Although classroom visits can be time consuming, they are a primary way of engaging with local students and teachers. Further, visits to one or two classrooms allow for replication of similar presentations and activities in future classroom visits, cutting down on preparation time. Here, we propose and discuss guidelines we have implemented to improve the quality and quantity of classroom visits by paleontologists. First, we carefully select schools and classrooms where we will have the greatest impact. This includes visiting students that will benefit from the types of experiences paleontology can provide. For example, we annually visit the Tennessee School for the Blind and teach lessons that require students to make inferences about fossils by their sense of touch. Unable to use visual teaching tools, students and faculty are challenged to communicate paleontological science through creative mediums. Second, we involve both graduate and undergraduate students in classroom visits to walk them through the teaching process by providing examples of appropriate classroom activities, and allowing them to build confidence in a new environment. Through group and individual visits, each student will quickly gain the confidence to independently visit other classrooms throughout a given year. Third, we aim to tap into existing programs. Although independent classroom visits are beneficial to the individual classrooms visited, if we can infuse paleontological lessons into existing outreach programs that can be implemented by volunteers already engaged in classroom outreach, our efforts will stretch much further. As teachers are required to teach the standards, focusing on under taught standards such as evolution and climate change is an excellent way of ensuring these concepts are adequately discussed in public schools. Our guidelines help broaden the benefits of classroom visits while simultaneously giving students and teachers access to knowledgeable paleontologists who accept evolution. Classroom visits, while traditional and time consuming, are an important tool for improving communication outside of the ivory tower, and training undergraduate and graduate students in broader impact activities.
ASSESSING PREDATOR-PREY INTERACTIONS THROUGH THE IDENTIFICATION OF BITE MARKS ON AN AETOSAUR (PSEUDOSUCHIA) OSTEODERM FROM THE UPPER TRIASSIC (NORIAN) CHINLE FORMATION IN PETRIFIED FOREST NATIONAL PARK (ARIZONA, USA)

Ashley C., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States; DUFEAU, David L., University of Missouri, Columbia, MO, United States; MORHARDT, John T., University of Queensland, Brisbane, Australia; BEHRENSMEYER, Anna K., The George Washington University, Washington, DC, United States; VILLASENOR, Amelia, The George Washington University, Washington, DC, United States

Paleoecological interactions of extinct tetrapods are typically difficult to infer. Although scarce, trace fossils can offer a glimpse into predator-prey interactions in ancient communities. Here we provide evidence for a Late Triassic predator-prey interaction based on an aetosaur osteosperm (PEFO 34869) with feeding traces. The partial paramedian osteoderm of the aetosaur Typhosaurus exhibits multiple tooth marks, presumably produced by a predator/scavenger feeding on the aetosaur carcass. The feeding traces include a series of four punctures forming an approximately 125-degree arc on the ventral surface of the osteoderm (interpreted as single bite), with additional pits and scores with striations marking the dorsal surface. The punctures on the ventral surface have an average spacing of ~1.0 cm and range in width by 2.1-4.1 mm and in length by 4.6-9.1 mm. Carnivorous taxa from the same locality as well as other nearby sites from the Upper Triassic Chinle Formation, Petrified Forest National Park, include large-bodied (~3 meters) phytosaurs (Pseudosuchus), a rauisuchid, and numerous small-bodied (~3 meters) forms such as the dinosaur Chindesaurus and the non-archosaurian archosauromorph Vancleaveia. To identify the trace-maker, we compared the morphology of the bite marks to the tooth orientation and morphology of these taxa. Chindesaurus and Vancleaveia were ruled out based on their smaller size and more compact tooth-spacing (<0.5 mm) compared to the spacing of the punctures in PEFO 34869. This leaves the rauisuchid, pseudosuchid phytosaur, or an as yet undiscovered large carnivorous reptile as the possible trace-maker. Despite the high degree of heterodonty in pseudosuchid phytosaurs, the observed pattern (spacing, arc curvature, and puncture shape/sizes) of the four punctures is inconsistent with any portion of their dentition. The almond-shape of the punctures and striation density (~3 per mm) of the bite marks are most consistent with the teeth of a rauisuchian-grade animal (such as Postosuchus). Furthermore, the spacing and arc curvature of the punctures on the ventral surface closely matches the premaxillary teeth of Postosuchus kirki (raptorial (~3.0 cm spacing and 130-degree arc). Aetosaurs were protected by a dorsal and ventral carapace of osteoderms that was covered by skin or keratin in life, creating an obstacle to predators/scavengers trying to gain access to the flesh underneath. PEFO 34869 provides important insight into paleoecological interactions between terrestrial herbivores and carnivores in the Late Triassic of the American Southwest and may shed light on specialized feeding techniques used on heavily armored aetosaur carcasses.

Technical Session XIX (Saturday, October 20, 3:00 pm)

THE EFFECTS OF CRANIODENTAL SAMPLING ON ECOLOGICAL VARIABLES IN MODERN AND FOSSIL MAMMAL LANDSCAPE ASSEMBLAGES

DU, Andrew, The George Washington University, Washington, DC, United States; FAITH, John T., University of Queensland, Brisbane, Australia; BEHRENSMEYER, Anna K., National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; PATTERSON, David B., The George Washington University, Washington, DC, United States; VILLASENOR, Amelia, The George Washington University, Washington, DC, United States

Accurate paleoecological reconstructions depend on obtaining a representative sample of the animals living on past landscapes. However, due to limited resources, surface collection and recording of mammal fossils in open-air sites is often limited to a subset of taxonomically informative specimens (e.g., teeth, horn cores). It is currently unknown how this selective sampling methodology could bias paleoecological reconstructions. Here we examine the effects of craniodental collection on three ecological variables: body size distribution, species richness, and relative abundance. Seventeen systematic transects in which all surface fossil specimens are documented were conducted in the Ibera Tuff Complex (1.53–1.51 Ma) of the Okote Member (Koobi Fora Formation, East Turkana, Kenya), resulting in a total mammalian sample of 430 identified specimens (NISP) with a craniodental subset of 767 NISP. To address our question of potential bias resulting from craniodental sampling, various statistical analyses were conducted comparing the entire faunal samples to the craniodental subset of 767 NISP. To address our question of potential bias resulting from craniodental sampling, various statistical analyses were conducted comparing the entire faunal samples to the craniodental subset. Only craniodental remains does bias body size distributions but not species richness or relative abundance. Seventeen systematic transects in which sampling methodology could bias paleoecological reconstructions. Here we examine the effects of craniodental collection on three ecological variables: body size distribution, species richness, and relative abundance. Seventeen systematic transects in which all surface fossil specimens are documented were conducted in the Ibera Tuff Complex (1.53–1.51 Ma) of the Okote Member (Koobi Fora Formation, East Turkana, Kenya), resulting in a total mammalian sample of 430 identified specimens (NISP) with a craniodental subset of 767 NISP. To address our question of potential bias resulting from craniodental sampling, various statistical analyses were conducted comparing the entire faunal samples to the craniodental subset. Only craniodental remains does bias body size distributions but not species richness or relative abundance. Thus, we expect that diversity measures should be minimally affected by craniodental sampling, but caution is required when analyzing body size distributions derived from only mammalian craniodental remainas.

Post Session I (Wednesday, October 17, 4:15 - 6:15 pm)

ONTOSTEGIC CHANGE IN THE CRANIAL ENDOSCAT AND ENDOSSEOUS Labyrinth of AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS): IMPLICATIONS FOR THE INTERPRETATION OF EXTINCT ARCHOSAURS

DUFEAU, David L., University of Missouri, Columbia, MO, United States; MORKHARDT, Ashley C., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States

Extant crocodilian skulls undergo dramatic transformation during ontogeny. For example, rapid growth of the face and suspensorium relative to the braincase reorients neurosensory structures such as the eyes and tympanum. How this growth pattern impacts endocranial anatomy has never been evaluated. Moreover, although anecdotal reports suggest that “young” crocodilians resemble the neuroanatomy of adults in having the braincase fill the endocranial cavity, the relationship of ontogeny to any measure of how well the endocranial spaces for a proxy for brain structure has never been documented, which has implications for the study of extinct archosaur brain/endocast evolution. We present the results of an extensive ontogenetic analysis of Alligator mississippiensis comprising 15 specimens ranging from embryos to old adults and encompassing an 18-fold difference in skull length. Specimens were CT-scanned, and 3D representations of the inner ear and dorsal envelope were generated in Amira. Some specimens were soaked in an iodine/potassium-iodide solution to stain the neural tissues, allowing direct comparisons of the brain and endocast. Ontogenetic trends include: (1) the olfactory tracts become increasingly elongate and are less acutely angled from the cerebrum parasagittally; (2) the optic lobes become increasingly less prominent and lose contact with the meninges as the venous sinuses enlarge; (3) the general proportions of the brain change whereby the forebrain dominates in perinates, becoming about equal to the midbrain and hindbrain by a year of age, whereas in adults the midbrain and hindbrain together occupy most of the endocranial space; (4) the common crus of the inner ear elongates, resulting in a 20% increase in the angle of elevation of the rostral and caudal semicircular canals from the horizontal plane, increasing their effective length; and (5) this increase in the arc of the canals tracks an increase in the volume of the cerebellum situated medial to the labyrinth. Ontogenetic changes in endocranial anatomy may reflect ecological shifts from active pursuit of small prey to ambush predation of larger prey. Change in elevation of the olfactory lobes likely reflects the progressive enlargement of the feeding apparatus, whereas changes to the inner ear and cerebellum may reflect increasing reliance on the rapid head movements of ambush predation. More broadly, the ontogenetic trend of the endocast becoming a progressively poorer proxy of the underlying brain may pertain to extinct archosaurs, shedding light on anatomical interpretation of fossil endocasts, but also perhaps even allowing tests of similar ontogenetic shifts in functional and ecological roles, as has been suggested to occur in tyrannosaurs.

Post Session II (Thursday, October 18, 4:15 - 6:15 pm)

BUILDING A BETTER DATABASE: PROTEIN IDENTIFICATION AND LONGEVITY IN CROCODILIAN DENTITION AND TEETH

DZIKIEWICZ, Katherine M., North Carolina State University, Raleigh, NC, United States

Despite increasing evidence that informative biomolecules may persist across geological time, the phylogenetic utility of recovered molecules is hampered by, among other things, the sparsity of appropriate extracellular molecular database for non-mammalian taxa. We address this by comparing recovered sequences. Without such a database, the entire proteome may exist, but be unrecognized by current search algorithms. Therefore, because members of Crocodylia are, along with birds, extant sister taxa to Dinosauria, we present the first representative bone and tooth proteome for extant members of this crown clade. Though few crocodylian proteins have yet been sequenced, we have conducted mass spectrometry on extant samples, and identified bone and tooth proteins using the databases of birds and other vertebrates. These data provide a baseline for comparing sequences recovered from extinct representatives of this clade as we begin the first ever time-point sampling across a single clade to test the hypothesis of a limited time interval to molecular preservation. Although bone and tooth DNA from a single organism are identical, the bone proteome as the expression of the “directions” of DNA, is different than the tooth proteome. Here we also compare bone and tooth proteomes because these tissues types are most likely to preserve in the rock record. This comparison will allow us to objectively state which tissues are the best targets for molecular recovery from fossils.

COMPARATIVE NEUROANATOMY OF FOSSIL AND LIVING WATERBIRDS

EARLY, Catherine M., North Carolina State University, Raleigh, NC, United States; SCLAFALE, Michelle, North Carolina State University, Raleigh, NC, United States; BALANOFF, Amy M., American Museum of Natural History, New York, NY, United States; KSEPKA, Daniel T., North Carolina State University, Raleigh, NC, United States

Waterbirds are a diverse avian clade that includes species adapted to many unique ecologies such as wing-propelled diving, foot-propelled diving, and plunge-diving. Several shifts in neuroanatomy have been proposed to accompany these ecologies, and thus may offer insight into the prey-capture strategies of extinct species. We examined an array of fossil and living waterbird skulls through computed tomography imaging. Using the program Avizo, we rendered virtual endocasts of the brain and semicircular canals and estimated the volume of neuroanatomical structures such as the floccular lobe and sagittal eminence. Additional fossil taxa that have been studied using the same technique were included from the literature. Previous workers have proposed that thickening of the subarachnoid space is characteristic of deep diving birds. Cerbellar fields were not visible in the endocasts of any deep diving taxa we examined. Deep diving birds sampled in this study also exhibited an expanded floccular lobe. While most lineages had a prominent sagittal eminence, interestingly this structure was poorly developed in fossil and living Sulidae and in the storm petrel Oceansites. This distribution suggests multiple independent reductions of this structure. Fossil representatives of the Sulidae and Spheniscidae show strong similarities to their extant relatives, suggesting that these groups had attained modern ecologies by at least the...
Oligocene Epoch. In contrast, stem members of Phaethontidae show marked differences from their extant relatives and may have differed from their modern equivalents in their ecologies.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

ISOTOPIC INDICATORS OF SEASONALITY AT A LATE MIocene PRIMATE LOCALITY IN HUNGARY

EASTHAM, Laura C., University of Toronto, Toronto, ON, Canada; BEGUN, David R., University of Toronto, Toronto, ON, Canada; KORDOS, Laszlo, Geological Institute of Hungary, Budapest, Hungary

The Vallesian Crisis (9.7 Ma), a Late Miocene mammalian turnover event recorded throughout Europe, marks the extinction of many closed forest adapted faunal forms, including the hominoids. In western and eastern Europe, this turnover event is associated with increasing seasonality and aridity, as well as a shift in the vegetation from closed canopy subtropical evergreen to more open canopy deciduous forest and woodland. Floral and faunal data for Late Miocene central Europe indicate the persistence of humid and relatively aseasonal conditions throughout this period. The rich Late Miocene primate locality of Rudabanya in north-central Hungary provides a unique opportunity to examine the paleoecology of central Europe during this time. The degree of seasonal variation in temperature and/or precipitation was examined in four genera of medium to large bodied herbivores at Rudabanya by serially sampling stable oxygen isotope values found within tooth enamel. Sampled taxa include Hippotherium intrus, Tetralophodon longirostris, Aceratherium incisivum, and Propatamocherus palaeeochoerus. Serial samples were collected using a dental drill on the external tooth surface, as well as from thin sections using a computerized MicroMill. Oxygen isotope results for all sampled taxa reveal a pattern of seasonal enamel growth. Serial samples demonstrate an intra-tooth range of oxygen isotope of variation between 2.3% and 2.9%, with a mean range of 2.7%. The homothermic species T. longirostris showed the greatest range of oxygen isotope variation (3.1%), whereas the equid, H. intrus showed the least (2.2%). These results suggest that the Rudabanya fauna experienced a moderate degree of seasonal variation in temperature and/or precipitation. The examination of intra-tooth isotopic variation provides insight into the paleoecology of Rudabanya during a highly dynamic period in the evolution of terrestrial mammals in Europe.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

THE FOSSIL RECORD OF THE DIAMONDBACK TERRAPIN, MALACLEMYS TERRAPIN (TESTUDINES: EMMYDIDAE)

EHRET, Dana J., Monmouth University, West Long Branch, NJ, United States; ATKINSON, Benjamin K., University of Florida, Gainesville, FL, United States

New fossil materials of the diamondback terrapin (Malaclemys terrapin) are described from Late Pleistocene coastal deposits of South Carolina, Georgia, and Florida. The only previous records for the genus included two late Pleistocene carapace fragments recovered from South Carolina, a faunal list inclusion from the Page-Ladson locality in Florida (late Pleistocene), and a Holocene shell and postcranial elements from Bermuda. This paucity of fossil materials made it one of the least well-known fossil genera within the extant eumydids. Turtles. Here we describe new fossil material of the diamondback terrapin from Edisto Beach, South Carolina, the South Brunswick River, Georgia, and specimens from Florida’s Audubon and DeSoto Rivers, the U.S. Gulf Coast. These newly described materials expand the fossil range for the genus Malaclemys into southeastern Georgia and peninsular Florida. Specimens represent carapacial bones from numerous individuals at each locality. Fossils are identified as Malaclemys based on the features of scute sulci and the presence of annuli scars on most specimens. Today, diamondback terrapins occur along the Atlantic and Gulf coasts of the United States from Cape Cod, Massachusetts to south Texas, with a disjunct population of unknown origin existing in the Bahamas. The general lack of fossil material for Malaclemys is likely the result of misidentification (or non-identification), inadequate collecting in areas where specimens may be found, and the fragile nature of the material. Furthermore, ecological restriction of Malaclemys to coastal salt marshes, mangroves, and tidal creeks limits the potential for fossilization. Fossil localities for Malaclemys appear to reflect historical shorelines during Pleistocene glacial-interglacial cycles. Based on current geographic and fossil distributions, it appears that Malaclemys terrapin evolved and dispersed along the southeastern Atlantic and Gulf coasts prior to the Late Pleistocene.

Technical Session V (Wednesday, October 17, 3:45 pm)

PHYSIOLOGICAL AND EVOLUTIONARY IMPLICATIONS OF THE COCHLEAR MORPHOLOGY OF MIOCENE MYSTICETI (CETACEA)

EKDALE, Eric G., San Diego State University, San Diego, CA, United States

Morphology of the cochlea that houses the organ of hearing reflects that sensitivity. Sensory evoked potentials and functional imaging techniques have shown that the cochlea evolved a lower LF threshold than the balaenopterids and allied taxa. Additionally, cochleae of the extinct whales (Balaena and Balaenoptera) coil more loosely and to a lesser degree (<2.5 turns versus >2.7 turns in the fossils) than the extinct whales, suggesting independent evolution of the low degree of coiling in extant balaenopterids and balaenids, and an increase in LF thresholds through geologic time. Using this information, the most recent common ancestor of crown Mysticeti is hypothesized to have possessed a cochlea with over 2.5 turns, a tightly coiled apical whorl, and low LF thresholds relative to extant taxa. Reconstruction of the cochlea of Oligocene and Eocene outgroups is planned in order to polarize the anatomy and test this hypothesis.

Technical Session XV (Saturday, October 20, 9:30 am)

COMPLEX DENTAL STRUCTURE AND WEAR BIOMECHANICS IN HADROSAURID DINOSAURS

EKRISSON, Gregory M., Florida State University, Tallahassee, FL, United States; KRISS, Brandon, University of Florida, Gainesville, FL, United States; NORELL, Mark A., American Museum of Natural History, New York, NY, United States; SAWYER, W. G., University of Florida, Gainesville, FL, United States

In an examination of the evolution of auditory morphology and physiology of baleen whales, the internal and gross anatomy of fossil cochlea of mysticetes allied with two major extant clades, Balaenidae (right whales) and Balaenopteridae (rorquals), were reconstructed utilizing high resolution CT data. Most phylemagenetic hypotheses suggest that these two lineages diverged early in mysticete evolution, most likely during the late Oligocene to early Miocene. The extinct taxa studied include new information from fossils of the Tambler Formation (middle Miocene), namely Periplopecus vesivelifer (stem balenid) and Paripetolebaena secures (stem balenopterid), and published data of Herpetocetus sp. (stem balaenopterid; Yorktown Formation, Lower Pliocene). Anatomical features associated with LF sensitivity are present in the Miocone and Pliocene taxa, but variations reflecting phylogeny and functional differences also were observed. For example, extinct Periplopecus and extant Balaena share a reduced secondary laxis that is hard restricted to the first half of the basal turn of the cochlea, whereas the lamina extends into the final third of the basal turn in the extinct and extant members of the balaenopterid lineage. The reduction of the secondary lamina unites the baalenid lineage, but it also suggests that the clade has evolved a lower LF threshold than the balaenopterids and allied taxa. Additionally, cochleae of the extant whales (Balaena and Balaenoptera) coil more loosely and to a lesser degree (<2.5 turns versus >2.7 turns in the fossils) than the extinct whales, suggesting independent evolution of the low degree of coiling in extant balaenopterids and balaenids, and an increase in LF thresholds through geologic time. Using this information, the most recent common ancestor of crown Mysticeti is hypothesized to have possessed a cochlea with over 2.5 turns, a tightly coiled apical whorl, and low LF thresholds relative to extant taxa. Reconstruction of the cochlea of Oligocene and Eocene outgroups is planned in order to polarize the anatomy and test this hypothesis.

Education and Outreach Poster Session (Posters displayed October 17 – 20)

NEW SCIENCE OUTREACH MODEL FROM STUDENT-RUN PILOT PROGRAM, PARADIGM SHIFT

ELSHAFIE, Sara J., University of Nebraska-Lincoln, Lincoln, NE, United States; THOMPSON, Kari, University of Chicago, Chicago, IL, United States; CALAND PUYMARTIN, Gay K., University of Chicago, Chicago, IL, United States

Among the scientific disciplines, paleontology is particularly well suited for the hands-on, creative learning processes that students respond to best. This program has the dual potential of programs that can take paleontology beyond natural history museums; programs that increase student involvement in outreach; and programs that bridge institutions with communities. A new student-run science outreach program, “Paradigm Shift,” brings current science to classrooms through engaging, relevant activities and personalized, prolonged mentorship. In 2012, the authors successfully launched a pilot program that involved over twenty student participants at the University of Chicago and served over fifty minority students in a local middle school.

In the Paradigm Shift program, mentors work consistently with middle school students in weekly one-hour sessions over a nine-week period. A low mentor: student ratio, between 1:2 and 1:4, ensures direct interaction and personal attention, and the prolonged duration of the program allows mentoring relationships to develop. Each mentor designs a 45-minute activity on a science topic of his or her choice. All activities include a hands-on component and emphasize critical thinking, use of the scientific method, and real-world application. Mentors share their expertise and enthusiasm while gaining teaching experience. Mentors also incorporate their own studies into the curriculum, giving middle school students insight into scientific fields and education and career opportunities.

In the second part of the program, students work with their mentors to create learning tools that communicate their topics of investigation to a general audience. Students then use these tools to educate the public at a culminating showcase event. This exercise reinforces creative concepts and gives students presentation and communication skills. Learning tools and activities developed through the Paradigm Shift program are available on an open-source web domain. Paradigm Shift also incorporates tracking mechanisms for immediate and long-term impact assessment.

The emphasis of the Paradigm Shift program on collaboration, hands-on activity, and scientific and creative thinking make it a viable model for education in paleontology and other natural sciences. Topics covered in the 2012 pilot program included Comparative Anatomy, Earth History, Plate Tectonics, and Natural Selection, in lessons designed using current research and resources rather than textbooks and conventional material. Paradigm Shift also offers an opportunity for students at multiple levels to connect and learn from each other. The program’s emphasis on personalized and perpetual learning, as well as its versatile applicability, makes this model a valuable tool for any institution.
The grinding teeth of mammals (e.g. horses) are biomechanical marvels. Their complex four-tissue composition strategically wears, creating course surfaces to comminute tough and abrasive plants (e.g. grasses), liberating nutrients inaccessible to other herbivores. Grinding dentitions evolved repeatedly and almost exclusively in mammals. A rare occurrence outside this group is the occurrence of elongate anterior cervicals in a small dinosaur from the Upper Cretaceous of western Africa, Sigilmassasaurus. The presence in Sigilmassasaurus of elongate anterior cervicals and broad centra, a short neural spine, and a robust ilium with a prominent auricular surface suggest that it might represent a further taxon of spinosaurid, as originally suggested, indicating that spinosaurid diversity in the Cretaceous of western Africa was greater than is currently recognized.

Technical Session XI (Friday, October 19, 2:30 pm)

PHYLOGENETIC ANALYSIS OF LATE TRIASSIC – EARLY JURASSIC NEOTHEROPOD DINOSAURS: IMPLICATIONS FOR THE EARLY THEROPOD RADIATION

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New discoveries and studies have improved our knowledge of early neotheropod dinosaurs in the last decade. However, an updated and comprehensive phylogenetic analysis of Late Triassic and Early Jurassic theropods is currently lacking. In order to assess the phylogenetic relationships of these taxa, a data matrix composed of 39 terminals and 633 informative characters was compiled. In the most parsimonious trees recovered by the analysis, Eudromaeus was found as the sister-group of Neotheropods and Liliensternus, Procompsognathus, Lophostropheus, Gavirasaurus and a specimen previously identified as a juvenile of Dracovenator, were recovered within a polytomy at the base of Coelophysioidea. The latter taxa were the sister-taxon of a clade composed of a “Syntarsus” kaysenkatakei + Kayentavenator clade and a group including Segisaurus, Coelophysosaurus, Barycoelichthys rhodesiensis, Camarasaurus and an unnamed Mexican coelophysoid. The position of Kayentavenator elysae indicates that it should be considered a junior synonym of “Syntarsus” kaysenkatakei. The putative juvenile specimen of Dracovenator might actually represent a distinct form of basal coelophysoid. After a posteriori pruning of wildcard taxa, Liliensternus was placed as the most basal coelophysoid, Lophostropheus as the most basal member of Coelphysioidea, and Coelophysosaurus as the sister-taxon of a clade composed of Camarasaurus, Segisaurus and Coelophysosaurus rhodesiensis. Outside Coelophysioidea, Zapaysaurus was found as the sister-taxon of a group including Dilophosaurus and Averostra. Dilophosaurus was composed of Dracovenator, Cryptosaurus and Dilophosaurus wetherilli, in agreement with some previous analyses. Within Averostra, Nodosaurus woodii was recovered as a basal ceratosaur, probably representing the oldest member of the clade. Optimization of femoral length under a maximum parsimony criterion revealed a reduction of body size in Coelophysioidea and an overall increase in the lineage leading to Averostra. However, a conspicuous increase in body size is not documented during the Early Jurassic, contra to some prominent hypotheses of ‘ecological release’ for theropods following the Triassic–Jurassic extinction. The results also indicate that basal coelophysoids (i.e. those outside the “Syntarsus” + Coelophysosaurus clade) are currently the most abundantly sampled late Norian–Rhaetian theropods. However, following the Triassic–Jurassic extinction event, theropod assemblages are composed of derived coelophysoids, dilophosaurids and basal averostraids. Accordingly, this mass extinction appears to have had a deep impact on the early evolutionary history of Theropoda, resulting in a shift of the taxonomic content of the group across the Triassic–Jurassic boundary.
**isis** was likely a predator feeding on very young *D. ater* and large fish. prey was predominantly captured from a lateral position and killed with one or two powerful bites. Diet and predation strategy of *B. isis* can be compared to those of the modern killer whale, *Orcinus Orca*. *B. isis* is the only archaecete known to date that most likely preyed on other cetaceans.

**Poster Session IV** (Saturday, October 20, 4:15 - 6:15 pm)

**RECONSTRUCTING LIMB KINEMATICS OF SMALL BIPEDAL DINOSAURS TRAVERSING SEMI-FLUID SUBSTRATES**

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The fossil tracks described by Edward Hitchcock and housed at the Benesi Museum of Natural History, Amhurst College, include a wide variety of track morphologies. Among them are a number of tracks, predominantly from the Wethersfield Cove locality, which show considerable variation over successive exposed surfaces. Commonly referred to as undracks, these successive prints have recently been interpreted as subsequent exposures of penetrative tracks, where the trackmaker’s foot has directly interacted with, and passed through, each layer throughout the course of the step cycle. Track morphology on uppermost surfaces displays extremely narrow slit-like digit impressions, highly elongated, often with a long posterior impression behind the apex of the digits. At the lowest levels, track morphology is reduced to 3 or less drag marks, formed during a sweeping motion of the foot in which only the digit tips deform the substrate. Intermediate exposed surfaces show transitional morphologies: digit tips appear to translate with increasing depth, becoming more parallel (thus altering interdigital angle). Common to most, if not all, surfaces within a volume is an exit trace, formed as the foot is withdrawn, digits together. This exit trace often occurs in a spatially consistent location throughout the track volume, indicating a vertical foot withdrawal rather than a forwards removal of the foot as in other diapsid tracks (e.g., those from Greenland). We interpret these features as resulting from a backwards sweeping motion of the foot and lower leg. The substantial deformation and considerable depth that some track volumes display, implies that the substrate was so soft as to behave in a semi-fluid manner. In order to understand the limb kinematics, including where, when, and how the substrate provided resistance and supported the foot during the step cycle, we used computer simulation and animation. Digitised fossil tracks were used to three dimensionally reconstruct the path of the foot. This foot motion was then used to generate virtual tracks that show similar track morphologies to those seen amongst the Amhurst collection.

**Technical Session XVI** (Saturday, October 20, 8:00 am)

**THE RELATIONSHIP BETWEEN LOPHODONTY, HYPSODONTY, BODY MASS AND DIET IN EXTINCT AND EXTANT UNGULATES**

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The interaction between tooth morphology and wear has an important effect on how well herbivorous mammals, specifically ungulates, combat the effects of elevated tooth wear from abrasive diets by either changing the occlusal enamel length, or by changing relative hypsodonty. This tradeoff has been widely seen in the fossil record of Equidae (horses) as they adapted to living in cooler, drier, and more open habitats in the Mesozoic. We expect that the enamel length and hypsodonty should be greater in ungulate taxa that feed on grasses than in non-grass feeders. We tested this hypothesis by digitally photographing 174 maxillary tooth rows from 72 species of extinct and extant ungulates (ranging from 1036 teeth) and measuring their occlusal enamel length and true occlusal area. We then statistically compared the influences of taxonomy, feeding strategy, tooth position, and tooth area on both hypsodonty and occlusal enamel length including principle components analysis (PCA), multiple linear regression, nested multivariate analysis of variance (MANOVA), and discriminate function analysis. Our PCA indicated a strong correlation between enamel length and tooth area, but little correlation of either with hypsodonty. Our multiple linear regression showed that tooth position (p=0.8718) had no significant relationship to hypsodonty, while only feeding strategy (p=0.4834) was not significant for enamel length. These results were also supported by our nested MANOVA. Our discriminate function analysis produced a significant prediction of feeding strategy from a combination of hypsodonty and enamel length with only 21.81% misclassified. Consequently, these data may be used to approximate feeding strategy in some extinct ungulate taxa. Our results suggest that the occlusal enamel length in ungulates varies by factors such as the size of the tooth and, by proxy, the mass of the individual, not diet. However, hypsodonty is determined by diet, not mass.

**New Rebcahisaurid Sauropod from Tunisia**

FANTI, Federico, Museo Geologico Giovanni Capellini, Bologna, Italy; CONTESSI, Michela, Dipartimento di Scienze della Terra e Geologico-ambientali, Bologna, Italy; ANDREA, Cau, Museo Geologico Giovanni Capellini, Bologna, Italy

New material of a rebcahisaurid sauropod from the Tafnaouine region of southern Tunisia, represents the first record of an articulated dinosaur from the Aptian-Albian deposits of northern Africa. The partial skeleton was recovered in the fluvial and marginal-marine beds of the Oum ed Diab Formation, the youngest siliciclastic unit of the “Continental Intercalare,” that crops out extensively along the Jefara escarpment in southern Tunisia. The preserved skeleton includes an articulated sacrum, the anteriormost five caudal vertebrae and an incomplete pelvis. The sacral neural arches and spines form a continuous lamina produced from the fusion of the intercentra and spinallaminae. The neural and caudal neural spines are extensively laminated and pental-shaped. The first five caudal vertebrae were recovered articulated with each other and the sacrum. The first caudal centrum bears a preurocoel. The neural arches are apneumatic. The caudal vertebrae bear hypsodont ridges, a spindipodialyseal lamina running along the lateral surface of the neural spine and distinct from the prespinal laminae (the latter confined to the anterior surface of the spine) and joined ventrally by an accessory ventral lamina. The ilium is acumenate anterodorsally and has a slender pubic peduncle directed ventrally. The iliac peduncle of the ischium shows a constricted neck, a dorsolateral scar and a large medial fossa. Phylogenetic analysis places this new taxon as the basalmost nigersaurine. In addition, a diverse vertebrate fauna has been recovered from the main quarry, including isolated elements of non-avian theropods, crocodilians (represented by three different taxa), actinopterygians, sarcopterygians, and shark teeth. Detailed stratigraphic and sedimentological analyses performed at the main site indicate that at the time of deposition sediments accumulated in a large estuarine system under arid climatic conditions. Similarly, the faunal assemblage (including microwebrate remains) supports the co-existence of non-marine, brackish and marine taxa. Rebbacisaurid sauropods are primarily known from the mid-Cretaceous of Africa, South America and Europe. Albeit partially biased by poor sampling and the uncertain position of some fragmentary taxa, the paleogeography of the two recognised rebcahisaurid subclades may indicate some regionalism in their distribution: limaysaurine remains occur mainly in South America, while nigersaurine appears to be centered along the margins of western Tethys. In the peri-Mediterranean area rebcahisaurids play a fundamental role for paleobiogeographic hypotheses, whereas sites from South America provide information on ecological partitioning of these sauropods relative to contemporary titanosaurs.

**Poster Session I** (Wednesday, October 17, 4:15 - 6:15 pm)

**ONTOGENY IN THE HADROSAURID DINOSAUR PARASAUROLOPHUS REVEALED BY AN ARTICULATED SKELETON FROM THE KAIPAROWITS FORMATION OF SOUTHERN UTAH**

FARKE, Andrew A., Raymond M. Alf Museum of Paleontology, Claremont, CA, United States; CHOK, Derek, The Webb Schools, Claremont, CA, United States; HERRERO, Ana, The Webb Schools, Claremont, CA, United States; SCHLIERI, Brandon, The Webb Schools, Claremont, CA, United States

The lambeosaurine hadrosaur Parasaurolophus, distinguished by its elongated tube-like crest that contains a portion of the nasal passages, is well-represented by adult crania from Campanian-aged deposits in Alberta, New Mexico, and Utah. In contrast with other lambeosaurines, however, the cranial ontogeny of Parasaurolophus is poorly known. Thus, a juvenile skull and articulated skeleton from the Kaiparowits Formation of southern Utah, referred to *Parasaurolophus*, provide important new data. The specimen, RAM 14000 (Raymond M. Alf Museum of Paleontology) has a humerus and femur measuring 180 mm and 315 mm long, respectively. Because the tail is incomplete, scaling from other juvenile hadrosaurid estimates total body length between 1.9 and 2.5 m, roughly 25% of maximum adult body size. The skull measures 240 mm long from the snout to the posterior margin of the quadrate, and the dentary is 138 mm long. The parallel, fluted impressions of the soft tissue associated with the upper beak shows that the tip of the beak extended up to 30 mm beyond the end of the premaxilla. This not only reduced bite force at the tip of the beak relative to the condition without a keratin extension, but also would have increased the overall area cropped in each bite. In addition, the presence of the bill contributed to faster cropping of food. The crest is approximately 50 mm tall above the apex of the orbit and is semicircular rather than tubular in lateral profile. The crest-nout angle is approximately 55°, with a prominent premaxilla-nasal fontanelle. Although the morphology is similar to that in juvenile Corythosaurus, Lambeosaurus, and Hypacrosaurus, the crest in RAM 14000 is comparatively more strongly developed than in somewhat larger juveniles of the other taxa. This suggests that Parasaurolophus initiated growth of the crest at an earlier ontogenetic stage, as expected from the extreme adult morphology of the crest in this taxon. Unlike other juvenile lambeosaurines, the narial passages occupy nearly the entire volume of the crest in RAM 1400; additional morphological differences occur in the position and size of features such as the S-loops and common medial chamber. The comparatively early development of cranial ornamentation in hadrosaurs (and other dinosaurs) parallels the condition seen in extant mammals (e.g., bovids), but differs from the late onset seen in extant birds (e.g., hornbills, casuaries). The integration of the ornamentation into the respiratory system perhaps necessitated the early development of the crest in juvenile hadrosaurs.

**Poster Session III** (Friday, October 19, 4:15 - 6:15 pm)

**COMPARATIVE PECTORAL AND FORELIMB MORPHOLOGY OF ORNITHOPODA: DOES ORYCTODOREUMS CUBICULARIS EXHIBIT SPECIALIZATION FOR DIGGING?**

FEARON, Jamie L., Montana State University, Bozeman, MT, United States; VARRICCHIO, David J., Montana State University, Bozeman, MT, United States

This study examined the forelimb morphology of the mid-Cretaceous basal ornithopod *Oryctodromeus cubicularis* using traditional and geometric morphometric statistical analyses to assess the presence of burrowing adaptations relative to other ornithopods. The holotype
of *Oryctodromeus* occurred with two juvenile specimens in a burrow structure, and the initial description suggested morphological features such as a robust and fused scapulocoracoid representing digested adaptations. As there is no analog for a forelimb-assisted scratch-digging bipedal dinosaur within the extant phylogenetic bracket or among mammals, quantifying the forelimb variation within Ornithopoda in a phylogenetic context is necessary to understand any specializations of *Oryctodromeus* and their potential application in burrowing. I analyzed scapular and humeral morphology of ornithopods using traditional and geometric morphometrics to describe the morphological variation. A principal components analysis (PCA) of measurements of the humerus and scapula describes the variance of the specimens in terms of principal components (PC). Locations of landmarks on the humerus and scapula were computed using TPSDig2 and then a thin plate spline (TPS) analysis was used to describe the shape mathematically. PCA results for the humerus indicate that iguanodontians and hypsilophodontids have similar proportions, and that it is primarily adult size that describes variation between the groups. The iguanodontians and hypsilophodontid group is distinguishable from hadrosaurids based on deltopectoral crest morphology (PC1). TPS analysis of the humeri shows that hypsilophodontids and iguanodontians form two slightly overlapping groups, however *Oryctodromeus* does not graph near iguanodontians. PCA results for scapulae indicate that hypsilophodontids are morphologically distinct, while hadrosaurids and iguanodontians group together. Most variance in scapulae is due to the broadening of the anterior and posterior ends (PC1). *Oryctodromeus* scapulae group together, however more hypsilophodontid material is needed to determine if they are statistically distinct in the group. Geometric morphometric results for the scapulae indicate that *Oryctodromeus* is morphologically distinct from the hypsilophodontids and other ornithischians, primarily that the pubis of *Oryctodromeus* is thin and rod-like bone also calls for caution. Thin, rod-like bones are subject to bending loading. Bending loading, however, results in high mechanical stresses which are not well addressed by a thin, rod-like bone. Although bones are adapted to tolerate bending loads to a certain extent, excessive bending loading is avoided. A mechanism to minimize bending loading is required.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**ON THE MECHANICAL LOADING OF THE PUBIS IN EXTANT ARCHOSAURS AND ITS RELEVANCE FOR THE RECONSTRUCTION OF SOFT TISSUES IN ORNITHISCHIAN DINOSAURS**

**FECHINER, Regina, Ruhr-Universität Bochum, Bochum, Germany; GÖSSLING, Rainer, Ruhr-Universität Bochum, Bochum, Germany; SVERDLOVA, Nina S., Ruhr-Universität Bochum, Bochum, Germany**

Ornithischian dinosaurs are characterized by an opisthopubic pelvic architecture, in which the pubis is directed posteroventrally. The retroversion of the pubis is induced by changes in the biological roles of the associated muscles. According to the extant phylogenetic bracket, the biological roles of the muscles attached to the pubis of ornithischians are locomotion, ventilation, and trunk stabilisation. Locomotion and ventilation are especially important aspects of the biology of an organism. Accordingly, our understanding of the biology of ornithischian dinosaurs strongly depends on precision in the reconstruction of these muscles. For several reasons the reconstruction of the muscles attached to the pubis of ornithischian dinosaurs is not trivial. Besides the well-known limitations of the extant phylogenetic bracket, the new ornithischian taxa that are described recently are an additional problem. This poster addresses these challenges by a detailed reconstruction of the muscles attached to the pubis of *Oryctodromeus*. Studies of ornithopod musculature identify the posterior scapular blade as the attachment site for the deltoideus muscle, a muscle used in digging in mammals, supporting the hypothesis that *Oryctodromeus* exhibited some specialization for digging.
Partnerships formed with other institutions that possess additional skeletal reconstruction of for the taxon. Preparation of the material was accelerated when it was decided that a full semi-arid or seasonal climate for the area in the Maastrichtian. The specimen included (Sauropoda: Titanosauria) in the Javelina Formation (Late Cretaceous: Maastrichtian) Dallas (UTD) field party discovered a partial adult skeleton of Alamosaurus. The Pleistocene/Holocene faunal turnover was drastic, including major losses of diversity at ordinal and family levels (from 11 to 8 orders, and from 33 to 23 families), largely involving extinction and an important reduction of the Neotropical component; major biogeographic shifts involving disjunction of once continuous areas of distribution, wholesale displacement of many taxa both latitudinally and altitudinally, reduction of ranges, and seemingly a finer partitioning of habitats to allow a greater number of species in the same space (resulting in a greater speciation rate?). The change in the herbivore/carnivore ratio might be related to biodiversity loss. The extent of the change is similar to that of Mexico’s Neartic region, but greater than that of the Neotropical region. There is no agreement on the cause/causes responsible for the Pleistocene/Holocene faunal turnover, but it appears that environmental or climate change was one of them (largely operating through ecological stress), while selective hunting by humans adversely affected the population structure of megafaunal species.

Technical Session XVI (Saturday, October 20, 9:45 am)

ON THE PREDATORY BEHAVIOUR OF THE THYLACINE: A COMPARATIVE APPROACH BASED ON FORELIMB ANATOMY

FIGUEIRIDO, Borja, University of Malaga, Malaga, Spain; JANIS, Christine M., Brown University, Providence, RI, United States; WU, Dominic, Brown University, Providence, RI, United States

The recently extinct thylacine (Thylacinus cynocephalus, the “Tasmanian tiger” or “marsupial wolf”) was the subject of a scientific investigation of its behavior. Despite the existence of a few eye-witness accounts, its mode of hunting prey remains conjectural. While its overall morphology (e.g., relatively short metapodials) makes it unlikely that it was a pack-hunting predator like a placental wolf, its general fox-like appearance has led to the suggestion of fox-like pounce-pursuit behavior.

Our previous work showed that the morphology of the elbow joint (i.e., the distal humerus) of the thylacine was more like that of a cat-like ambush predator than of a either a wolf-like pursuit predator or a fox-like pounce pursuit predator. Here we continue this investigation of forelimb anatomy, including 54 features of all forelimb elements except for the second and third phalanges, to see how the morphology of the thylacine compared with other carnivores of known predatory style (pursuit, pounce-pursuit, and ambush). Our data set included felids (11 species/23 individuals), canids (15/27), hyaenids (3/7), mustelids (1/1), dasyurid marsupials (2/3), and 5 individuals of Thylacinus.

Principal component analysis of log-transformed data showed three significant factors explaining 87% of the variance. Factors two and three did not distinguish between pursuit and pounce-pursuit predators, but these together had little overlap with the ambushers. The thylacine specimens all clustered with the ambushers. A step-wise discriminant analysis identified five significant variables, including aspects of shape of the humerus and the scapula, and metacarpal length. This resulted in a more clear separation of all of the three types of predators, with the thylacines again clustering with the ambushers. We thus conclude that, despite its overall canid-like appearance, the thylacine did not have the predatory style of any extant canid, which are all either pursuit or pounce-pursuit predators. Rather, its forelimb morphology is most similar to that of a medium-sized feline such as the ocelot.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

THE FIRST ARTICULATED CERVICAL SERIES OF AN ADULT ALAMOSAURUS SANJUANENSIS (DINOSAURIA: TITANOSAURIA) AND AN ALAMOSAURUS SKELETAL RECONSTRUCTION AT THE PEROT MUSEUM OF NATURE AND SCIENCE

FIORILLO, Anthony R., Museum of Nature and Science, Dallas, TX, United States; TYKOSKI, Ronald S., Museum of Nature and Science, Dallas, TX, United States; MAY, Peter, Research Casting International, Trenton, ON, Canada

In 1997 a joint Perot Museum of Nature and Science (PMNS) - University of Texas at Dallas (UTD) field party discovered a partial adult skeleton of Alamosaurus sanjuanensis (Sauroptera: Titanosauria) in the Javelina Formation (Late Cretaceous: Maastrichtian) of Big Bend National Park, Texas. The Javelina Formation consists of fluvial channel and overbank facies, including minor shallow lake deposits and paleosols that indicate a semi-arid or seasonal climate for the area in the Maastrichtian. The specimen included an articulated string of nine cervical vertebrae, the first articulated cervical series known for the taxon. Preparation of the material was accelerated when it was decided that a full skeletal reconstruction of Alamosaurus would be an iconic exhibit in the new PMNS. Partnerships formed with other institutions that possess additional Alamosaurus material, including the Smithsonian Institution (Washington, D.C.), and The University of Texas at Austin, and also Research Casting International (RCI) enabled further preparation of fossil material, laser scanning of specimens, and fabrication of the skeleton. The nine articulated vertebrae measure approximately six meters in length and come from the posterior part of the neck. Neurocentral and cervical rib sutures are fused, an indication that the individual was relatively mature at the time of death. The smallest, but incomplete, vertebral is more than 60 cm long, and over 50 cm tall from the edge of the parapophysis to the dorsal tip of the neural spine. More posterior vertebrae are much larger, some measuring more than 70 cm long, a meter high, and nearly a meter wide across the diapophyses of the cervical ribs. The lateral surfaces of each centrum are excavated by anteroposteriorly elongate pneumatic fossae. The tall, triangular neural spines differ from the dorsoventrally low spines described in an immature individual from the area. The base of each neural spine is excaved by a deep spinodiodophyseal fossa, and the postzygapophyseal fossae reach to or extend posterior to the end of the centrum as in some other titanosaurians. In the most posterior vertebrae, the prezygapophyseal centrodiphaphyseal fossa is divided into distinct dorsal and ventral sub-fossae by a delicate accessory lamina, a potentially diagnostic feature. Given the importance of vertebral morphology in sauropod systematics, this articulated cervical series is a unique and important resource. These specimens and the full skeletal reconstruction of Alamosaurus erected at the PMMS provide new insights into the paleobiology and relationships of this taxon.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 9:45 am)

WESTERN APALACHIA DINOSAURIA AND ASSOCIATED VERTEBRATES OF THE LATE CRETACEOUS OF SOUTHEAST MISSOURI

FIX, Michael F., University of Missouri, Saint Louis, MO, United States; DARROUGH, Guy E., Bolinger County Museum of Natural History, Marble Hill, MO, United States; PARRIS, David C., New Jersey State Museum, Trenton, NJ, United States; GRANDSTAFF, Barbara S., School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA, United States

The Late Cretaceous (Campanian) Chronistor Site of southeastern Missouri is the only known locality in the state that contains Mesozoic terrestrial vertebrate remains. Current excavation by the Missouri Ozark Dinosaur Project is being conducted under an enclosure to keep out water, and utilizes a 60 m² hanging grid to facilitate detailed mapping and taphonomic record keeping.

Fossils occur within clay that shows considerable soft sediment deformation due to the close proximity of a normal fault, on whose downthrown block it has been preserved. The environment of deposition as indicated by faunal and stratigraphic evidence was a predominately low energy body of fresh water, with occasional influxes of higher turbidity as indicated by a prominent gravel zone. This deposit may represent a backwater, wetland, or oxbow lake.

The fauna includes three types of dinosaur that have been positively identified: Hypsilophodon missouriensis, a hadrosaur of uncertain affinities, an undetermined genus of tyrannosaurid; and an undetermined genus of dromaeosaurid. Recently, skull material from H. missouriensis has been recovered. This material includes dentitions that suggest affinities to Gyrrosaurus. The associated fauna of hybodontids, batoids, lepisosteids, amiids, hadrocodonts, aquatic turtles, and crocodylians found with the dinosaurs indicates that a substantial body of water was located not far from the eastern shoreline of the epicontinental sea. The semiaquatic fauna suggests this body of water had some connection to the seaway in the adjacent southeastern lowlands. Virtually all major taxonomic groups thus far identified at the Chronistor Site are also known from the Ellisdale Site, Campanian of New Jersey.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

PALEOCENOLOGICAL RECORDS FROM THE LATE CRETACEOUS WINTON FORMATION, CENTRAL-WESTERN QUEENSLAND, AUSTRALIA: NEW OBSERVATIONS BASED ON LEAF MARGIN ANALYSIS, CLIMATE LEAF ANALYSIS MULTIVARIATE PROGRAM, BIOCLIMATIC ANALYSIS AND FOSSIL WOOD GROWTH INDICES

FLETCHER, Tamara L., University of Queensland, Brisbane, Australia

Over the last decade the mid-Cretaceous (late Albian–Cenomanian) Winton Formation of western Queensland, Australia, has proven to be a rich source of terrestrial vertebrates, boasting a fauna that includes dinosaurs, crocodilians, squamates, turtles and fishes. To support our understanding of this fauna I investigated the climatic and seasonal indices associated with vertebrate-bearing horizons at sites near Winton and Isisford. The former sites are dominated by sauropods, while crocodylians and fast-swimming teleost fishes are the most abundant remains at the latter sites. Significantly, many of these sites include well-preserved plant macrofossils. Using Leaf Margin Analysis, Climate Leaf Analysis Multivariate Program, Bioclimatic Analysis and fossil wood growth indices, the data indicate that the Winton Formation was wet and relatively cool and equable. When the climate results are compared with current Cretaceous global climate estimates for the same paleolatitude (~54 degrees south), the signal is much more consistent with a late Cenomanian–Turonian age, rather than the current estimate of late Albian–Cenomanian (which is based mainly on palynology). The Isisford localities are significantly different in terms floral preservation; leaves are extremely rare, and wood associated with bone is typically preserved only as casts. This contrasts with the beds of finely preserved leaf impressions and wood that preserves microscopic internal characteristics at the Winton sites. These observations suggest that vertebrate-bearing sites in each of the two areas, previously considered to be near coeval, may be temporally separated. Refining the climatic signal and floral environments associated with these localities is improving our understanding of the
nature of the Winton Formation vertebrate fauna, the relationship between sites and details of related depositional settings.

Technical Session XVII (Saturday, October 20, 11:45 am)

SYNERGISM IN DENSSER FOSSIL RECORDS: ECOLOGICAL COMPLEXITY EMERGES FOR MIDDLE Oligocene Siwalik Rhizomyine Rodents

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The beauty of a dense fossil record, one with many superposed fossil samples, is that successive samples may be compared, and differences evaluated for passage of time or change in paleoecology. Increase in sampling density results in larger aggregate collections, records of more taxa, and finer scale metrical comparisons. For the Miocene Siwaliks of the Indian subcontinent, a multinational team has built a composite sequence on the Potwar Plateau, Pakistan. The sequence is well dated and spans 12 million years (18 to 6 Ma) and thousands of meters of sediment. Particularly densely sampled is the Middle Miocene Chinji Formation, with 29 small mammal levels distributed over a 3 million year interval (14.3 to 11.3 Ma). Although not evenly distributed, data are available for most 100,000 year subintervals. Previously, with very few of these sites studied, a simplistic view of faunal succession was developed under a model in which one or two small rhizomyines characterized Chinji faunas. This view of samples widely spaced in time, small mammals appeared formerly to show evolutionary stasis. The paradigm of a Chinji mammal community with characteristic rodents including a single (or two) small rhizomyines underestimates true diversity and fails to distinguish subtle biotic trends. The greatly expanded fossil record presently available shows more small rhizomyines contributing to the Chinji community, with up to four species present at a single locality. These rhizomyines were early root rats adapted to burrowing and above-ground foraging; a new paradigm might make room for multiple lineages in close proximity. In addition, the greatly expanded data set indicates change in size in some lineages, which can be evaluated with global trends of isotopic change, such as that associated with the end of the mid-Miocene climatic optimum. One may begin to pose paleoecological questions about body size correlated to paleohabitat. The present denser fossil record allows exploration of more complex paleobiological questions than could be approached constructively with limited data.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

THE OLDEST SCOLECOPHIDIAN SNAKE

FOLIE, Annelise, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

Scolecophidiens are primitive, tiny snakes represented by two extant families (Typhlopidae and Leptotyphlopidae) that live mainly in tropical areas. The only European representative of this group is Typhlops vermicularis that lives around the Mediterranean Basin. Here we describe two isolated prococeous trunk vertebrae from the early Paleocene locality of Hainin (MP1-5, Belgium). These vertebrae are clearly referable to a scolecophidian because of the following characters: they are 1.5 mm long and 1 mm high and wide; the centrum is narrow and does not bear a central carina; the orientation of the prezygapophyseal facets differs from the orientation of the prezygapophyseal processes; the neural arch is low and does not present a medial notch on its posterior border nor a neural spine. Fossil scolecophidiens can be identified based on their vertebrae but they are not generally considered to be diagnostic to a familial, generic or specific level. However, some characters have recently been proposed to differentiate families according to the shape and placement of the synapophyses, shape of the cotype, size of the zygophene, and shape of the prezygapophyseal facets. We thus also discuss these characters in the Belgian Paleocene taxon.

Fossil scolecophidiens are known from North America, Europe, Africa and Australia. The oldest recorded occurrence of this group is known from the late Paleocene of Adrar Mogn (Ouardazate Basin, Morocco). In Europe, the oldest scolecophidian was identified from the earliest Eocene of the Dormaal locality (MP7, Belgium). The scolecophidian from the early Paleocene of Hainin thus represents the oldest occurrence of this group.

Technical Session V (Wednesday, October 17, 3:15 pm)

LONG-TUSKED ARCHAIC Oligocene ODONTOCETES FROM OREGON AND BAJA CALIFORNIA SUR, EASTERN PACIFIC MARGIN

FORDYCE, Robert E., Dept Geology, University of Otago, Dunedin, New Zealand; FITZGERALD, Erich M., Museum Victoria, Melbourne, Australia; GONZALEZ BARBA, Gerardo, Universidad Autonoma de Baja California Sur, La Paz, Mexico

Two new species of archaic dolphin from the eastern Pacific represent a new genus of putative basal odontocetes. One is USNM (US National Museum) 205491, of late early Oligocene age (~30 Ma); Alea Formation, Yaquina River, Oregon, comprising skull, mandibles, teeth, tympanopectones and fragmentary postcrania. USNM 205491 has been mentioned in print as a “non-squalodontid”, or an Eocene Eurhodophilidae, or an Agorophiidae. The second species is known from a partial skull with one cheektooth and a bulla (Universidad Autonoma de Baja California Sur-UBACS collections) of middle late Oligocene age (~25 Ma; El Cien Formation, La Paz, Baja California Sur). In both, the skull has a prominent narial “snout” separating bilateral facial fossae for nasofacial muscles implicated in high-frequency sound production. Archaic features include parietals exposed at a prominent intertemporal constriction, anteriorly-placed narial fossa, and premaxilla without a postero lateral fold but with a narrow elongate premaxillary sac fossa. USNM 205491 has long, tusk-like, procumbent anterior teeth, and cheekteeth with wide diastemata, delicate high triangular crowns, and barely-discernable denticles. The rostrum is long and dorsally compressed, with an open mesorostral groove and gracile mandibles in which the large panbone is ventrally inflated. The incomplete feeding apparatus in the UABCS skull is of similar structure. These dolphins lack the highly disparate derived features of near-contemporaneous Xenorophidae and Simocetus, and are not clearly close to other Oligocene families such as Waipatiidae, Squalodelphinidae, and Squalodontidae. The rostral/tooth structure in the Oregon and Baja dolphins closely matches those of putative “dalpiazinid” dolphins from the New Zealand Oligocene. The latter, however, are more derived in many cranial features, raising the possibility of homoplasy in the feeding apparatus. New Zealand assemblages have not yet produced Late Oligocene dolphins of archaic grade comparable to those that dominate assemblages from the northeast Pacific.

Technical Session XV (Saturday, October 20, 10:15 am)

A NEW TAXON OF Iguanodontoid Dinosaur FROM THE Kirkwood FORMATION (VALANGINIAN) OF SOUTH AFRICA BASED ON AN ASSEMBLAGE OF JUVENILE SPECIMENS

FORSTER, Catherine A., The George Washington University, Washington, DC, United States; POOLE, Karen E., The George Washington University, Washington, DC, United States; DE KLERK, William J., Rhodes University and Albany Museum, Grahamstown, South Africa; CHINNAMY-TURAN, Anusuya, University of Cape Town, Cape Town, South Africa; ROBERTS, Eric J., James Cook University, Townsville, Australia

A new taxon of iguanodontid dinosaur from the Early Cretaceous (Valanginian) Kirkwood Formation, Eastern Cape Province, South Africa, is represented by the disarticulated remains of numerous immature individuals from a single site. Based on non-overlapping parts of left femora, the most numerous element in our sample, at least 27 individuals are present. Complete femora range in length from 18.4 mm to 54.7 mm (n=12), which histological studies demonstrate to be recent hatchlings to young, rapidly growing juveniles lacking secondary osteons. Despite our scattered and disarticulated sample, nearly every element of the skeleton and skull is represented.

All specimens were recovered from a 30 cm thick zone within an upward-coarsening reddish brown, mottled, clay-rich paleosol in a localized area approximately 14 m². The bone-bearing paleosol is overlain by a sandy crevasse-splay deposit suggesting it developed on a flood plain. There is no preferred orientation of elements and only four instances of articulation between elements were noted during excavation and preparation despite the collection of well over 200 individual elements. Although many elements are complete, others exhibit pre-burial breakage and crushing. Immature iguanodontid elements comprise 96% of all remains at the site; rare turtle shell fragments, fish bones, a sphenodontian braincase, elements from a sub-adult iguanodontid, and crocodile, theropod, saurupod, and stegosaur teeth also occur. These factors suggest that the site may represent seasonal attrition at or near a nesting area.

A phylogenetic analysis places the new Kirkwood taxon within the Iguanodontoida, along with Iguanodon, Mantellisaurus, Jinouhausaurus, and others. Characters supporting its inclusion in this clade are marginal denticles of the teeth with mammillated edges and hatched shaped sterne plates. Although all confirmed specimens of the Kirkwood iguanodontoid are immature, these characters are not known to change through ontogeny, lending confidence to its placement within Iguanodontidae. This is the first confirmed, well-represented iguanodontid from sub-Saharan Africa.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

PLEISTOCENE CROCODYLIDAE FROM VENEZUELA, AND THE DESCRIPTION OF A NEW SPECIES OF CAIMAN

FORTIER, Daniel C., Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; RECON, Ascacio D., Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela

The fossil record of post-Miocene caimans is sparse and fragmentary, but caimans have been recovered in many localities all over South America. Here, we present the first crocodylian remains from the Pleistocene of Venezuela, found in the asphalt deposits of El Breal de Orocual, which is a high diversity mammalian fossil locality. Most of the fossil crocodylians found in this locality are undiagnostic fragments. However, some of them could be either associated to indeterminate Caimaninae of Caiman sp. The most important material represents a new taxon which is described on the basis of fragmentary but diagnostic remains. The species is unique among caiman species by the possession of a premaxilla that is twice as long as it is wide in ventral view, with a long contact between the premaxillae posterior to the incisive foramen. The El Breal de Orocual is one the most diverse localities in South America, and is probably the most important crocodylian bearing locality from the continent during the Pleistocene.
Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

3D FINITE ELEMENT ANALYSIS OF A CAPITOSAURIAN SKULL (TEMNOSPONDYLI) FROM THE TRIASSIC OF MADAGASCAR

FORTUNY, Josep, Institut Català de Paleontologia, Cerdanyola del Valles, Spain; MARCÉ-NOGÜÉ, Jordi, Universitat Politècnica de Catalunya, Terrassa, Spain; STEYER, J. S., Muséum national d’Histoire naturelle, Paris, France

Capitosaurians are Triassic temnospondyl amphibians characterized by large, parabolic and heavy skulls as well as extensive pectoral girdles. They exhibit aquatic features such as flattened skulls, decreased bone ossification, and lateral line canals. Cosmopolitan in distribution, these amphibious top-predators haunted the brackish, fluvial, and sometimes coastal ecosystems. They are usually compared with crocodilians because they seem to capture prey by direct bite using active swimming, but their precise feeding ecology remains poorly known. To start to solve this problem, we analyzed the skull of Edingerella madagascariensis, a basal capitosaur from the marine Olenekian (Early Triassic) of Madagascar. Using 3D Finite Element Analysis (FEA), a CT scan of the Edingerella adult skull resulted in a 3D model. We analyzed this model under three different biting simulations (bilaterial, unilateral and lateral cases). Previous works testing 2D FEA on capitosaurus suggested that the skull of E. madagascariensis is one of the weakest among capitosaurians during feeding. Our 3D analyses reveals that the skull roof displays an important amount of stress near the circumorbital region and the otic notch area during biting. In the palate, the stress is considerable on the parasphenoid and pterygoid whereas the cultriform process shows low stress during biting. The stress also increases in the vomerine plate during unilateral biting. These results are interesting because they are similar with those obtained from archosaurian skulls in which the secondary palate provides lower stress values. This stress is especially important during unilateral bite. We therefore interpret that this unilateral type of bite was not optimal for taxa without secondary palates, such as temnospondyls.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

CRANIAL MORPHOMETRICS, DISPARITY AND EVOLUTIONARY HISTORY OF PTEROSAURIA (DIAPSIDA: ARCHOSAUROISA)

FOTH, Christian, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; BRUSATTE, Stephen L., American Museum of Natural History, New York, NY, United States; BUTLER, Richard J, Ludwig-Maximilians-Universität München, Munich, Germany

Pterosaurs, the Mesozoic flying reptiles, are an intensively investigated clade that were morphologically, ecologically and taxonomically highly diverse during their ~145 million year evolutionary history. Substantial research has focused on the establishment of long-term patterns and trends in pterosaur diversification, and the timing of peak pterosaur morphological diversity (dispparity). Here, we use landmark-based geometric morphometrics to characterise broadscale patterns of cranial morphological diversity for 31 taxa of pterosaurs. This approach allows us to quantify the principal ways in which pterosaur skulls differ and determine major evolutionary changes in cranial morphology. The majority of cranial shape variation is summarised by the first two PCs, which together describe over 65% of total variance. The first PC axis describes the relative length of the snout, the relative size of the orbit and postorbital region, the size and dorsosphenial depth of the naris-anterior fenestra region and the position of the jaw joint relative to the orbit. The second PC axis describes the relative position of the orbit, the depth of the anterior part of the skull roof posteroordinal to the orbit and the position of the jaw joint relative to the orbit along the dorsosphenial axis. In order to assess the relationship between phylogenetic relationships and cranial morphology, we mapped phylogeny into cranial morphospace, recovering a significant phylogenetic signal. Measurements of cranial morphological disparity suggest that monofenestran pterosaurs were more anatomically diverse than non-monofoenestran pterosaurs (at least when the aberrant anurognathids are excluded). Moreover, peak cranial disparity may have occurred in the Early Cretaceous, relatively late in pterosaur evolution. We recognize broad congruence between our results from cranial disparity analyses and disparity measures from analyses based on whole skeleton discrete character and limb proportion datasets. This congruence suggests that these different approaches might document a consistent pattern of pterosaur morphological evolution. Therefore, pterosaurs provide an exemplar case showing that different proxies for morphological form converge on the same disparity signal. This result is encouraging, because often only one such proxy is available for extinct clades represented by fossils.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

HOW TO EAT A TRICERATOPS: LARGE SCALE OF TOOTHMARKS PROVIDES NEW INSIGHT INTO THE FEEDING BEHAVIOR OF TYRANNOSAURUS

FOWLER, Denver W., Museum of the Rockies, Montana State University, Bozeman, MT, United States; SCANNELL, John B., Museum of the Rockies, Montana State University, Bozeman, MT, United States; GOODWIN, Mark B., University of California Museum of Paleontology, Berkeley, CA, United States; HORNER, John R., Museum of the Rockies, Montana State University, Bozeman, MT, United States

Tooth-marked bone, created by the feeding behavior of carnivorous dinosaurs, provides direct evidence of ecological interactions between predator and prey. However, examples are typically limited to small sample sizes, restricting behavioral inferences for specific taxa. In this study, we present one of the largest samples (n=14) linking a single carnivore, Tyrannosaurus (Tyrannosauroidea), with a prey taxon, Triceratops (Ceratopsidae), revealing consistent patterns of carcass processing. Approximately 100 Triceratops specimens have been collected from the late Maastrichtian of Montana as part of the multi-institutional Hell Creek Formation Project (1999–2011). From this, toothmarks were identified on eight individuals of Triceratops, with possible toothmarks on an additional six individuals. With the exception of one Ymlb, tooth-marked elements are from partially to fully disarticulated complete or partial skulls. Although the total sample includes many Triceratops collected from sandstones, all tooth-marked elements are derived from mudstones. In the absence of any signs of healing, all toothmarks presumably formed during post-mortem carcass processing.

Specimens exhibit a suite of puncture, bite-and-drag, and drag marks, which in combination with tooth-spacing patterns are similar to traces previously attributed to tyrannosaurid theropods. This supports our assignment of these scars to Tyrannosaurus, the only accepted tyrannosaurid from the Hell Creek Formation. Two unassociated juvenile squamosals exhibit extensive punctures up to 2 cm wide, and bite-and-drag marks up to 10 cm long. An associated young subadult juvenile squamosal and parietal show multiple parallel drag marks. These might be unexpected as the parietosquamosal frill would have been mostly bone and keratin, yielding little edible flesh. However, the marks may have been formed as the Tyrannosaurus attempted to move the frill to access the generous neck muscles connected to the skull. This would be consistent with deep parallel gouge marks observed on two occipital condyles, one associated with a punctured braincase. By contrast, 3-4 short, parallel drag marks on an unassociated nasal and premaxilla are more consistent with delicate and precise bites from the incisiform premaxillary arcade.

The laterally thickened teeth of adult tyrannosaurids appear well-suited for resisting lateral stresses, which may have enhanced their ability to dismember carcasses. Relatively older Tyrannosaurus individuals may have employed different feeding strategies than younger individuals as their tooth morphology thickened with a concurrent reduction in total tooth count in the dentary.

Technical Session VIII (Thursday, October 18, 3:45 pm)

WARMER CLIMATES WEAKEN BIOTIC LATITUDINAL GRADIENTS

FRASER, Danielle, Carleton University, Ottawa, ON, Canada; HASSALL, Christopher, Carleton University, Ottawa, ON, Canada; GORELICK, Root, Carleton University, Ottawa, ON, Canada; RYBCZYNSKI, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada

Ecological studies on short timescales (~100 years) demonstrate dramatic range shifts, relocations, and expansions for many groups of terrestrial animals in response to modern global warming. On longer timescales, disproportionate increases in high latitude productivity may enable larger numbers of taxa to persist further north either through increasing speciation or decreasing extinction. We hypothesize that such polar amplification on a geologic timescale acts to weaken biotic latitudinal gradients. We also expect the opposite during global cooling; biotic latitudinal gradients should be steeper. We tested this hypothesis by comparing latitudinal trends in hoofed mammal diversity between the mid (warm, Arctic sea ice likely absent; ~15 Ma) and late (cool, perennial Arctic sea ice present; ~7 Ma) Miocene. We created occurrence matrices and used detrended correspondence analysis (DCA) as well as non-metric multidimensional scaling (NMSD) to test for taxonomic turnover with latitude and longitude. To compare the strength of mid and late
Micocene taxonomic gradients to modern communities, we also created locality data by randomly sampling the geographic ranges of all extant North American mammals. Mid Miocene taxonomic turnover was not well explained by latitude and longitude due to high primary productivity and the absence of Arctic sea ice. In contrast, late Miocene community composition varied strongly with both latitude and longitude as a result of lower productivity and the formation of perennial Arctic ice. Finally, we found that modern latitudinal and longitudinal biotic gradients are uniformly stronger than for the Miocene, supporting our hypothesis. The current presence of a strong latitudinal biotic gradient is the result of our relatively cool climate, and the associated steep latitudinal climate gradient. Given the rate of current warming, however, we can expect dramatic changes to high latitude faunas and the alteration of faunal patterns as we know them today.

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

A LONG-SNOUTED PROTOROSAURIAN FROM THE MIDDLE TRIASSIC OF SOUTHERN CHINA
FRASER, Nicholas C., National Museums Scotland, Edinburgh, United Kingdom; LI, Chun, Institute of Vertebrate Paleontology and Palaeoanthropology, Beijing, China; RIEPPEL, Olivier, Field Museum of Natural History, Chicago, IL, United States

The "Xingyi fauna" of southwestern Guizhou and eastern Yunnan Provinces, China is characterized by a remarkable diversity of Middle Triassic (Ladinian or earliest Carnian) marine reptiles and fishes. These include the protorosaur genera Tanystropheus and Macrocnemus, both of which are known also from Alpine Europe. We describe a new protorosaur on the basis of a single specimen from Guizhou Province. It is somewhat unusual among protorosaurians in possessing a markedly elongate snout. Like the protorosaur on the basis of a single specimen from Guizhou Province. It is somewhat similar to the form. Two vertebral centra are greatly expanded across their articular faces and fused ventrally by proliferative bone forming a spondyloarthropathy that extends dorsally to cover the lateral centra, but does not extend into their articular faces; neural arches are unaffected. Intervertebral distance is reduced. Articular faces between the two pathologic centra display normal bone texture, but possess an interlocking hook-and-socket structure that joins the centra without endplate fusion. Absence of a fracture restricts the differential diagnosis to mechanical stress-induced fusion or inflammation due to infection. A degenerative disorder induced by mechanical stress, such as spondylosis deformans, is consistent with the ventral exostosis. However, extent of the exostosis and endplate remodeling is more consistent with diskospondylitis resulting from infection. Similar infection-derived endplate and endplate exostoses occur in Alligator and Varanus. Although osteopathy of hadrosaur neural spines has been commonly noted, pathologic centers are less well sampled. A global census of hadrosaur osteopathy is encouraged, to elucidate patterns in incidence rates and causes in populations over time.

Technical Session II (Wednesday, October 17, 11:45 am)

THE GEOLOGICAL AGE AND BIOGEOGRAPHY OF CIChLID FISHES: SETTING THE (FOSSIL) RECORD STRAIGHT
FRIEDMAN, Matt, University of Oxford, Oxford, United Kingdom

Cichlids represent an important model system in many areas of biological research, but considerable controversy surrounds their deep evolutionary history and large-scale biogeographic patterns. Living cichlids are widely distributed in freshwater habitats across southern landmasses exclusive of Australia and Antarctica, and their pattern of evolutionary divergences matches area cladograms for the fragmentation of the Mesozoic supercontinent Gondwana. The earliest cichlid fossils are Cenozoic in age and substantially postdate the mid-Mesozoic onset of Gondwanan breakup, but paleontological evidence has been used to argue both for and against the hypothesis of drift-based vicariance. This ambiguity stems from uncertainty about the reliability of the fossil record of cichlids and the consequent need to rely on other methods to constrain their evolutionary history. Two contrasting approaches to estimating plausible times of evolutionary origin were applied to the fossil record of cichlids. The first method uses the distribution of cichlid-bearing fossil horizons plus a function describing fossil recovery potential, while the second draws on the sequence of stratigraphically consistent outcrops to cichlids. Despite considering different paleontological data, both approaches yield similar estimated times for the evolutionary origin of cichlid fishes. The distribution of fossil cichlid horizons implies an age of origin between 83.1 and 55.8 Ma (Campanian-Thanetian), depending on whether analyses included all cichlid fossils or were restricted to articulated material alone. Even when secular variation in available fish-bearing fossil horizons is considered, preservation potential of cichlids must have been approximately one to two orders of magnitude lower in the Cretaceous than during their sampled history in order for the Gondwanan vicariance to be plausible. Analysis of ages of the oldest fossil representatives of cichlid outgroups yields similar age estimates for the clad. The divergence of cichlids is estimated between 87.8 and 56.3 Ma (Coniacian-Thanetian) depending on the hypothesis of outgroup relationships. These results strongly contradict the temporal predictions of the Gondwanan vicariance model of cichlid biogeography, and imply a role for dispersal in generating the transitional pattern of cichlid distribution. These results contribute to the broader debate on biotic connections between Africa and South America, with a growing body of evidence suggesting the migration of many groups with limited potential for oceanic dispersal from the latter continent to the former in the Paleogene.

Technical Session XVI (Saturday, October 20, 10:15 am)

TEMPO AND MODE OF ECOCOMMUNITY DIVERSIFICATION IN CARNIVOROUS THERIAN MAMMALS
FRISCAI, Anthony R., University of California - Los Angeles, Los Angeles, CA, United States; SLATER, Graham J., University of California - Los Angeles, Los Angeles, CA, United States

Carnivora (mammalian carnivores) are often used as a model group for evolutionary analyses because of both their taxonomic and ecological diversity. Recent studies have made excellent phylogenetic data freely available for both living and fossil taxa. We constructed a time-calibrated molecular phylogeny of Carnivora and used an ecologically motivated dataset to examine rates of phenotypic diversification throughout the history of this group. The data show an early burst of evolution along the first ecologically motivated axis, associated with degree of carnivorality, early in the history of Carnivora, as families divided up this ecologically space. This is especially true at the extremes, with both felines and urusids moving to occupy the hyper- and hypocarnivorous (respectively) niches quickly, and staying in those areas of ecospaces. Along subsequent ecocommunity axes, dealing mainly...
with prey size and hardness, we find evidence for accelerating rates of ecomorphological evolution, indicative of late diversification within clades. Integration of fossil taxa into our phylogenetic model fitting strengthened our analyses and highlights Carnivora as a prime example of a Simpsonian adaptive radiation, with early diversification into major ecological roles, and later diversification within those roles.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

MORPHOMETRIC ANALYSIS OF INTRACOLUMNAR AND INTRASPECIFIC VARIATION IN CERVICAL VERTEBRAE OF THE GREAT BLUE HERON (ARDÉA HERODIAS): IMPLICATIONS FOR PHYLOGENETIC CHARACTER SELECTION IN SAUROPOD DINOSAURS
FROMIMOS, John A., University of Michigan, Ann Arbor, MI, United States
The large number of distinct characters observable in sauropod vertebrae, combined with their great variability, has made these elements important to the interpretation of evolutionary relationships within the group, and many taxonomic proposals have been based upon the similarity or dissimilarity between the vertebrae of the taxa concerned. Determining whether vertebral characters are diagnostic above the species level requires understanding the extent of intracolumnar, ontogenetic, and intraspecific variability, as well as asymmetry associated with pneumatic features. As a consequence, the extent to which the character states of vertebrae, especially those isolated of those features, can be used to identify species or more inclusive taxa depends on a number of factors that are not always well described or even known for a given taxon. Investigating the relative contributions of these factors can be facilitated by the use of extant taxa for which species identifications are well-established, material is abundantly available, issues of incompleteness, damage, and distortion are avoided, and interspecific as well as intraspecific comparisons can be more easily performed. A morphometric analysis was conducted on cervical vertebrae from great blue herons (Ardea herodias), which share with sauropods hyper-elongation of the neck and complex, pneumatic vertebrae. The analysis reveals a high degree of within-series variation in great blue herons, with much of the shape change occurring over short spans between regions of comparatively consistent morphology. Considerable shape variation exists between individuals but is insufficient to obscure intracolumnar trends. Asymmetry of pneumatic features on the centrum and neural arch and of the length of cervical ribs is widespread. Characters prone to asymmetrical development, such as pneumatic foramina and fossae, are more likely to be informative in their presence or absence throughout the column than in local variations in presence and position, for which developmental noise may overwhelm the phylogenetic signal.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

A NEW TOMISTOMINE FROM THE OSAKA GROUP IN KISHIWADA CITY, OSAKA PREFECTURE, JAPAN
FURUI, Sora, Natural History Sciences, Hokkaido University, Sapporo, Hokkaido, Japan; KOBAYASHI, Yoshiyuki, Hokkaido University Museum, Hokkaido University, Sapporo, Hokkaido, Japan; CHIBA, Kentaro, Natural History Sciences, Hokkaido University, Sapporo, Hokkaido, Japan
A partial skeleton of a crocodylian, the Kishiwada tomistomine, was found from the sediments near the lower boundary of Ma5 (approximately 0.6 Ma) of the Osaka Group in Kishiwada City of Osaka Prefecture in 1994. A brief preliminary study suggested that the Kishiwada tomistomine pertained to Toymatophaneina machikaniensis, known from a younger horizon (0.4 Ma) of the same group in Osaka Prefecture. Detailed comparison of these two specimens shows that the Kishiwada tomistomine differs in: a more slender snout, and larger foramen on the ventral surface of the quadrate, and a small foramen on the ventral surface of the quadratojugal. The difference in these characters implies that the Kishiwada tomistomine is not Toymatophaneina machikaniensis. The Kishiwada specimen belongs to Tomistominae because it has a deep splenial symphysis and the anterior portion of the splenial is narrow and V-shaped. Its phylogenetic position implies that the Kishiwada tomistomine is not Toymatophaneina machikaniensis. The Kishiwada specimen belongs to Tomistominae because it has a deep splenial symphysis and the anterior portion of the splenial is narrow and V-shaped. Its phylogenetic position implies that the Kishiwada tomistomine is not Toymatophaneina machikaniensis.
followed by teeth of Carcharias saskatchewanensis. Osteichthyian fishes consists of 14 taxa, including Micropycnodon kansansensis, Pycnodontidae indet., Protosphyraena sp., Elosopus sp., Pachyrhizodus minimus, Enchodus cf. E. gladiolus, Enchodus cf. E. shumardi, and three additional unidentified teleoetes. The most common identifiable osteichthyian fossils are teeth of Enchodus cf E. gladiolus, followed by teeth of Pachyrhizodus minimus. Remaining remains include two squamate taxa, Coniasaurus crassidentis and an indeterminate terrestrial squamate, Scincomorpha indet. The taxonomic composition of the fauna broadly resembles previously described mid-Cenomanian localities in North America that further demonstrates the high taxonomic homogeneity of vertebrates in the Western Interior Seaway. Although the occurrence of terrestrial lizard is noteworthy, proportions of common taxa at the Table Mesa locality are particularly similar to another basal Lincoln Limestone locality situated about 100 km to the west where remains of bony fishes also dominate.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleocology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 8:30 am)

CHONDRICTHYIAN AND OSTEICHTHYAN MATERIAL FROM ELIZABETHTOWN, NC, AND BOWIE, MD, AND THE FISH FAUNA OF THE CAMPAIGN-MAASTRICHTIAN OF EASTERN NORTH AMERICA

GARCIA, William J., University of North Carolina Charlotte, Charlotte, NC, United States; HIPPMENSTEEL, Scott P., University of North Carolina Charlotte, Charlotte, NC, United States

Material collected from the Late Cretaceous at the Bladen County Landfill Annex in Elizabethtown, NC and the Severn Formation of Bowie, MD (Maastrichtian) allows further description of the shallow marine fauna of the eastern seaboard during the Cretaceous, as well as comparison of this region to contemporaneous North American vertebrate localities such as those from the Western Interior Sea and Gulf Coast. Scapanorhynchus texanus and Squalicorax pristodontus are the most common taxa at Elizabethtown, representing over half the specimens collected. This compares with published abundances from Phoebus Landing, NC where S. texanus was also the most common taxon, accounting for over 75% of the specimens collected; however, the relative abundance of S. kaupi at Phoebus Landing is not as high as at Elizabethtown. The Elizabethtown material contains a higher proportion of Squalicorax pristodontus, and a smaller proportion of ray material, than material previously reported from the locality. Notable osteichthians from Elizabethtown include Enchodus sp., Trichiurides sp., and Sphyraena sp., which are present in small numbers. Material from Bowie, MD is dominated by Cretolemna appendiculata, Squalicorax kaupi, Squalicorax pristodontus, Odontaspis sp., and Enchodus sp. To test whether faunal differences between localities reflect biogeographic influence, cluster analysis and non-metric dimensional scaling of generic-level presence/absence data of selachians from 26 Late Cretaceous localities from the Western Interior Sea, Gulf Coast and Atlantic Coast were employed. The results indicate affinities among Atlantic Coast faunas, specifically between faunas from New Jersey and North Carolina. Common Late Cretaceous genera such as Squalicorax, Ischyrybida and Odontaspis are cosmopolitan across North America and have little utility at the generic level in discriminating regional differences. Differences between regions were more pronounced when the analyses were conducted using data at the species-level, although similarities between clusters are low overall. Abundance data from Atlantic Coast faunas indicates significant ecological differences between faunas, possibly reflecting differences in environment such as proximity to shore or water depth. The abundance of terrestrial material from Elizabethtown supports this explanation.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

VARIATIONS IN ECOMORPHOLOGICAL DIVERSITY OF SHARK TEETH FROM LATE CRETACEOUS THROUGH MODERN MARINE ECOSYSTEMS OF NORTH CAROLINA

GATES, Terry A., Ohio University, Athens, OH, United States

Marine sediments of North Carolina record a long history of vertebrate species ranging in age from Late Cretaceous through the modern. Shark teeth are some of the most common vertebrate fossils obtained from these sediments, and as such, offer the opportunity to study the ecomorphological diversity of this vertebrate group through time. Shark teeth accessioned at the North Carolina Museum of Natural Sciences, representing most of the known morphotypes documenting by current taxonomic diversity from the Cretaceous, Miocene, Pliocene, and Holocene deposits of that state, were subjected to ten measurements and discrete characters describing overall tooth form. The dataset was then subjected to Principal Components Analysis in order to show the approximate breadth of ecomorphological diversity within shark teeth from each time window. General taxonomic diversity trends depict increasing species richness through time with the Cretaceous beds producing only 17 species of sharks, whereas the Miocene, Pliocene, and modern yield 36, 28, and 56 species, respectively. Undoubtedly, disruptive temporal sampling and variable taxonomic splitting plays some role in the observed taxonomic trends, but the data produced in this study demonstrate that ecological factors also were key. PCA results show that there is an ecomorphological subset that is largely conserved through the last 75 million years of North Carolina coastal ecosystems. Forms falling into this category include "tiger shark"-type teeth (e.g., Squalicorax and Galeocerdo) and long thin teeth with or without cusplets (cretolamnids). Tooth taxa pertaining to the latter morphotype are numerous throughout the study interval because of apparent clade-l level turnover observed since the Cretaceous (that is, if current taxonomy of fossil sharks accurately reflects past diversity). Interestingly, shark teeth typified by long, wide central cusps with large denticles, such as seen within the genera Carcharodon, Hemipristis, and Charcharhinus, are missing from the Cretaceous cohort, which possibly is a response to the presence of other large predatory vertebrates such as mosasaurs, plesiosaurs, and the actinopterygian fish Xiphactinus living in the same estuary/ marine ecosystem, or alternatively a lack of prey items that required such cutting dentitions. Indeed, the Cretaceous shark fauna is overwhelming dominated by tearing-type dentition. A tooth size increment was observed from the Eocene to the Pliocene deposits, culminating in the giant C. megalodon, again as a possible response to larger and more diverse prey items (e.g., cetaceans).

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

A BIPLANAR X-RAY METHOD FOR 3-D ANALYSIS OF TRACK FORMATION

GATESY, Stephen M., Brown University, Providence, RI, United States; ELLIS, Richard, University of Colorado, Boulder, CO, United States

Tracks arise through a complex interplay between animal and substrate. Studying this dynamic process is challenging because most foot-sediment and sediment-sediment interactions are rapid and hidden from view. We sought to resolve a fundamental question in ichnology: how do sedimentary particles move from their starting locations in untrod ground to their ultimate resting places? Herein, we describe a new method for recording and quantifying the 3-D movements of a morphologically realistic indenter and sedimentary markers during track formation. Our method uses two (biplanar) x-ray systems and an animation-based workflow to reconstruct the trajectories of metal beads seeded throughout the sediment volume. x-rays allow sub-surface motion normally concealed by the foot and opaque matrix to be analyzed at sub-millimeter resolution. Video frequencies of 30 Hz and higher reveal temporal dynamics inaccessible by destructive methods, which provide only single snapshots of the track creation. Results from two case studies of tridactal tracks in semi-liquid mud provide novel, animated visualizations of ensemble and particle-specific data. A biplanar x-ray approach has the potential to: mechanistically link specific track features to foot movement, clarify track formation, validate computational models, and set a new standard for evidence-based reconstruction of locomotion from fossil footprints.

Technical Session XII (Friday, October 19, 3:00 pm)

ASSEMBLING THE SQUAMATE TREE OF LIFE: PERSPECTIVES FROM THE PHENOTYPE AND THE FOSSIL RECORD

GALBIER, Jacques A., Yale University, New Haven, CT, United States; KEARNEY, Maureen, National Science Foundation, Arlington, VA, United States; MAISANO, Jessica A., The University of Texas, Austin, Austin, TX, United States; RIEPPEL, Olivier, Field Museum of Natural History, Chicago, IL, United States

We assembled a dataset consisting of 192 carefully selected species (51 extinct and 141 extant) and 976 apomorphies distributed among 610 phenotypic characters to investigate the phylogeny of Squamata (= “lizards,” including snakes and amphisbaenians). These data enabled us to infer a tree much like those derived from previous morphological analyses, but with better support for some key clades. There are also a number of novel elements, some of which pose striking departures from historical ideas about lizard evolution (e.g., that mosasaurs and polyglyphanodontians are on the scleroglossan stem, rather than being parts of the crown, and related to varanoids and teiids, respectively). Long-bodied and limb-reduced taxa such as snakes and “snake-like” fossorial lizards (most notably dibamids, amphisbaenians) have been and continue to be the chief source of character conflict in squamate morphological phylogenetics. Carnivorous lizards (especially snakes, mosasaurs
and varanoids) have proven a close second. Genetic data, presumably less burdened by the potential for adaptive convergence related to fossoriality, were expected to resolve these conflicts. Although recent gene phylogenies appear to do so, they also differ radically from any phylogeny based on the phenotype, especially for the most ancient crown-squamate diversifications that occurred during the latter half of the Mesozoic. This result was all the more surprising as we anticipated that heavily burdened phenotypic characters and intermediate fossils would be especially useful for insights into deep-time phylogenetic events. Our study relied upon traditionally-prepared specimens as well as high resolution CT scans that afforded unprecedented access to the cranial anatomy of Squamata. This, along with the inclusion of stem fossils, provided an unparalleled sample of the phenotype enabling us to more fully explore the extreme incongruences between molecular and morphological topologies for the squamate Tree of Life. Despite this extensive new database, we were unable to find morphological support for the major rearrangement of the deep diversifications in Squamata proposed by recent molecular studies. Instead, our data strongly support the same fundamental topology suggested by most previous morphological studies (an Iguania-Scleroglossa basal split, a sister-group relationship between Gekkota and Autarchoglossa, and the divergence between Anguimorphs and Scinciforms) and documents the extreme degree of morphological homoplasy required by those molecular topologies.

Poster Session I (Thursday, October 18, 4:15 - 6:15 pm)

NEW POSTCRANIAL ELEMENTS FOR TEILHARDINA BELGICA, AN EARLY EOCENE FOSSIL PRIMATE

GEO, Daniel L., Northern Illinois University, DeKalb, IL, United States; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; DAGOSTO, Marjan, Northwestern University, Chicago, IL, United States

Teilhardina belgica is one of the most primitive fossil primates known to date and the earliest haplorhine with associated postcranials making it relevant to a reconstruction of the ancestral primate morphotype. Here we describe newly discovered postcranial elements of Teilhardina belgica that were recovered from the collections housed at the Royal Belgian Institute of Natural Sciences (Brussels, Belgium) from the site of Dormaal. Teilhardina belgica is a small primate similar in size to a mouse lemur (between 30-60 g). Its hindlimb anatomy (e.g., tarsals, a distal femur, a first metatarsal and phalanges) suggests frequent and forceful leaping with excellent foot mobility and grasping capabilities. Teilhardina exhibits critical primate postcranial synapomorphies such as a grasping hallux, a tall knee, and nailed digits. This anatomical pattern and behavioral profile is similar to what has been inferred for other Early Eocene primates. The nodal and intermediate feature of Teilhardina belgica is its elongated middle phalanges (most likely manual phalanges) suggesting that this early primate may have had very long digits similar to those of living tarsiers.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

MORPHOMETRY.ORG, A NEW WEBSITE FOR SHARING MORPHOMETRIC DATA

GELNAW, William B., University of Texas at Austin, Austin, TX, United States

Morphometrics, the study of structure through size and shape, has blossomed as a field of study over the last two decades, with a proliferation of techniques for collecting and applying data. The most immediate impediment to advancing morphometrics as a mode of investigation has been the lack of an efficient way to share data between researchers. Morphometry.org is a new website for sharing traditional morphometrics, as well as 2D and 3D geometric morphometric data, in a searchable database. In the same spirit as GenBank and MorphoBank, Morphometry.org aims to improve morphometric investigations by eliminating time-intensive data collection and allowing incremental addition to ongoing projects, facilitating peer-review of data accuracy and precision as well as the resulting analyses. Requirements of submission for all linear measurements and landmark coordinates include written definitions of how the measurement was taken or where the landmark is placed, the list of specimens examined with associated specimen numbers, and the values of the data as a tab-delimited table. For 2D geometric data, submissions must include the photographs used for landmark placement. Morphometry.org does not require submission of data collection metadata or 3D reconstruction data, but will do so in the future. Submitted data can optionally include illustrated references for taking measurements or placing landmarks, links to additional data about the specimens examined (such as in VertNet.org and Digimorph.org), geographic coordinates for the collection site of the specimen, and user-defined classification and metadata tags.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

SEMIONOTID FISHES (NEOPTERYGI; SEMIONOTIFORMES) FROM THE UPPER TRIASSIC CHINLE FORMATION OF SOUTHERN UTAH: NEW SPECIES AND COMMENTS ON THE RELATIONSHIPS OF FISHES WITHIN THE FAMILY SEMIONOTIDAE

GIBSON, Sarah Z., University of Kansas Department of Geology, Lawrence, KS, United States

Fossilized remains of ganoid semionotiform fishes from the Upper Triassic Chinle Formation of the southwestern United States are abundant, yet poorly studied and understood. The extinct family Semionotidae has been subject to taxonomic confusion and is in need of further study. In this investigation, we describe two species of Semionotus from specimens collected from Triassic deposits (approximately 210-205 Ma) in Lisbon Valley, Utah, including one new species, as well as the previously described Semionotus kanabensis. The new species of Semionotus displays a unique combination of characteristics that diagnose it as a new species, including a unique cranial suspensorium with a short, ventrally-extended neural arch superficial pericardium, expanded inframandibular flanges, a deep, single-layer neural arch, and a single-layer neural arch. This evidence indicates that the genus Semionotus is not monotypic and that the fauna preserved by the Kayenta Formation changed during the formation’s deposition. Further work is also needed to determine if a fragmentary specimen from southwestern Utah is also attributable to Semionotus n. sp. If so, this would represent a significant expansion of the known range of Semionotus.

Poster Session II (Friday, October 19, 9:00 am)

LUGOL’S IODINE AS A CONTRAST AGENT IN X-RAY µCT IMAGING: METHODOLOGICAL REFINEMENTS AND POTENTIAL SIGNIFICANCE FOR INFERRING SOFT-TISSUE ANATOMY IN FOSSIL VERTEBRATES

GIGNAC, Paul M., Stony Brook University, Stony Brook, NY, United States; KLEY, Nathan J., Stony Brook University, Stony Brook, NY, United States

Visualization methods vastly enhance our ability to appreciate complex anatomical relationships and to harness these relationships for understanding the nature of developmental and/or evolutionary changes in morphology. Most notably, the new widespread use of non-destructive X-ray computed tomography (CT) and micro-CT (µCT) has greatly augmented our ability to comprehensively detail and quantify the internal anatomy of fossil vertebrates. Refining these techniques for use on hard tissues such as bone, dentine, and enamel has led to substantial gains in both the quality and quantity of anatomical comparisons among extinct taxa and between fossils and their extant descendants or analogues. However, the utility of X-ray imaging for gaining similar paradigm-altering insights into the soft tissues of living vertebrates has yet to be fully realized, as arguments against it have been constrained by a large degree by the relatively low X-ray absorption of non-mineralized tissues and by a paucity of non-toxic and inexpensive contrast agents. Here we systematically test and quantify contrast in µCT images of intact neonate and yearling Alligator mississippiensis heads that were prepared with a simple, non-toxic, and inexpensive staining protocol using Lugol’s iodine (I₂KI) that facilitates stunning visualization of soft tissue anatomy in high-resolution X-ray µCT images. To date, similar methods have been experimented with using collagen scaffolding, invertebrates, vertebrate embryos, adult mice, and a yearling alligator—in all cases yielding promising results. Our protocol expands upon these earlier studies by making possible extensive visualization of vertebrate soft tissues in X-ray µCT images. We demonstrate that the soft-tissue anatomy of the head and neck, including differences between white and grey matter of the spinal cord, nuclei of the brain, fascicle lengths of the cranial musculature, and the complete pathways of all cranial nerves, can be fully visualized and readily reconstructed using 3D computer imaging software. Similar to visualization work that has been done previously on sinuses and cranial nerve roots, these soft-tissue reconstructions can then be matched directly to the osteological correlates they leave behind for comparison to similar correlates in fossil forms. This technique will make rapid, non-destructive mapping of intricate anatomical relationships possible in a wide variety of extinct vertebrates. We briefly demonstrate its
utility by: (1) quantifying differences between brain size and shape to those inferred from cranial endocasts; (2) generating reconstructions of the cranial musculature; and (3) mapping the courses of cranial nerves throughout the head, between our *A. mississippiensis* specimens and their fossil crocodyliform relatives.

**Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)**

**EVOLUTIONARY STASIS OF NORTH AMERICAN GLYPTODONTS DURING THE GREAT AMERICAN BIOTIC INTERCHANGE**

GILLETTE, David D., Museum of Northern Arizona, Flagstaff, AZ, United States; CARRANZA-CASTÁNEDA, Oscar, Centro de Geociencias Universidad Nacional Autonoma de Mexico, Campus Juriquilla, Queretaro, Mexico; WHITE, Richard, International Wildlife Museum, Tucson, AZ, United States; MCCORD, Robert, Arizona Museum of Natural History, Mesa, AZ, United States; THIRASHER, Larry, Bureau of Land Management, Safford, AZ, United States

Glyptodonts originated in South America in the Paleogene, diversified through the Neogene, and expanded into North America no later than about 4 million years ago during the Great American Biotic Interchange. Apparently only one genus (*Glyptotherium*) became established in Central America and eventually expanded into Mexico and southern United States. Until recently, three commonly recognized species seemed to fit an anagenetic model of evolution through the Pliocene and Pleistocene in North America: *Glyptotherium texanum* (Blanco), *G. arizonnae* (Late Blancan-Irvingtonian), and *G. floridanum* (Rancholabrean). The evolutionary positions of two other species (*G. cylindricum* and *G. mexicanum*) from Mexico were enigmatic due to poor stratigraphic records and incomplete skeletal material for the holotypes. Newly collected glyptodonts from Los Galvenes and Cecocillas areas, Guanajuato, in central Mexico, and from the 111 Ranch fauna of southeastern Arizona add to the hypodigm of *G. texanum* and indicate that *G. texanum* and *G. arizonnae* are synonymous. The newly recovered specimens include babies, juveniles, and fully grown adults, as large as the largest individuals formerly assigned to *G. arizonnae*. All of the characters that seemed to distinguish the two species are now attributable to ontogeny and sexual dimorphism.

The species changed little, if at all, over the course of this 2.5 million year interval (Early Blancan, 3.9 mya, to Early Irvingtonian, 1.4 mya). The hypodigm of the late Pleistocene species, *G. floridanum* can be distinguished from that of the expanded hypodigm of *G. texanum* only in minor details of the carapacial armor, which may be related to growth acceleration that changed proportions of the external sculptures but did not culminate in any recognizable autapomorphies. These observations lead to the hypothesis that the *Glyptotherium texanum* - *G. floridanum* lineage remained practically unchanged for at least four million years. The species definitions of *G. cylindricum* and *G. mexicanum* remain to be reevaluated in this context. The Gulf Coastal Plain was probably the principal center of dispersal for *Glyptotherium*, expanding during sea level retreats, and contracting but never disappearing during advances. Changing climatic conditions and tectonic activity affected habitats and distribution, but there is little evidence that climate change stimulated evolutionary change in the morphology of *Glyptotherium*.

**Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)**

**PALEOPATHOLOGICAL ANALYSIS OF *TAPIRUS* SPP. FROM FLORIDA AND TENNESSEE**

GILMORE, Laura S., East Tennessee State University, Johnson City, TN, United States; BREDEHOEFT, Kerla E., Hagerman Fossil Beds National Monument, Hagerman, ID, United States

The two largest samples of fossil tapiurs known are from the Gray Fossil Site in Gray, Tennessee and Haile 7G in Newberry, Florida. Large numbers of individuals and high numbers of identified specimens (NISP) at these two sites present an unparalleled opportunity to analyze patterns in a fossil sample. Despite the age differences of the two sites, the late Miocene Gray Fossil Site and the early Pliocene (Blanco) Haile 7G have been referred to as sister sites, due to their similar environments and unusually large proportion of tapiurs. The results of our preliminary collection efforts in these areas are presented here, and recovered fauna includes typical Chinji zone taxa such as rodents, tragulids, bovids, suids, carnivores, giraffids, rhinocerotids, squamates, and crocodylians, all of which have previously been found in association with primates in these areas. Many of these faunal elements are important biostatigraphic and paleoecological indicators as well. Thus, future geological, palaeontological and paleoclimatological research in the Lower Siwaliks of India should result in the eventual recovery of new primate specimens and help to clarify the nature and timing of primate and mammalian evolution in Asia.

**Technical Session II (Wednesday, October 17, 8:30 am)**

**ENDOSKELETAL ANATOMY OF THE STEM ACTINOPTERYGIAN *CHEIROLEPIS* REVEALED BY HIGH-RESOLUTION COMPUTED TOMOGRAPHY**

GILES, Simon, University of Oxford, Oxford, United Kingdom; BRAZEAU, Martin D., Naturalis, Leiden, Netherlands; ATKINSON, Robert C., University of Oxford, Oxford, United Kingdom

The Middle Devonian *Cheirolepis* occupies a critical position in vertebrate phylogeny: it is the sister group of all other actinopterygians and the earliest definitive ray-finned fish. Despite its significance and a comparative abundance of material, *Cheirolepis* remains poorly known in many respects. Previous treatments of this genus have relied heavily on unpublished specimens, and provide only vague details of endoskeletal structure. The model for early ray-finned fish anatomy has instead been based largely on the Late Devonian actinopterygians *Minimipiscis* and *Myosthomias*, which are known in stunning detail from acid-prepared, uncompressed specimens from the Gogo Formation of Australia. Re-examination of material of *Cheirolepis* from classic Old Red Sandstone localities of Scotland using lab-based and synchrotron X-ray computed tomography substantially alters our understanding of endoskeletal structure in this genus, with important implications for understanding patterns of character evolution deep within the osteichthyan crown. Here we focus on results from two individuals preserved in concretions, one from Gamrie and another from Tynet Burn. The Gamrie specimen preserves both pectoral-fin endoskeletons and a hyomandibular. The scapulocoracoid bears a long, narrow articular surface for the radials. In contrast to previous interpretations, the construction of the fin endoskeleton is broadly similar to that of other early actinopterygians, although the protractorium appears to be imperfectate. The hyomandibular is fused with the dermohyal, but assumes proportions more similar to those found in some early sarcopterygians (*e.g.*, *Onchodus*) than those of *Minimipiscis* and *Myosthomias*. Significantly, the Tynet Burn specimen yields a largely complete braincase showing anatomical detail comparable to that known from the Gogo ray fins. Many aspects of the neurocranium are comparable to those of later actinopterygians (*e.g.*, a narrow interorbital septum), but important exceptions include the lack of any dermal ascending processes of the preoperculum and the absence of a transverse canal, both of which likely represent pleisomorphic osteichthyan features. Collectively, these new data help clarify primitive conditions within ray-finned fishes, which in turn have important implications for understanding features likely present in the last common ancestor of living osteichthphans.
Technical Session XIII (Friday, October 19, 3:15 pm)

EOCENE DARWINIUS, EUROPEOLUM AND NOTHARCTUS (PRIMATES, ADAPOIDA): WHAT IS A CLAW, WHAT IS A GROOMING CLAW, AND WHEN DID GROOMING CLAWS EVOLVE?

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Living primates are distinguished from tree shrews and other mammals by their grasping hands and feet, which have distal phalanges bearing nails rather than claws. Exceptions include Dentrhontia and Callitrichidae with claws on all digits except the hallux. Various authors have argued that (1) claws on all digits; (2) nails on all digits; or (3) nails and pedal grooming claws are primitive for primates. Interpretation depends on the taxa included in the order, on phylogenetic relationships (as yet uncertain), and on identification of grooming claws.

Claws are laterally compressed, longitudinally curved, and have pointed distal ends, as do the underlying bony distal phalanges. Nails are broader and flatter with more columnar underlying phalanges. Grooming claws are thought to differ from nails on other digits in being longer and standing at a steep angle to the dorsal surface of the digit as a whole. Toenail claws are not always easy to identify from their underlying bony phalanges. Micro-CT images were measured for all pedal distal phalanges (PDPs) of Tapiaia and 25 primate species (14 prosimians, 11 anthropoids). Principal components analysis (PC or PCA) enables clawed PDPs to be distinguished from other distal phalanges. Clawed PDPs are laterally compressed and longitudinally curved, falling in the lower left quadrant of a PC-Ⅱ vs. PC-Ⅲ morphospace. PDPs for grooming claws of 14 prosimian species overlap slightly with PDPs for other digits, but generally occupy the lower right quadrant of the morphospace. Addition of Eocene adapoids suggests that Europolemur had grooming claws on digit II, and Notharctus had grooming claws on digits II and III.

Linear discriminant analysis (LDA) of the same measurements distinguishes most grooming-claw PDPs from non-grooming-claw PDPs. Europolemur is again classified as having a grooming claw, but Notharctus appears not to have had grooming claws. LDA for all 40 measurements of PDP-Ⅰ through IV in a foot collectively separates grooming-clawed primates from the others, but here it appears that neither Europolemur nor Notharctus had a grooming claw. Requisite measurements are not available for Darwinius, but it clearly had PDPs similar to those of Notharctus.

Ambiguity concerning the presence of grooming claws in Eocene Adapoida, and the lack of evidence one way or another in Eocene Tarsiosidea, mean it is difficult to know whether grooming claws of Lemuroidea and Tarsioidea are homologous, and it is difficult to be certain when grooming claws evolved.

Technical Session I (Wednesday, October 17, 8:45 am)

PNEUMATIC PATTERNS IN THE SKULL OF ALIORAMUS ALTAI, A LONG-SNOUTED TYRANNOSAURID (DINOSAURIA: THEROPODA), FROM THE LATE CRETACEOUS OF MONGOLIA

GOLD, Eugenia, Richard Gilder Graduate School, New York, NY, United States; BRUSATTE, Stephen L., American Museum of Natural History, New York, NY, United States; NORELL, Mark A., American Museum of Natural History, New York, NY, United States

Alioramus alai is an aberrant tyrannosaurid theropod from the Late Cretaceous of Mongolia, which exhibits a long and gracile skull, slender postcranial skeleton, and smaller size compared to other tyrannosaurids, such as the coeval Tarbosaurus and Tyrannosaurus. The holotype of A. alai is an exceptionally preserved juvenile that includes nearly all of the disarticulated cranial bones. Several of these bones exhibit extreme pneumaticity, including internal sinuses associated with the antorbital fenestra, tympanic system, and median parotid system. Because tyrannosaurus are basal coelurosaurans, and because A. alai is an unusual long-snouted taxon, a closer examination of his cranial pneumaticity may reveal insight into the origin and evolution of coelurosaurian cranial sinuses on the line to birds, as well as changes in pneumaticity associated with the origin of a novel cranial bauplan. We CT scanned all of the pneumatic bones of the face, palate, and lower jaw of the A. alai holotype, which reveal important pneumatic features that are not discernable externally and which help clarify homologies across Theropoda. The maxilla includes the normal suite of antorbital sinuses. The antorbital sinus lies along a vertical passage between the posterior border of the maxillary fenestra and the anterior border of the antorbital fenestra. This extends ventrally to where the roots of the maxillary teeth begin, and then into the main body of the maxilla to reach the posterior margin of the last maxillary tooth. Posteriorly, it is supported by a groove in the ventral process of the maxilla. In addition, the premaxillary sinus extends posteriorly to the anterodorsal margin of the maxillary fenestra and communicates with the antorbital sinus via a small opening near the maxillary fenestra. The quadratojugal pneumaticity in the palate fills the complex shape of this bone and appears to continue into the finger-like mental process, but does not extend into the maxillary process. Alioramus possesses many of the characteristic cranial recesses of derived coelurosaurans (including birds), supporting the hypothesis that these features evolved early in theropods. Furthermore, the retention of these recesses indicates that the pattern of theropod cranial pneumaticity may be stable in the face of extreme morphological change, such as snout elongation.

Technical Session I (Wednesday, October 17, 11:30 am)

NEW VERTEBRATES FROM THE LATE CRETACEOUS KALLAMEDU FORMATION, CAUVERY BASIN, SOUTH INDIA, INCLUDING A TROODONTID Dinosaur, A GONDWANATHERIAN Mammal, AND A SIMOSUCHUS-LIKE NOTOSUCHIAN CROCODOYLIFORM

GOSWAMI, Anjali, University College London, London, United Kingdom; PRASAD, Gunapalli V., University of Delhi, Delhi, India; BENSON, Roger B., University College London, London, United Kingdom; VERMA, Omkar, Indira Gandhi National Open University, New Delhi, India; FLYNN, John J., American Museum of Natural History, New York, NY, United States

Late Cretaceous vertebrate faunas of India are known predominantly from intertrappean deposits in the Deccan volcanic province. A thick sequence of Early Cretaceous to Early Paleocene fossiliferous sediments exposed in the Cauvery Basin of South India has been comparatively poorly explored. Here, we present a preliminary description of a new fauna consisting of vertebrate fossils discovered from the continental Upper Cretaceous (late Maastrichtian) Kallamedu Formation. The Kallamedu Fauna includes ganoid fishes, amphipods, turtles, crocodyliforms, dinosaurs, and mammals, with many taxa suggesting Late Cretaceous biotic links between India and other Gondwanan landmasses. Teeth of abelisaurid dinosaurs and gondwanatherian mammals support pan-Gondwanan distributions for these clades. Of great significance is the first discovery of a Simosuchus-like notosuchian crocodile outside of Madagascar. This close-shaped tooth with multiple homogeneous cusps and a ventrally flaring root is reminiscent of the crown morphology of Simosuchus clarki, known from the Upper Cretaceous Maaswaram Formation of Madagascar. The single known tooth is tentatively placed within the posterior series of the right dentary, due to the presence of eight cusps and flaring of anterior part of the root similar to that described for some of the dentary teeth of Simosuchus. Previous analyses suggested close relationships among Late Cretaceous Indian and Madagascan species across a number of vertebrate groups, including gondwanatherian mammals, nigerohpoid snakes, and bothremyd turtles, and this report of the first Indian Simosuchus-like notosuchian further strengthens the evidence for close biotic links between India and Madagascar in the Late Cretaceous.

While most of the taxa identified in the Kallamedu Fauna are known from other Gondwanan landmasses, the identification of a troodontid maxillary tooth extends this predominantly Laurasian clade into the Late Cretaceous of India. The single recovered tooth displays a recurved apex, stronger curvature on the anterior margin than the posterior, mesiodistal constriction at the base of the crown, relatively large, apically-inclined denticles that are larger on the posterior carina than the anterior, and well-developed grooves expanding into pits between adjacent denticles. The denticles are not strongly hooked, as in most troodontids, but this is possibly due to abrasion. This discovery of a distinctly Laurasian theropod further complicates paleobiogeographic reconstructions of Late Cretaceous India and supports the presence of a direct or indirect dispersal route between Eurasia and India, potentially via Africa, as has been suggested for eutherian mammals.

Technical Session II (Wednesday, October 17, 11:15 am)

EXCEPTIONAL PRESERVATION AND UNUSUAL FEATURES IN A DISTINCTIVE NEW TARPON-LIKE FISH [ELOPOMORPHA] FROM THE CRETACEOUS OF THE CHATHAM ISLANDS, NEW ZEALAND

GOTTFRIED, Michael D., Michigan State University, East Lansing, MI, United States; FORDYCE, Robert E., University of Otago, Dunedin, New Zealand; LEE, Daphne E., University of Otago, Dunedin, New Zealand; KOEHLER, Richard, University of Otago, Dunedin, New Zealand

We report on a large and nearly complete elopomorph fish from the Cretaceous (possibly Paleogene) of Pitt Island, Chatham Islands, New Zealand. The exquisite specimen, which is three-dimensionally preserved in a volcanic tuff, is the most complete and informative fossil elopomorph reported to date from the Southern Hemisphere. Features supporting elopomorph affinities include the lack of a separate retroarticular ossification on the lower jaw, and a primitively retained median gular. Assignment to the elopomorph Family Megalopidae (tarpons) is indicated by the specimen’s superior mouth position, large posttemporal fossae, and laterally compressed body covered in large and extensively overlapping cycloid scales. A number of distinctive features, including the elongate body, a high and strongly developed coronoid process on the mandible, an enlarged median gular, a relatively low-profile head, a series of anametasic bones in the cheek region, and the continuation of the lateral line scales onto the base of the caudal fin, indicate that the Pitt Island fish represents a distinctive new taxon within megalopids. One highly unusual feature is a transverse fissure that extends across the skull roof just posterior to the orbits; this structure appears internally continuous on CT-scans and symmetrically disposed, and is therefore interpreted as representing a real structure and not an artifact. The overall morphology of the specimen suggests a fish similar in many respects to the extant tarpons Megalops atlanticus and M. cyprinoides but with a more slender head profile and more attenuated body, and with several unique skeletal features not previously reported on megalopid fishes.

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Romer Prize Session (Thursday, October 18, 9:30 am)

ARTICULAR SURFACE MORPHOLOGY AND THE EVOLUTION OF CURSORYLIA IN PALEOGENE UNGLATES: THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC ANALYSIS OF COMPLEX TOPOLOGIES

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Joint surface morphology reflects joint function as indicated by biomechanics and anatomy. Thus, the quantitative study of articular surfaces is a fruitful avenue of research for inferring functional morphology in fossils. In mammals, qualitative differences in distal femoral shape have been tied to, among others, arboreal and cursorial modes of locomotion. However, complex topology has made quantitative testing of evolutionary hypotheses tied to these observations difficult. In particular, specialization for cursorylilia has been suggested as a key factor in the origin of the modern ungulate orders Artiodactyla and Perissodactyla. Studies of comparative anatomy have shown that the paraphyletic group Condylarthra, which is thought to contain the sister taxa to these orders, contained arboreal forms, but some taxa, also had a flattened trochlea. The aims of this study were to test quantitatively the relationship between distal femoral morphology and locomotion, and to use changes in femoral morphology in condylarths and early North American artiodactyls and perissodactyls to examine the changes in locomotion in ungulates through the Paleogene. Using three-dimensional geometric morphometrics I analyzed the shape of the entire distal femoral articular surface. Surface scans were collected from 42 extant mammal genera classified into 5 locomotor categories. Geometric morphometric analysis showed significant differences between arboreal and cursorial taxa across different taxonomic orders (Multivariate Analysis Of Variance on principal component (PC) scores Wilks λ (2.688, 60)=0.01919, p<0.001). Shape variation recovered on the first PC is significantly associated with differences in locomotor mode and supports previous biomechanical and functional anatomical assessments of ecologically different taxa: antero-posterior elongation and extension of the patellar groove in cursorial forms, versus medio-lateral broadening of the condyles in arboreal forms. A discriminant analysis is highly significant, with percent correct classifications between 80% and 100%. All fossil artiodactyls and perissodactyls are recovered as either cursorial or terrestrial in locomotion, whereas condylarths occur in all locomotor categories, including arboreal and cursorial. Thus the diversification of the modern ungulate orders is not associated with the origin of cursorylialia but rather with a reduction in the range of locomotor ecologies. Three dimensional geometric morphometrics of articular surfaces though labor intensive are a powerful quantitative tool for testing qualitative hypotheses of anatomical variation. They are therefore invaluable in studying ecological changes associated with major evolutionary transitions and adaptive radiation.

Technical Session III (Wednesday, October 17, 3:00 pm)

PHALANGEAL MORPHOLOGY OF SUSPENSOY MAMMALS: IMPLICATIONS FOR THE LOCOMOTION OF MALAGASY SUBFossil SLOTH LEMURS (PRIMATES: PALAEOPROPTHECIDAE)

Granatovsky, Michael C., Duke University, Durham, NC, United States; Miller, Charlotte E., Duke University, Durham, NC, United States; Lemelin, Pierre, University of Alberta, Edmonton, AB, Canada; Schmitt, Daniel, Duke University, Durham, NC, United States

Based on osteological similarities in the back, arm, and wrist, the subfossil sloth lemur of Madagascar have been reconstructed as committed inquadrupedal similar to extant sloths. However, in contrast to extant sloths and other suspensory species like bats and colugos, sloth lemur are characterized by what appear to be prrehensile hands and feet more typical to those of primates, though few metric studies of phalangeal anatomy exist to support this contention. To investigate the extent to which sloth lemur may differ in phalangeal morphology compared to primates and other mammals, we compared a broad sample of suspensory and non-suspensory taxa to sloth saxolus—Pleopropithecus, Megalopygus, and Babayostis—using both univariate analyses and principal components analyses (PCA).

Results from the PCA indicated that the intermediate phalanx of non-primate suspensory mammals and babiroussas, bats, and colugos has a narrower proximal articular surface, and a dorsoventrally expanded distal trochea when compared with primates and other non-suspensory mammals. Additionally, phalangeal proportions of non-primate suspensory taxa vary considerably from other species. While primates tend to have longer proximal phalanges and shorter distal phalanges, non-primate suspensory taxa all have long claws on the distal phalanges and relatively longer intermediate phalanges. These differences are most likely to represent a trade-off between passive digital flexion vs. enhanced prehensility. Non-primate suspensory taxa have anatomical features that provide passive resistance mechanisms against the postures of the hand and foot to support the body against gravity during suspension. Primate hands and feet have none of the features associated with such passive resistance mechanism, but in turn have much greater grasping prowess and dexterity. Sloth lemur were clearly committed inquadrupedal that retained prrehensile hands and feet with nails rather than claws, a feature typical of other primates. This anatomical arrangement was potentially energetically costly, requiring muscular rather than passive stabilization and weight support mechanisms. However, the retention of the primate-like grasping extremity would have been advantageous for effective movement between substrates of varying diameters and effective manipulation during food acquisition.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 8:00 am)

SKELETONS IN THE CRETACEOUS CLOSET – AN OVERVIEW OF THE HISTORY OF PALEONTOLOGY IN APPALACHIA

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While vertebrate paleontology in North America began during colonial times, the earliest vertebrates included placoderm and lepisosteid vertebrates. Cretaceous vertebrates from New Jersey were described before the mid-1800s. In 1830, Charles Knight and the early New Jersey fossil sites. New Jersey was the only part of Pennsylvania producing fossils during the late 19th and early 20th centuries. Cretaceous fossils were described from the Potomac Beds of Maryland and Virginia and from North Carolina (including Hypsilophus crassicaudatus, a notorius chimera). Western sections of Appalachia have also been productive. Missouri yielded Hypsilophus missouriensis, a dinosaur found in a well. Alabama has a rich Cretaceous fauna, and the eastern part of Texas (the ‘west coast’ of Appalachia) has yielded Cretaceous terrestrial and coastal marine fossils. Vertebrate fossils from Appalachia were well represented in the earliest history of our science in North America. This was not to last: while Cretaceous vertebrate remains continued to be found in the eastern subcontinent the focus of vertebrate paleontology largely shifted to more spectacular finds from the American west in the latter half of the 19th century. Currently, paleontologists have begun to re-explore the rich and diverse vertebrate fauna of Appalachia and its coastal waters. New work in the eastern subcontinent could be said to have begun with discovery of the Ellisdale Site in the early 1980s.

Technical Session III (Wednesday, October 17, 3:30 pm)

INFERRING LEVELS OF ARBOREALITY OF EXTINCT SLOTHS THROUGH A GEOMETRIC MORPHOMETRIC ASSESSMENT OF SCAPULA MORPHOLOGY

Grass, Andy, University of Iowa, Iowa City, IA, United States

One of the most persistent challenges with studying the fossil record is assessing the behavior of extinct organisms. Often times this can be addressed by identifying correlations between morphology and behavior in a closely related extant taxon, which can then be used to infer similar behaviors from similar morphologies in the extinct taxon. The mammalian scapula is well suited for these purposes, as it has been shown in many groups to have a high correlation between form and function. In primates in particular there is a very distinct difference in scapula morphology between arboreal and terrestrial groups. This is directly relevant to extant sloths, which are all commonly referred to as “ground sloths,” despite that several groups were much smaller and possibly less terrestrial than the archetypal giant ground sloths. Varying levels of arboreality have been demonstrated in these smaller sloths by comparing limb measurements which have been shown to distinguish arboreal and terrestrial primates, as well as modern arboreal and terrestrial anteaters, which are sloths’ closest living relatives. A geometric morphometric study was performed to determine if patterns of arboreality could also be parsed out through the scapula morphology of these sloths. Three-dimensional landmarks and sliding semi-landmarks were taken on the scapulae of extant and extinct sloths as well as extant anteaters, and a principal components analysis was performed on the procrustes residuals of these landmarks. The arboreal and terrestrial anteaters have little overlap in morphospace; however the putatively semi-arboreal sloth Hapalops tended more towards the giant ground sloths. This could potentially indicate that Hapalops was more terrestrial than previously thought. However, the giant ground sloth Megalonyx tended towards the area of morphospace occupied by modern tree sloths. Current phylogenetic estimates place Megalonyx and Choleopus, the modern two toed sloth, in the same family, Megalonychidae. This may reflect, that in sloths at least, scapula morphology is influenced less by adaptation and more by phylogenetic constraint. Bradypus, the modern three toed sloth, which is in the monotypic family Bradypodidae, and thus not closely related to Choleopus, plotted in the same area of morphospace as Choleopus. This may have implications for the supposition of extreme convergent evolution between Choleopus and Bradypus, and indicate that their similar scapula morphology is instead a result of the selective and less by evolutionary constraint.
ANALYSIS OF DENTAL MICROWEAR IN THE XENARTHRA: DOES SCANNING ELECTRON MICROSCOPY REVEAL A LINK BETWEEN FEEDING ECOLOGY AND TOOTH SCARRING?

GREEN, Jeremy L., Kent State University at Tuscarawas, New Philadelphia, OH, United States; RESAR, Nicholas A., Kent State University, Kent, OH, United States

Dental microwear has recently been supported as a proxy for feeding ecology in xenarthrans (including tree sloths, armadillos and their extinct relatives). However, the causal relationship between diet and fine-scale tooth wear has been studied almost exclusively using low-magnification microscopy. Here, we test the hypothesis that dental microwear patterns are significantly different among tree sloths and armadillos by analyzing tooth scars using scanning electron microscopy (SEM). Microwear patterns on 26 teeth from 5 xenarthran taxa were analyzed; each taxon was classified into one of 4 dietary groups: 1. carnivore-omnivores = Euphractus; 2. folivores = Bradypus; 3. frugivore-fohivores = Choloepus; 4. insectivores = Dasypus. Using SEM, two non-overlapping digital images of microwear were captured for each tooth at 500x magnification. In a blind, randomized design, each image was independently analyzed by both authors using the semi-automated software package, Microwear 4.02. To determine the reproducibility of our results, both intra- and interobserver error in microwear feature recognition was statistically assessed for both observers. Pearson correlation coefficients reveal that datasets from both observers are highly correlated and that both observers recovered the same relative between group differences. Scratch count and scar width variables showed the most discrimination, with insectivores and folivores consistently having the lowest number of scratches and greatest width of scars, whereas frugivore-fohivores and carnivore-omnivores recorded the opposite. When dietary groups from the same habitat (i.e., arboreal folivores and frugivore-fohivores) are compared, distinct differences in microwear patterns are present, suggesting that microwear records differences in xenarthran feeding ecology. These results represent critical baseline data that can be used to reconstruct paleodiet in extinct ground sloths, glyptodonts, and pampatheres.

Technical Session X (Friday, October 19, 11:30 am)

THE EFFECT OF THE CRETACEOUS ANGIOSPERM RADIATION ON EARLY MAMMAL TAXONOMIC DIVERSITY AND MORPHOLOGICAL DISPARITY

GROSSNICKLE, David, Indiana University, Bloomington, IN, United States

Fossil discoveries over the past 30 years have radically transformed old views of the evolution of Mesozoic mammals. Similarly, recent research on early angiosperm radiation has provided a more detailed account of the roughly contemporaneous diversification of angiosperms and Mesozoic mammals. Though studies have speculated about the possible co-evolution of angiosperms and mammals, there has been no recent quantitative paleontological study on mammals that examines parallel patterns between groups. In this study, three hypotheses were considered: 1) angiosperm radiation had little or no effect on the overall taxonomic and morphologic diversity of Cretaceous mammals; 2) angiosperm radiation led to an increase in the overall diversity of mammals, possibly due to food sources that were new (e.g. fruit), increasing (e.g. seeds), and/or improving (e.g. increased plant matter owing to higher photosynthetic capacity); and 3) angiosperm radiation led to a decrease in mammalian diversity, with only herbivorous and insectivorous mammals flourishing, as these groups would have been most likely to profit from the co-evolution and radiation of insects with angiosperms. Diversity curves were created to analyze taxonomic changes, with measurements being used as a proxy for body size and disparity, and geometric morphometric analysis of jaws was used to examine changes in morphological and dietary disparity. Results indicate significant morphologic and taxonomic changes in mammals at the time of angiosperm radiation, including a decrease in the number of eutriconodontans and ‘symmetrodontans.’ The two mammalian clades that appear to have been most successful in the Late Cretaceous are the herbivorous multituberculates, which show evidence of morphologic radiation through increased jaw and tooth disparity, and insectivorous therians, which experienced a taxonomic radiation. Body size and morphologic disparity of non-multituberculate mammals, primarily therians, appear to decline with the advent of angiosperms, suggesting the possible occurrence of a morphological ‘bottleneck’ that resulted in a shift towards small insectivores. The results of this study call for more exhaustive research concerning the possibility of mammal-angiosperm-insect co-evolution.

REFINING HADROSAURID DIVERSITY IN THE SAN JUAN BASIN THROUGH THE REEXAMINATION OF HISTORIC SPECIMENS

GUENTHER, Merrilee F., Elmhurst College, Elmhurst, IL, United States; WOSIK, Mateusz, Elmhurst College, Elmhurst, IL, United States; MCCARTHY, Stephanie, Elmhurst College, Elmhurst, IL, United States

Understanding hadrosaur diversity in the San Juan Basin can be difficult due, in part, to limitations on the number and quality of specimens. A reexamination of specimens collected in New Mexico in 1922 by Charles H. Sternberg reveals increased taxonomic diversity of hadrosaurids in the San Juan Basin. These specimens include disarticulated cranial and postcranial elements from the Kirtland Formation of McKinney County, New Mexico, approximately 85 miles northeast of Thoreau, New Mexico. All of the adult cranial and postcranial specimens belong to hadrosaurinae taxa. Morphological variation indicates that at least two taxa of hadrosaurs are present in this collection. Cranial material includes dentaries, jugals, prefrontals, and quadrates. Based on the preserved morphology, the cranial elements are referable to the genus Gryposaurus. The postcrania exhibit the gracile morphology characteristic of hadrosaurs. The best-preserved postcranial elements are humeri and pubes. The pubes are also referable to Gryposaurus as indicated by the profile of the prepuccus process of the pubis. Presence of this taxon in the San Juan Basin extends the geographic range of Gryposaurus and represents the southernmost example of this genus.

This collection also represents individuals from a wide range of growth stages from juvenile to adult. The smallest individuals are represented by fragmentary elements. The juvenile elements consist of postcrania including rib, scapula, and femur, and skull elements, such as a partial quadratojugal. The smallest element, a scapula that is 66 mm in length, is comparable in size to those of hatchling hadrosaurs of other genera. The lateral profile of the dorsal margin of this scapula is cranio-caudally straight, suggesting that the hatchling represents a basal hadrosaurid taxon. A partial dentary, 53 mm in length, is approximately half the size of the other adult dentaries found, signifying the presence of more advanced juvenile hadrosaurs. At the opposite extreme, are adult elements that represent hadrosaurid individuals that are among the largest known. A large humerus, hadrosaurine based on delteopectoral crest proportions, measures 861 mm in length.
pectoral muscle fractions and gracile forelimbs. This explains how animals such as modern birds, which are capable of flight, have evolved despite possessing overall morphology little changed from the ancestral condition.

Flight control functions were relatively evenly distributed between the forewings and the auxiliary hindwings in the evolution of flight in small theropods. We suggest that a new and more compelling general model for the evolution of flight in birds is emerging. Early in the evolution of theropod flight, major flight control functions were relatively evenly distributed between the forewings and the auxiliary hindwings. The tail could not have provided significant control in yaw or roll, but the forewings and hindwings would have been well suited for control along the axis of the body. While a depressed position could counter positive pitch, the tail fan well behind the center of mass would supply a long pitching moment. Some pitch control could have been provided by the tail fan, however, because the position of the tail fan well behind the center of mass would supply a long moment arm for pitch control. This is not mutually exclusive to other tail uses, such as display or balance during running and climbing.

Specimens of *Microraptor gui* show that a fan of feathers existed near the terminus of the tail. We apply a conservative flat-plate flow analysis to the discernable tail fan of the holotype specimen *Microraptor gui*, and estimate that the tail could plausibly compensate for the equivalent of 100-150g of mass acting in pitch. This would be sufficient to correct for small deviations of the center of gravity from the center of lift. While we expect that the tail would mostly function to reduce positive pitch (nose-up motion), the tail could also be used to dampen negative pitching moments produced during the initial deployment of the hindwings in turning or the dual deployment of the hindwings as airbrakes. We note that the tail was capable of functioning as either a passive pitch stabilizer or an active pitch control device. In active stabilization, a slightly elevated tail position could counter negative pitch while a depressed position could counter positive pitch. The tail could not have provided significant control in yaw or roll, but the forewings and hindwings would have been well suited to providing those control functions.

We suggest that a new and more compelling general model for the evolution of flight in paravians and early birds is emerging. Early in the evolution of theropod flight, major flight control functions were relatively evenly distributed between the forewings and the auxiliary hindwings — namely, the hindwings and tail. This allowed the comparatively robust hindlimbs and tail of paravians to carry much of the mechanical loading associated with tight maneuvers, launching, and landing. As a result, volant paravians could engage in flight behavior despite possessing overall morphology little changed from the ancestral condition. In more derived members of the avian line, most control function shifted to the forewings, though primary launch power continued to be provided by the hindlimbs. This model explains how animals such as *Microraptor* could fly in cluttered environments with small pectoral muscle fractions and gracile forelimbs.

Technical Session XVIII (Saturday, October 20, 2:00 pm)

**AERODYNAMICS OF THE TAIL IN *MICRORAPTOR* AND THE EVOLUTION OF THEROPOD FLIGHT CONTROL**

HABIB, Michael, University of Southern California, Los Angeles, CA, United States; HALL, Justin, University of Southern California, Los Angeles, CA, United States; HONE, David W., University College Dublin, Dublin, Ireland; CHIAPPE, Luis M., Natural History Museum of Los Angeles County, Los Angeles, CA, United States

Microraptoran dinosaurs may have experienced intrinsic difficulties with pitch control because they retained a trunk of typical dromaeosaurid proportions, as opposed to the shortened trunk of ornithine birds. As a result, any appreciable forward sweep of the wings could bring the center of gravity in front of the center of lift, resulting in an ineffective or injurious pitching moment. Some pitch control could have been provided by the tail fan, however, because the position of the tail fan well behind the center of mass would supply a long moment arm for pitch control. This is not mutually exclusive to other tail uses, such as display or balance during running and climbing.

Specimens of *Microraptor gui* show that a fan of feathers existed near the terminus of the tail. We apply a conservative flat-plate flow analysis to the discernable tail fan of the holotype specimen *Microraptor gui*, and estimate that the tail could plausibly compensate for the equivalent of 100-150g of mass acting in pitch. This would be sufficient to correct for small deviations of the center of gravity from the center of lift. While we expect that the tail would mostly function to reduce positive pitch (nose-up motion), the tail could also be used to dampen negative pitching moments produced during the initial deployment of the hindwings in turning or the dual deployment of the hindwings as airbrakes. We note that the tail was capable of functioning as either a passive pitch stabilizer or an active pitch control device. In active stabilization, a slightly elevated tail position could counter negative pitch while a depressed position could counter positive pitch. The tail could not have provided significant control in yaw or roll, but the forewings and hindwings would have been well suited to providing those control functions.

We suggest that a new and more compelling general model for the evolution of flight in avialans is emerging. Early in the evolution of avialans, major flight control functions were relatively evenly distributed between the forewings and the auxiliary hindwings — namely, the hindwings and tail. This allowed the comparatively robust hindlimbs and tail of avialans to carry much of the mechanical loading associated with tight maneuvers, launching, and landing. As a result, volant avialans could engage in flight behavior despite possessing overall morphology little changed from the ancestral condition. In more derived members of the avian line, most control function shifted to the forewings, though primary launch power continued to be provided by the hindlimbs. This model explains how animals such as *Microraptor* could fly in cluttered environments with small pectoral muscle fractions and gracile forelimbs. The development of constant frequency echolocation may have been in response to the increased ability of insect prey (in particular moths and other large flying insects) to detect and avoid low duty-cycle bat predators. In addition, high duty-cycle echolocation would have increased the ability of bats to hunt in clumped and complex habitats in order to access insect prey.

Technical Session XVII (Saturday, October 20, 1:45 pm)

**A NEW MODEL FOR HINDWING FUNCTION IN THE FOUR-WINGED THEROPOD DINOSAUR *MICRORAPTOR GUI***

HALL, Justin, University of Southern California/Natural History Museum of Los Angeles County, Los Angeles, CA, United States; HABIB, Michael, University of Southern California, Los Angeles, CA, United States; HONE, David W., University College Dublin, Dublin, Ireland; CHIAPPE, Luis M., Natural History Museum of Los Angeles County, Los Angeles, CA, United States

The evolution of powered flight in birds remains a contentious issue in vertebrate paleontology. The small dromaeosaurid dinosaur *Microraptor gui* preserves evidence of extensive, lift-generating feathers on each manus and forearm, but also preserves evidence of lift-generating feathers associated with the hindlimbs, effectively forming a pair of “hindwings”. Similar morphology has also been described for the hindlimbs of *Pedopenna*, *Anchiornis* and *Xiaotingia*. Phylogenetic analyses consistently place all of these taxa as paravians and thus close to the origin of birds. Combined with anatomical and functional studies, this indicates that flight evolved at least once within the lineage originating with the common ancestor of birds and dromaeosaurs. Thus, the four-wing design and its inferred flight performance may represent an ancestral four-winged stage in avian flight evolution. Alternatively, the evolution of flight may not have represented a single monophyletic event and there could be multiple abandoned body plans attempting to solve flight performance issues. Under such a case, M. gui may represent an alternative solution to aerodynamic issues experienced by early flying theropods.

Prior authors modeled the hindlimb of *M. gui* in a strongly abducted four-winged gliding position that may require an anatomically implausible orientation of the hip socket. We suggest an alternative model in which the hindlimbs were generally held below the body during steady flight, but deployed unilaterally, or bilaterally, to produce additional roll and yaw during unsteady flight maneuvers, such as turning. In this way, the hindwings could serve as control surfaces, enhancing maneuverability. The effect of a single, laterally deployed hindwing can be calculated for any bank angle. We calculate a 38% decrease in turning radius for a 45 degrees bank angle and a 16-17% decrease in angles of 15-20 degrees bank angle. Deployment of the hindwings as control surfaces held below the body generates a substantial potential locomotor advantage, is supported by aerodynamics and requires no unusual positioning of the hindlimb.
EVIDENCE FOR SUSPENSO USE OF LOCATOR ADAPTATIONS IN A LATE MIOCENE FOSSIL APE BASED ON IN VIVO/VALIDATED MODELS OF HIP JOINT ABDUCTION
HAMMOND, Ashley S., University of Missouri, Columbia, MO, United States

Suspensory locomotion plays an important role in hypotheses for the origins of great ape locomotion. When and how suspensory behaviors evolved is currently debated. Early Miocene apos are hypothesized to have been above-branch quadrupeds with suspensory capacities inferred to have originated in the middle to late Miocene, but few data have been available with which to test this hypothesis. Hominoid suspension is thought to require an increased range of hip joint abduction compared to monkey-like above-branch quadrupedal behaviors. If hip joint mobility can be accurately reconstructed from bone morphology, this would provide an opportunity to evaluate locomotor abilities based on hip joint function in fossil apos. Here I present results of in vivo and in silico measures of hip joint abduction capacity in suspensory (Symphalangus, Hylobates, Pongo, Gorilla, Pan, Ateles) and non-suspensory (cercopithecines, Cebus) extant anthropoids. Angular abduction at the hip was measured on anesthetized living primates using a goniometer. Pelvis and femora of the same taxa were laser scanned and 3D polygonal models were digitally articulated. Maximum hip abduction was modeled using PolyWorks software using strictly-defined morphological criteria for joint movement. In silico and in vivo data are strongly correlated, validating the use of digital reconstructions of hip joint mobility. Suspensory taxa have greater ranges of hip abduction than non-suspensory primates using both types of data. When these methods are applied to Miocene apos, results show that the early basal hominoid Proconsul had hip abduction similar to non-suspensory quadrupedal anthropoids, whereas the late Miocene crown hominoid Budapeithicus displays hip abduction capacity comparable to suspensory extant apos and Ateles. This project provides the first evidence for suspensory abilities from the hindlimb of any Miocene ape.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

NEW SPECIMENS OF ELASMOThERIINI (RHINOCEROTIDAE, PERISSODACTyla) FROM THE NAMURUNGULE AND NAKALI FORMATIONS (EARLY LATE MIOCENE) OF NORTHERN KENYA
HANDA, Naoto, Kagoshima University, Kagoshima, Japan; Nakaya, Hideto, Kagoshima University, Kagoshima, Japan; Nakatsu-Kasai, Masato, Kyoto University, Kyoto, Japan; Kunimatsu, Yutaka, Kyoto University, Kyoto, Japan; University, Kagoshima, Japan; Nakatsukasa, Masato, Kyoto University, Kyoto, Japan; Kunimatsu, Yutaka, Kyoto University, Kyoto, Japan; Kunimatsu, Yutaka, Kyoto University, Kyoto, Japan.
The early Late Miocene Namurungule and Nakali Formations are distributed in northern Kenya. Previously, Kny therium bipus is the only elasmotheriine described from the Namurungule and Nakali Formations. The Japan-Kenya joint expedition team has discovered several Rhinocerotidae fossils from these formations. We report new Elasmothereii fossils from the Namurungule and Nakali Formations.

The specimens from the Namurungule Formation consist of a maxilla with molars (M2 and M3), a mandible with lower p4 to m2 and isolated teeth of upper P4 and upper M3. These specimens were preliminarily identified as Iantherini sp. nov. The specimens from the Nakali Formation include isolated teeth of upper M1 or M2 and upper M3.

These specimens share the following diagnostic characters of the tribe Elasmothereii: crown cement, constricted protocone of the upper molars and bucco-lingually elongated postfossette of upper P4. These specimens are distinguished from Kenyu therium bipus by lacking characters of the species such as united protocone and hypocne of the molars and developed enamel folding. These specimens are characterized by lingually elongated protoloph and metaloph, undeveloped enamel folding and small crochet. These characters indicate that these specimens resemble following the middle Miocene Elasmothereii: Victoriacerus kenynesi from Maboko of Kenya, and Haungitherium lintungense from Lintung, Shaax, China.

However, the specimens of the Namurungule and Nakali Formations have a small enamel plication in the mediusinus of the upper molars. This character is not seen in the upper molars of V. kenynesi and H. lintungense. Additionally, molar size of these specimens is smaller than those of V. kenynesi and H. lintungense. Therefore, these specimens belong to a new taxon.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

INVESTIGATING THE IMPACT OF COMPETING INTERPRETATIONS OF PECTORAL GIRDLE PLACEMENT AND APPENDICULAR FUNCTION ON SAUROPOD HEAD HEIGHT
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Previous attempts to reconstruct the posture and potential range of motion in the cervical series of sauropod dinosaurs have focused on restoring the osteological neutral position (ONP) of the axial column, and attempts to link ONP with the degree of habitual vertebral flexion observed in extant vertebrates. While placement of the pectoral girdle has met with passing discussion, the roll of differing interpretations of appendicular posture has been largely ignored.

To evaluate the impact of competing functional interpretations of the pectoral girdle and appendicular skeleton, a quantitative analysis was conducted on the three most commonly used interpretations of pectoral girdle placement in the literature, and several models of limb kinematics. Testing was carried out on a 3D digital dataset of Camarasaurus, as well as dimensionally-accurate skeletal diagrams of Camarasaurus and several other neosauropods to increase taxonomic sampling.

Results show that differing interpretations of the angle of the scapula on the body had a minimal impact on the elevation of the presacral column, while the location of the pectoral girdle had a significant impact, with more ventrally and posteriorly located pectoral girdles leading to progressively higher head height.

Published interpretations of forelimb posture in sauropods vary mostly in the orientation of the humerus and the degree of elevation in the elbow. Neither was found to have a significant impact on head height. Hind limb kinematics were found to have a larger impact on head height, as knee and ankle flexure reduced pelvic height, which in turn raised the cervical series. Differences in restoring the pes of sauropods differ markedly, from digitigrade to plantigrade; lowering the foot into a plantigrade stance was found to increase head height.

These findings demonstrate that restoring the ONP of vertebrae is insufficient to accurately estimate head height in sauropods. Competing interpretations of pectoral girdle position and hind limb kinematics can influence the angle of the cervical series significantly, suggesting that a more holistic approach must be taken with regard to saurapod neck posture.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

A NEW SPECIES OF CANID FROM THE MALAPA HOMININ SITE, GAUTENG, SOUTH AFRICA
HARTSTONE-ROSE, Adam, Penn State Altoona, Altoona, PA, United States; KJNIN, Brian F., Institute for Human Evolution, University of the Witwatersrand, Johannesburg, South Africa; NALLA, Shaheed, Institute for Human Evolution, University of the Witwatersrand, Johannesburg, South Africa; WERDELIN, Lars, Department of Palaeozoology, Swedish Museum of Natural History, Stockholm, Sweden; BERGER, Lee R., Institute for Human Evolution, University of the Witwatersrand, Johannesburg, South Africa.

The newly discovered hominin bearing site of Malapa (Gauteng South Africa), type locality for Australopithecus sediba, has yielded a mammalian fossil assemblage that is remarkable in both its taxonomic breadth and preservational quality. Many of the specimens that have been identified from this assemblage are represented by multiple elements from single individuals – a rarity for the South African fossil record. Numerous specimens of carnivores have also been described from the site including both large and small species. Here we examine a smaller sample of specimens that represent the second new species (after A. sediba) to emerge from the 1.977 million year old Malapa sample – a new small canid that we attribute to the genus Vulpes.

The type specimen, University of the Witwatersrand (UW) 88-812 is a right mandibular fragment that includes part of the alveolus of the p3, the complete p4 and m1, the alveoli of m2 and m3 and the entire distal portion of the mandible. The coronoid, condylar and angular processes as well as mandibular foramen and masticatory muscle insertion scars are well preserved. Another specimen (UW 88-814) is a complete right m2 crown that we believe is from the same individual. Likewise, a complete right rib (UW 88-813) from a small canid was also recovered from the same breccia block. Given the preservational state of Malapa (almost no taphonomic mixing of the sample), this specimen likely came from the same individual.

Relative to a large sample of individuals of modern and fossil Vulpes as well as other small canid genera (which can be excluded based on morphology), the new Malapa species of Vulpes is defined by the lack of distal accessory cusp on its p4, mesiodiastally compressed and relatively large m1 trigonid, relatively large m2, and relatively small condyle. Overall, this new species is gracile with high-crowned sharp teeth, suggesting, despite its lack of accessory cusps, a tendency toward hypercarnivory or insectivory.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

DIYROSAURID CROCODYLIFORMS ATTAIN PEAK TAXONOMIC DIVERSITY AND CRANIAL MORPHSPACE DISPERSITY IN FRESHWATER FOLLOWING LATE CRETACEOUS LARGE MARINE TETRAPOD EXTINCTION
HASTINGS, Alexander, University of Florida, Gainesville, FL, United States

The Cretaceous-Paleogene (K-Pg) boundary marked the extinction of most large marine tetrapods. While other large marine tetrapods were nearly absent in the following Paleocene, dyrosaurid crocodyliforms have been recovered from marine depositional environments from the Late Cretaceous through the Eocene, when their extinction coincides with the diversification of cetacean mammals. The lack of competition by other large marine tetrapods during the Paleocene may have enabled dyrosaurids to radiate into new habitats and occupy new morphospace. Dyrosaurid fossils from the Paleocene Cerrejón Formation of South America indicate adult individuals occupied entirely freshwater with very different skull morphologies from their saltwater counterparts. Past studies of stable isotypes from dyrosaurids have indicated similar behavior to extant Crocodylus porosus which inhabits freshwater as a juvenile then moves to more saline waters with maturity. This suggests the possibility that typically saltwater dyrosaurids inhabited freshwater as adults through paedomorphic modification of ontogeny. The Cerrejón dyrosaurids provide a test for the hypothesis that dyrosaurids diversified into new habitats and occupied new morphospace through paedomorphic modification in a non-marine habitat during the Paleocene. To quantify and compare fresh versus saltwater dyrosaurids, skulls of each dyrosaur species, for which nearly complete fossils have been recovered (n=10), were analyzed using geometric morphometrics and compared to the same analyses for four extant crocodylian
species (all n≥20). Results of modern morphospace analyses show a significant correlation (all p<0.0001) between Relative Warp 1 (mostly variance in snout length) and size (a proxy for age). This same shift in Relative Warp 1 is seen in dyrosaurids from adult freshwater species to adult saltwater species. This similar shift is consistent with the hypothesis that dyrosaurids diversified in freshwater through retention of juvenile skull morphology. This paedomorphic shift in ontology increased diversity and disparity of Dyrosauridae during the Paleocene.

Analysing the evolution of the theropod halluc for unravelling the evolution of foot function
HATTORI, Soki, Nagoya University, Nagoya, Japan
Among the four pedal digits of non-avian theropods, only pedal digit I (hallux) could not reach the ground mainly because of its size relative to other digits. The presence of an opposable halluc is regarded as an important indicator of increasing arboreality because it had a crucial function in perching ability. There are, however, only a few studies of the function of the non-reversed halluc in non-avian theropods, even during cursorial locomotion. Therefore, the purpose of this study is to clarify the form and function of the halluc and foot of non-avian theropods during bipedal locomotion, based on an analysis of both extant birds and non-avian theropods.

In ornithischians, sauropodomorphs and basal theropods, metatarsal I is articulated with the ankle joint like other metatarsals, but this contact is lost in more derived theropods (i.e. neotheropods). I observed several specimens of neotheropods such as Coelophysis, Allosaurus, Albertosaurus, Khaan, Citipati, Deinonychus and Troodon. The Coelophysis specimens did not provide information on the detailed structure of the pes because of their state of preservation, but all observable parts of the hallux could be seen to lie on the plantar side of the metatarsus. Metatarsal I in the other taxa has a pointed proximal end, a trochlea surface at its distal end, and deeper lateral collateral ligament fossae than medial ones. In the studied specimens of Allosaurus and Albertosaurus, this trochlea is well-developed on the flexor surface, but rounded like a ball joint on the extensor surface, and there is a mediolaterally directed groove adjacent to this rounded joint. In Khaan and Citipati, extensor or medial views are observable but they seem to have the same features as described above. Deinonychus also has a half-rounded trochlea, but the mediolaterally directed groove is invisible. Troodon has a more unusually shaped metatarsal I, where the distal end is strongly twisted towards its extensor side.

An articular facet for metatarsal I is located on the lateroplantar surface of the proximal end of metatarsal I; however, the detailed morphology of this facet varies in Allosaurus, Albertosaurus and Deinonychus.

The torsion of metatarsal I, which causes completely reversed hallux and significant grasping ability, is commonly seen as a crucial difference between extant birds and non-avian theropods. However, some features such as deeper lateral collateral ligament fossae and mediolaterally directed grooves are commonly seen in both non-avian theropods and extant birds. Therefore, additional research and comparison of form and function of metatarsal I potentially enables us to understand the unknown function of the halluc in non-avian theropods.

Testing evolutionary size trends in the ophiacodontid (Synapsida, Eupelycosauria) skull
HAWTHORN, Jessica R., University of Toronto at Mississauga, Mississauga, ON, Canada; REIZS, Robert R., University of Toronto at Mississauga, Mississauga, ON, Canada
Members of the synapsid family Ophiacodontidae provide the earliest record of amniote diversification, and are known from the Middle Pennsylvanian to Early Permian of North America and Europe. There is a clear trend of increasing body size within the family, from the small Middle Pennsylvanian genus Archaeothyridella florissant to the much larger Ophiacodon major from the Early Permian. Increasing skull length relative to trunk length through time has also been reported within Ophiacodontidae, with the latest and largest species thought to have proportionally larger heads. Large heads are unusual among Palaeozoic amniotes, and the dimensions of the elongate, lightly constructed skulls of ophiacodontids differ greatly from those of contemporary eupelycosaur; however, the apparent emergence of this highly atypical morphological trend has not previously been tested to determine if it is merely an artifact of an overall increase in body size. Elongation of the antorbital region of the skull, another trend reported within Ophiacodontidae, has also not previously been tested. Total skull length was regressed against presacral vertebral column length, and antorbital skull length was regressed against total skull length using log-transformed data in order to test the hypotheses of increasing skull relative to trunk length and antorbital elongation, respectively. The residuals from each analysis were plotted against stratigraphic order. The results support allometric antorbital elongation through
time for *Ophiacodon*, but not all ophiacodontids. The trend of increasing relative skull length through time is not supported, though this may be an artifact of the current paucity of specimens with both measurable cranial and postcranial positively associated with the same individual. Evaluation of these perceived trends is critical to understanding the taxonomic diversity of ophiacodontids and constructing hypotheses of lifestyle, such as the possible adoption of a secondarily aquatic mode of life, within the family through time.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**PHYLLOGENETIC AND ONTOGENIC VARIATIONS OF BONE HISTOLOGY IN THYREOPHORAN OSTEODERMS**

HAYASHI, Shoji, University of Bonn, Bonn, Germany; ZHAO, Qi, University of Bristol, Bristol, United Kingdom; WATABE, Masahito, Hayashibara Museum of Natural Sciences, Setouchi, Japan; CARPENTER, Kenneth, Prehistoric Museum, Utah State University - College of Eastern Utah, Price, UT, United States; XU, Xing, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Within vertebrate evolution, only thyreophorans have evolved huge and bizarrely shaped osteoderms. Their function and extreme size evolution remain controversial; possible functions include defense, display, species recognition, and thermoregulation. In this study, we explored ontogenetic and phylogenetic changes in thyreophoran osteoderm histology to shed light on the evolutionary history and functional implications of osteoderms in thyreophorans. Late juvenile ankylosaurians (*Pinacosaurus*) lack large postcranial osteoderms, with the exception of the cervical half-rings and small bony ossicles. This developmental delay of osteoderm formation with respect to the body skeleton is similar to living reptiles. Contrary to this, a juvenile *Stegosaurus* (*Denver Museum of Natural History and Science 33359*) already has a well-developed dorsal plate. Additionally, a histological comparison between the body skeleton and osteoderms of a growth series of *Stegosaurus* shows that bony birds continue to grow well after skeletal maturity has been reached. In terms of evolutionary heterochrony, these observations indicate predisplacement and hypermorphosis in stegosaur osteoderm evolution. Ontogenetic variations of thyreophoran osteoderms are observed in their cortical thickness. The thickness of collagen fiber bundles in ankylosaur osteoderms and cortical bone of *Stegosaurus* spikes increases from juvenile to adult. Similar histological variations are also observed throughout their phylogeny. In ankylosaurians, derived taxa exhibit more extensively developed collagen fiber bundles with respect to the primitive taxa, and in stegosaurs, thick cortical bones of spikes are seen in derived taxa, but are lacking in any primitive taxa. All thyreophoran osteoderms are comprised of metaplastic bone, but important histological differences exist between derived ankylosaur and stegosaur osteoderms. In ankylosaurians, the structural and histological features of large osteoderms (cranial osteoderms, cervical half-rings, spikes, and clubs) are similar to those of small osteoderms embedded in the skin in that both have thin cortex bone, but have no cancellous bone and abundant collagen fibers. In contrast, the spike-shaped osteoderms of derived stegosaurians have a uniform structure that differs markedly from the plates in having thick cortical bone. Both spikes and plates lack abundant, thick collagen fiber bundles. This suggests that stegosaur spikes and ankylosaur osteoderms both were reinforced but by different strategies and for different purposes, i.e., protection against predation on one hand and inflicting wounds on the other. Stegosaur plates, on the other hand, have a weaker structure due to their spongious structure and their function was more likely for species recognition, display, and/or thermoregulation.

Technical Session I (Wednesday, October 17, 11:15 am)

**AN OVIRAPTORID ADULT-EGG ASSOCIATION AND THE ORIGIN OF AVIALAN REPRODUCTIVE STRATEGIES**

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Although avian reproduction is unique among living animals, some aspects derive from their non-avian theropod ancestry. Here we describe a new oviraptorid specimen from the Upper Cretaceous Nankang Formation of Jiangxi, China. This partial skeleton with two closely associated eggs provides our first glimpse into the theropod reproductive strategy. The adult female was in the posterior half of the skeleton (from the mid-sacral region) and shows its own small, poorly preserved precloacal foramen and left tibia show no evidence of medullary bone. One of the long, asymmetric eggs (19.3 x 7.2 cm) lies behind the sacrum, below caudals 4-7. Ornamentation consists of linear ridges aligned with the long axis. The second egg sits between the ischia adjacent to the left side with its blunt end apparently directed caudally. The 1.0 mm-thick eggshell consists of two calcite layers, separated by a distinct and irregular boundary. Although the eggs are of similar shell thicknesses the mammillary to continuous layer ratios vary significantly. The eggs belong to Elongatoolithidae, but overlapping sizes and shell thicknesses within this oofamily complicate more definitive assignment. Consistent with un laid eggs, there is no evidence of embryonic bone. The eggs’ arrangement relative to the adult parallels the occurrence of young external to and partially exiting adult ichthyosaurs. Similar extinction of young has been observed in drowned pregnant cattle, suggesting that the eggs were fully or partially extruded post-mortem due to the build up of decay-related gases internally. The displaced gastralia concur with an expanded or exploded abdomen. The narrow fit of the egg in the pelvic canal argues against the hypothesis that theropods laid eggs in bound pouches. The blood and feather arrangement within the internal egg differs from the typical oviposition alignment found in most extant birds. The presence of two equally developed clamps of the egg supports monoovotrophic ovulation as hypothesized for Maniraptora on the basis of within-clutch egg pairing in *Tridion* and oviraptorids. This iterative style of laying may have allowed production of larger eggs relative to adult body mass.

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 9:00 am)

**PALEOGENE SQUAMATES FROM THE NORTHERN NEOTROPICS: ECOLOGICAL IMPLICATIONS AND BIOGEOGRAPHIC HISTORIES**

HEAD, Jason J., Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE, United States; BLOCH, Jonathan I., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; RINCON, Aldo F., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; MORENO-BERNAL, Jorge W., Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE, United States; JARAMILLO, Carlos A., Smithsonian Tropical Research Institute, Ancon, Panama

The modern northern Neotropics possesses some of the highest diversity among extant squamates, but the sparse fossil record from this region has previously limited the ability to reconstruct their evolutionary histories. New discoveries from the early Paleogene of northern South America reveal biogeographic patterns and palaeoecology of modern clades. Squamates have been recovered as components of vertebrate faunas from the Early Eocene Cerrejon Formation and late Paleocene-Jurassic Bolivian faunas. The Cerrejon Formation represents large-scale fluvial deposits with associated rainforest flora and herpetofauna. The squamate record consists of snakes, including multiple individuals of the giant aquatic boa *Titanoboa cerrejonensis* and a single, poorly preserved praeocular vertebra assigned to Anilioidae on the basis of extreme reduction of the neural spine, broadly concave dorsal margin of the neural arch and comparatively narrow zygosphene. The presence of a fossorial leaf-litter specialist provides the first terrestrial component to the reptile record and indicates geographic proximity of the aquatic record to rainforest habitats within the Cerrejon Formation. The Muchelco Creek locality in the Bogotá Formation is dated to just before the Early Eocene Climatic Optimum (EECO). It represents smaller-scale fluvial deposition, and preserves a diverse squamate fauna consisting of iguanians, including the fossil record of holocephalans, and boine and caenophilotes, including arboresulus taxa, and the Bogotá squamate record represents a forest herpetofauna. Extant tropical forest squamates undergo thermal stress at high ambient temperatures, and inferred thermal tolerances of the Bogotá squamate record may constrain temperature estimates at the beginning of the equatorial EECO.

The Colombian squamate record indicates that the continental-scale biogeographic zonation of the modern northern Neotropics was established no later than the middle Eocene. Both the Bogotá and Cerrejon formations include representatives of extant clades that are either endemic or predominately South American (“aniloids”) or whose Central American distributions, display or represent more recent immigration from South America (holocephalans, boines). These records additionally indicate that the biogeographic events that initially assembled Neotropical squamate faunas, including New World immigration of iguanians and first occurrence of South American boines, were likely late Mesozoic in age.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**PHYLLOGENIC POSITION OF PROCERVULUS (CERVIDAE, ARTIODACTYLA, MAMMALIA) AND IMPLICATIONS OF CHARACTER EVOLUTION IN CERVIDS**

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Representatives of cervids are recorded for the first time from the early Miocene. A number of successive, adaptive radiations led to the diversity seen in the fossil record and the extant fauna, where cervids form the second most diverse family of large living mammals. Despite their widespread and common occurrence, much remains to be discovered concerning their phylogenetic history. Particularly interesting is the relationship of the early stem cervids to crown taxa of the family.

Previous studies dealing with cervid phylogeny generally focused on subsets of data, i.e., using molecular data or morphological data only, including only fossils or only living cervids. The work compiles for the first time morphological data, consisting of 150 cranial characters, and molecular data from fossil and living artiodactyls focusing on cervids. Molecular data include some or all of the mitochondrial genome and the nuclear
gene SRY (sex-determining region on the Y chromosome) (source: GenBank) for 40 living species and cytochrome b for the extinct Megaloceros giganteus.

These data were combined in a supermatrix and phylogenetic analyses were undertaken under three different optimisation criteria, Maximum Parsimony (PAUP), Bayesian Inference (MrBayes) and Maximum Likelihood (RAxML), all of which converged on a consistent result. According to the analyses, the early Miocene *Proceratops* is sister taxon to Cervinae, Muntiacinae and Capreolinae and more closely related to the Muntiacinae than to the other two subfamilies. This result proves the already known development from a relatively primitive two to three-tined antler in *Proceratops* to much more complex antlers on one hand and secondary development to simpler antlers on the other hand in living cervids, and also provides more insight to cranial and dental character evolution. For example, the angular mandible is strongly elongated in *Proceratops* and the processus coronoides is upright, both indicating differences in the mandibular muscle attachment compared to modern cervids. An elongation of the skull and especially the snout can be observed in the course of evolution. *Proceratops* possessed upper molars, which are wider than long, and bear lingual and sometimes even labial cingula. The long, upright pedicles are a sign of the relatively big orbits, different from the more inclined and further posteromedially positioned pedicles in living cervids. All these observations suggest an adaptation to a different environment and diet than extant cervids are adapted to.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

THE CURRENT KNOWLEDGE OF TRIASSIC VERTEBRATE ASSEMBLAGES OF THE DEEP RIVER BASIN (NEWARK SUPergroup: CHATHAM GROUP), NORTH CAROLINA, BASED ON RECENT DISCOVERIES

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Recent discoveries and the application of microvertebrate techniques, particularly screenwashing, at artificial outcrops (quarries) have substantially increased the known diversity of fossil vertebrates in the Deep River Basin of North Carolina. New discoveries come from all three sub-basins (Wadesboro, Sanford, and Durham) and from multiple stratigraphic horizons. The Pekin Formation in the Sanford sub-basin yields semionotids, coelacanths, temnospondyls, dicynodonts, the transversodont cynodont Boreogomphodon, and numerous archosaurs (phytosaurs, a rauisuchian, *Lucasuchus* and two new taxa of *aetosaurs*, and a new crocodylomorph). Fossils from the overlying Cumnock Formation in the Wadesboro sub-basin include redfieldid Lyons, lungfish, mosasporid temnospondyls, and three phytosaur skulls, two with associated skeletons. The Cumnock Formation in the Sanford sub-basin yields the richest and most diverse assemblages, including redfieldid *Cionichthys* and *Synichthys*, semionotids, the coelacanth *Diplurus*, the lungfish *Arganodus*, temnospondyls, the enigmatic amniote *Colognathus*, lepidosaurs, phytosaurs (including the type of *Raftodon carolinensis* Emmons), a rauisuchian, the venous archosauriform *Uachtidotodon schneideri*, *Revueltosaurus olsoni*, Boreogomphodon, and the dromatheriid cynodonts *Dromatherium sylvestre* Emmons and *Microcondon tenosirostis* Emmons. The Sanford Formation assemblage is limited to translorsodontids and a rauisuchian tooth. The stratigraphically problematic "Lithofacies Association II" of the Durham sub-basin yields additional lungfish and an exceedingly rare record (for the Newark Supergroup) to tooth. The stratigraphically problematic "Lithofacies Association II" of the Durham sub-basin yields additional lungfish and an exceedingly rare record (for the Newark Supergroup) to tooth. The stratigraphically problematic "Lithofacies Association II" of the Durham sub-basin yields additional lungfish and an exceedingly rare record (for the Newark Supergroup) to tooth.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

MYOLOGICAL RECONSTRUCTION OF THE BASAL CERATOPSIANS, *PSITTACOSAURUS* AND *PROTOCRATOPS*: UNDERSTANDING MUSCLE RELLOCATION RELEVANT TO POSTURE

HEDRICK, Brandon P., University of Pennsylvania, Philadelphia, PA, United States; DODDOR, Peter, University of Pennsylvania, Philadelphia, PA, United States

Ornithischian dinosaurs are pleiomorphically bipedal, with quadrupedality evolving independently in each of the major clades (Marginocephalia, Ornithopoda, Theropoda). Though all quadrupedal dinosaurs evolved quadrupedality secondarily, only ceratopsians and thyreophorans have evidence of semi-sprawling forelimb posture, whereas sauropods and ornithopods developed columnar forelimb posture. Traditionally, dinosaurian gait and posture has been examined through kinetic motion of joints and the length and orientation of muscle moment arms. A recent study used myology in order to understand stance of the bipedal basal ornithischian, *Leptoceratops*. This was done to evaluate the basal ornithischian condition and muscle attachment. In order to understand successively more derived muscular patterns in early margirineopohalans and the evolution of the semi-sprawling forelimb posture in derived ceratopsians, we reconstruct the musculature of the facultatively bipedal basal ceratopsian, *Psittacosaurus* and the more derived obligatorily quadrupedal basal ceratopsian, *Protoceratops*. Direct comparisons of two closely related taxa that represent completely different postures allow insight into this important stance transition. Changes in bone morphology and muscle scars (signifying origins and insertions of major muscles) in *Psittacosaurus* and *Protoceratops* reveal reduction, repositioning of major muscles. For example, the coracoid of *Psittacosaurus* has a pronounced eminence for the origin of the m. bicps brachii. The corresponding region in *Protoceratops* is flat. Thus the biceps was a more significant muscle in *Psittacosaurus*. *Protoceratops* has a long, defined ridge near the scapular origin of m. triceps brachii, whereas *Psittacosaurus* lacks muscle scars. The olecranon is in *Psittacosaurus* compared to the large rugose olecranon of *Protoceratops*. The transition of the m. bicps brachii and hypertrophy of the m. triceps brachii from *Psittacosaurus* and *Protoceratops* is an example of myological trends towards larger stabilization muscles of the forelimb in quadrupeds. However, such significant changes are not seen in the hindlimb.

Muscle reconstructions based on the extant myological bracket are compared to previous muscle reconstructions of other archosaurs with reference to phylogeny and posture. This study demonstrates that myological reconstructions are an effective method for evaluating functional changes, such as stance, across an evolutionary lineage. It also documents that the forelimb module undergoes significant hypertrophy and reduction of specific muscles across the lineage whereas the hindlimb module does not. These changes are crucial to the stance transition in basal Ceratopsia.

Romer Prize Session (Thursday, October 18, 10:30 am)

FROM EXTANT TO EXTINCT: LOCOMOTOR ONTOGENY AND THE EVOLUTION OF AVIAN FLIGHT

HEERS, Ashley M., University of Montana, Missoula, MT, United States

Transitional fossils are the record of evolutionary transformations, key to deciphering the origins of major clades and organismal diversification. Bringing these fossils ‘to life’ to better understand evolutionary transitions involves reconstructing the function(s) of their anatomical features, by investigating how comparable features function in living organisms. Yet, extant adult forms and extinct fossils are often very different and thus difficult to compare. Here, I use theropod dinosaurs and their avian descendants to show how postnatal developmental transformations can help elucidate evolutionary transitions. Though juveniles are not often discussed in extinct-extant comparisons, developing birds share a number of similarities with the extinct theropods whose transitional skeletons and protowings record the origin of avian flight. Many immature birds rely on dinosaur-like, transitional skeletons and protowings to navigate three-dimensional habitats and reach refugia. Though not yet capable of flight, these juveniles use their incipient wings and undeveloped skeletons for intermediate locomotor behaviors like wing-assisted incline running or ‘steaming’ over water, where wings and legs are used cooperatively. Developing birds can thus elucidate potential locomotor capabilities of extinct theropods with similar anatomies, by actualizing form-function relationships through behaviors that bridge obligate bipedal to flight-capable transitions. To document feather and skeletal ontogeny in the precocial chukar (*Alectoris chukar*), 1) I used a propeller apparatus to measure aerodynamic forces generated by dried wings over a range of ages and Reynolds numbers, and 2) used high resolution computed tomography scans and bilinear x-ray videos (X-ray Reconstruction of Moving Morphology) of different aged birds to quantify three-dimensional skeletal kinematics during various behaviors. My results show that juveniles and adults with highly disparate anatomies employ very similar skeletal kinematics, possibly due to differences in aerobic force production by protowings versus wings. Locomotor performance improves through ontogeny, but even young birds generate useful aerodynamic forces. This suggests that extinct theropods might also have been capable of more bird-like wingstrokes and greater aerobic force production than implied by their transitional morphologies. Developing birds depend on their transitional skeletons and protowings for a variety of behaviors, including flying behaviors, and though we are only beginning to explore locomotor ontogeny, juveniles that actualize the functional capacities of transitional anatomies may provide multifaceted and unique insight into life’s history.
The new anuran was recovered from a whitish, laminated, calcimicrite limestone as part (FMNH PR2384) and counterpart (held in a private collection). Most of the nearly complete and articulated skeleton is retained on the part where it is exposed in dorsal aspect. The counterpart is heavily restored and contains only a few pieces of original bone and very poor impression of the skull. The specimen is very small, with a snout-vent-length (measured from tip of snout to end of pelvic girdle) of 19.3 mm, which could indicate an immature ontogenetic age. An ossified columella and sphenethmoid are present, however, which indicates that the frog is postmetamorphic because these bones, when present, ossify after metamorphosis is completed. It is most likely a young adult, because the carpal bones are ossified but the distal tarsal bones, which generally ossify late, are not.

This anuran possesses an interesting mix of characters that initially did not readily ally it with any currently known anuran family. A phylogenetic analysis that incorporated representative costatans, anomocoelans, and neobatrachians was undertaken to determine its relationships. Results of this analysis places the Green River frog within Anomocoela, as the sister to Pelodytes. This clade is the sister taxon to the remainder of the anamnecoleans. The clade Anomocoela is the sister taxon of Neobatrachia, with Hadrornophrynus natatalensis basal to this clade.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)
PRELIMINARY FAUNAL ANALYSIS OF THE DONGGUTUO SITE, NIHBAN BASIN, CHINA

HENSLEY-MARSCHAND, Blaire, Indiana University, Bloomington, IN, United States
Donggutuo is a 1.1 million year old archaeological site in the Nihewan Basin of China located approximately 100 miles west of Beijing. The Nihewan Basin area is of great importance in human evolution because it recorded the behaviors of early hominids as they migrated out of Africa and into this new geographic area over one million years ago. The presence of over 10,000 stone tools at Donggutuo attests to the presence of Homo erectus in the Nihewan Basin, but as of yet there have been no H. erectus specimens found in this area. Joint US-Chinese teams excavated this site in 1991, 1992, and 2000-2001, and it was the first site in China to record precise provenience data during excavation. A thorough analysis of the material was conducted in an effort to establish an agent of accumulation for this site and to test paleoenvironmental reconstruction hypotheses for this area. The current analysis consists of 2162 specimens from all three recorded field seasons. Surface damage indicates carnivore involvement in the accumulation of this site, but there is an indication of hominid involvement as well in the form of both cutmarks and hammerstone percussion marks. Additionally, establishing a direct connection between stone tools made by early hominids and the accumulated fauna. In an effort to supplement paleoenvironmental reconstructions of the Nihewan Basin, specimens have been identified to the most specific taxonomic level possible. Despite a large amount of unidentified specimens (20.21%) and undentifiable long bone fragments (29.32%), the analysis of identifiable specimens thus far indicates a high frequency of Equidae in addition to Elephasidae, Rhinocerotidae, and Bovidae. The high proportion of Equidae may suggest a generally open environment during the time of deposition while H. erectus was moving into this new geographic area. However, further identification of the faunal specimens is required for a more specific paleoenvironmental reconstruction.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 11:15 am)

BONY ATTACHMENTS OF FLIGHT FEATHERS IN NEORNITHINE BIRDS: ANATOMY, HISTOLOGY AND FUNCTIONAL VARIATION

HIERONYMUS, Tobin L., NEOMED, Rootstown, OH, United States; SIMONS, Erin L., Midwestern University, Glendale, AZ, United States
Attaching feathers to the bird skeleton is a process that has evolved multiple times in the avian tree. However, most neornithine birds have a single common system of bony attachments for their flight feathers, the remainder of the body is composed of muscle and ligamentous soft tissue. A comparison of the bony exoskeleton and the soft tissue relationships of remex-related bony features were determined in a range of neoavian taxa, including anuran family. A phylogenetic analysis that incorporated representative costatans, anomocoelans, and neobatrachians was undertaken to determine its relationships. Results of this analysis places the Green River frog within Anomocoela, as the sister to Pelodytes. This clade is the sister taxon to the remainder of the anamnecoleans. The clade Anomocoela is the sister taxon of Neobatrachia, with Hadrornophrynus natatalensis basal to this clade.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

THE NONAVIAN THEROPOD QUADRATE: SYSTEMATICS USEFULNESS, MAJOR TRENDS AND PHYLOGENETIC MORPHOMETRIC ANALYSIS

HENDRICKS, Christophe, Universidade Nova de Lisboa, Lourinhã, Portugal; ARAÚJO, Ricardo, Southern Methodist University, Dallas, TX, United States; MATEUS, Octávio, Universidade Nova de Lisboa, Lourinhã, Portugal
The quadrate in nonavian theropods is incredibly diverse morphologically; however this morphological disparity has been underestimated for taxonomic purposes. The quadrate topological homologies and anatomy, as well as the terminology, among nonavian theropod clades are reviewed. In order to evaluate the phylogenetic potential and investigate the evolutionary transformations of the quadrate, we conducted a Catalano-Goloboff phylogenetic morphometric analysis using 3 morphometric characters, a total of 28 landmarks coded for 23 taxa, as well as a cladistic analysis using 115 discrete characters in 28 taxa. The clade Anomocoela is the sister taxon of Neobatrachia, with Hadrornophrynus natatalensis basal to this clade.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)
FIRST REPORT OF AN ANURAN FROM THE FOSSIL BUTTE MEMBER (EARLY EOCENE, WASATCHIAN) OF THE GREEN RIVER FORMATION, WYOMING

HENRICI, Amy C., Carnegie Museum of Natural History, Pittsburgh, PA, United States; BAEZ, Ana M., CONICET, Buenos Aires, Argentina; GRANDE, LANCE, Field Museum of Natural History, Chicago, IL, United States; SIMONS, Erin L., Midwestern University, Glendale, AZ, United States
The Green River Formation is primarily deposited in three lakes; Lake Uinta, Lake Gosiute, and Fossil Lake, during the Eocene. Although the formation is famous for the numerously exceptionally well-preserved fossils that it has produced, the remains of anurans are extremely rare with only three currently known specimens. One is an unidentified specimen preserved as a mostly carbonized skin imprint from the Wasatchian-Bridgerian Parachute Creek Member deposits of Lake Uinta. The second consists of an impression of a nearly complete, articulated skeleton of the pelobatid, *Eopelobates sp.*, from the Bridgerian Laney Member deposits of Lake Gosiute. The third, and articulated of this specimen, preserved as a nearly complete, articulated skeleton of a new genus and species from the Wasatchian Fossil Butte Member deposits of Fossil Lake.

The new anuran was recovered from a whitish, laminated, calcimicrite limestone as part (FMNH PR2384) and counterpart (held in a private collection). Most of the nearly complete and articulated skeleton is retained on the part where it is exposed in dorsal aspect. The counterpart is heavily restored and contains only a few pieces of original bone and very poor impression of the skull. The specimen is very small, with a snout-vent-length (measured from tip of snout to end of pelvic girdle) of 19.3 mm, which could indicate an immature ontogenetic age. An ossified columella and sphenethmoid are present, however, which indicates that the frog is postmetamorphic because these bones, when present, ossify after metamorphosis is completed. It is most likely a young adult, because the carpal bones are ossified but the distal tarsal bones, which generally ossify late, are not.

This anuran possesses an interesting mix of characters that initially did not readily ally it with any currently known anuran family. A phylogenetic analysis that incorporated representative costatans, anomocoelans, and neobatrachians was undertaken to determine its relationships. Results of this analysis places the Green River frog within Anomocoela, as the sister to Pelodytes. This clade is the sister taxon to the remainder of the anamnecoleans. The clade Anomocoela is the sister taxon of Neobatrachia, with Hadrornophrynus natatalensis basal to this clade.
with the following observations: (1) proportionally elongate ulnae appear to be related to prominent caudal ulnar papillae; (2) rounded wing tips show a similar pattern for the ulna with the inclusion of carpometacarpal papillae; and (3) pointed wing tips seem to co-occur more often with prominent digital fossae. The distribution of bony correlates for feather attachment in neornithine birds may be due to a trade-off between primary and secondary feathers in their contribution to the second moment of area of the wing, and thus the force generated in flapping flight. Bony correlates of feather attachment provide an additional line of evidence, alongside intramembral indices and limb cross-sectional properties, that may be used to infer the shape and function of forelimb feathers in extinct paravians.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)  
MINERALIZATION OF MAMMOTH MOBILAR
HIGGINS, Peninlyn, University of Rochester, Rochester, NY, United States; POTAPOVA, Olga, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States; AGBENBROAD, Larry, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States

Isotopic analysis of the tusks of mammoths and elephants (and their relatives) has been used extensively to understand behaviors and preferences of these enormous beasts, as well as their time of death. From this work, the mineralization patterns of tusks is well understood, and a great deal has been learned about extinct species of proboscidea. There are scenarios in which it could be advantageous to use molars instead of tusks, however. Molars possess enamel, which is arguably less prone to diagenetic alteration. Because enamel is less likely to be altered, one can more confidently analyze biologically derived carbonate in the enamel matrix, which is not only a simpler process, but also provides carbon isotopic data that can be related to diet. However, to effectively utilize isotopic data from mammoth or elephant molars tooth enamel, one must first understand the timing and pattern of mineralization in the tooth. Very little work has been done in this regard, with only a few, widely different, estimates for how long a whole tooth may take to mineralize and a little bit of information on the microstructures of elephant tooth enamel. Mammoth and elephant teeth are unique as they are constructed from a series of vertical plates. The plates are stacked together and worn, such that on the occlusal surface of the tooth is a repeating series of cementum, enamel, dentine, enamel, and back to cementum for as many plates as there are in the tooth. The roots are fused between adjacent plates. This fusion appears to occur after the bulk of the tooth has mineralized. We have conducted isotopic analysis to answer the following questions: 1) What is the overall pattern of mineralization for the plates? Does mineralization occur one plate at a time, from front to back, following the “conveyor belt” pattern of the tooth emergence/replacement that is characteristic for elephants? Or do all the plates mineralize simultaneously, from occlusal surface to root, as is the case for most mammals? Or is the pattern somewhat in between these two potential end-members? 3) How long does it take for an entire molar or an individual plate to mineralize? 2) At what point do the roots fuse, and do they fuse synchronously or in some sequence? Serial isotopic analysis of five individual plates from a single right upper molar from a mammoth from the Mammoth Site in Hot Springs South Dakota shows that all plates most likely mineralize simultaneously from occlusal surface toward the root. The complete mineralization seems to take about one year. Fusion begins sometime after the plates are essentially fully formed, and appears to begin at the front of the tooth and move toward the back, again, over the course of about one year.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 11:30 am)  
DEPOSITIONAL ENVIRONMENT AND REWORKING HISTORY OF THE SEVERN (BOWIE, MD) AND BLADEN (ELIZABETHTOWN, NC) FORMATIONS: TAPHONOMIC AND SEDIMENTOLOGICAL CHARACTERISTICS OF TWO LATE CRETACEOUS LAG DEPOSITS
HIPPENSTEE, Scott P, University of North Carolina at Charlotte, Charlotte, NC, United States; GARCIA, William J., University of North Carolina at Charlotte, Charlotte, NC, United States

The Severn Formation of Maryland (Campanian) and the Bladen Formation of North Carolina (Maastrichtian), while not strictly contemporaneous, are important Late Cretaceous vertebrate assemblages that have yielded an abundant and diverse assemblage of terrestrial and marine fossils. The fossils collected for this study came from the Elizabethtown Landfill Annex site (Bladen Formation) and from outcrops along a small unnamed tributary of the Patuxent River in Prince George’s County Maryland (Severn Formation). Both formations have been described as shallow/marginal-marine lag deposits; nevertheless, sedimentological and taphonomic analyses suggest they differ with respect to hydrodynamic energy, water depth, and reworking history.

To compare the taphonomic condition of the chondrichthyan teeth at each locality more closely, we measured the mean silica content of bison and elephant teeth from both sites will elucidate this relationship further, lending insight into how microwear features are affected by environmental conditions. A better understanding of the factors affecting microwear in ungulates will ensure more meaningful interpretations in future ecological and paleoecological studies using this method.  

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Preparers’ Session (Thursday, October 18, 8:30 am)  
HILUSKO, Leslja J., University of California Berkeley, Berkeley, CA, United States; NJAU, Jackson K., Indiana University, Bloomington, IN, United States

Olduvai Gorge was first brought to the attention of paleontologists in 1913 and has since provided tremendous insight to the last two million years of vertebrate evolution in East Africa. Thousands of fossils have been recovered from this site over the almost 100 years of field work, including numerous type specimens and records of first and last appearance dates. However, due to the long history and multiple investigators, the material is scattered across numerous museums, personal collections, and countries with no comprehensive database of the material. We have developed the Comprehensive Olduvai Database Initiative with the goal of creating an electronic repository of information about these fossils that includes bibliographic information, photographs, element identification, stratigraphic context, and current repository. As of April 2012, 20 monographs and other scientific publications dating from 1934 – 1990 had been entered into the database (approximately 3,700 specimens). Data entry from published work and visits to museums holding collections are underway, including the inventory of fossils held returned to the National Museum of Tanzania, Dar Es Salaam, from the Kenyan National Museums in 2011. With the launch of the CODI website at www.olduvai-paleo.org we have initiated the second phase of the project. This relies on scientific crowd-sourcing—to draw on the knowledge of other vertebrate paleontologists to identify unpublished or underpublished material. In our presentation we will introduce the audience to the on-line database, demonstrate some of its unique features, and request assistance in recovering information about fossil material from Olduvai Gorge, calling for the scientific community at-large to work collaboratively to record this information before it is lost to the passage of time.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)  
SILICA INGESTION IN GRAZING BISON AND ARIDITY: IMPLICATIONS FOR MICROWEAR ANALYSIS
HOFFMAN, Jonathan M., University of Wyoming, Laramie, WY, United States; CLEMENTZ, Mark T., University of Wyoming, Laramie, WY, United States

Microwear tooth analysis is used to interpret the diet and ecology of herbivorous mammals. However, microscopic wear (e.g., scratches and pits) has been attributed to both diet (i.e., plant type) and abiotic sources (i.e., exogenous grit or soil), complicating interpretations. Additionally, it is unclear whether environmental factors, such as aridity, affect levels of abiotic silica consumption and ultimately microscopic wear. To strengthen the interpretive power of microwear analysis, we have assessed the relationship between local aridity, silica consumption by grazers, and microwear features.

Loss-on-ignition analyses were conducted to measure the ingested silica content (as a proxy for abiotic silica consumption) in fecal samples from two populations of American bison (Bison bison), which represent environmental extremes in relation to aridity. The Tallgrass Prairie National Preserve is a temperate grassland in southeastern Kansas with a mean annual precipitation (MAP) of 8080 mm. By contrast, the Henry Mountains Wilderness of southeastern Utah is a cold desert that experiences much drier conditions (MAP = 204 mm). Fresh fecal samples were collected during the dry season for each locality. Additionally, bison teeth previously collected from each site were molded and cast for microwear analysis to test for correlations with aridity and silica consumption. If local aridity affects abiotic silica ingestion (e.g., grazers in arid areas consume more soil/ sand than grazers in wetter areas), then we would expect to see a significant difference in the mean fecal silica content of the two bison populations. However, we discovered no significant difference between the mean fecal silica content of the two bison populations (21.57% and 22.44% inorganic by dry weight for the Henry Mountains and Tallgrass Prairie populations, respectively), indicating no correlation between aridity and silica consumption. These results suggest that local aridity does not impact abiotic silica consumption by grazers and this environmental factor does not influence microwear. Microwear analyses of bison teeth in this regard, with other samples, will elucidate this relationship further, lending insight into how microwear features are affected by environmental conditions. A better understanding of the factors affecting microwear in ungulates will ensure more meaningful interpretations in future ecological and paleoecological studies using this method.
Systematic literature, we suggest they be redefined when necessary to be monophyletic. The taxa that were named prior to the advent of phylogenetic taxonomy and are entrenched in the spell out their contingency on the validity of other taxonomic concepts. Under this approach, definitions cover not only taxa to be included, but also taxa to be excluded, and also must spell out their contingency on the validity of other taxonomic concepts. Under this approach, priority becomes secondary to monophyly in choosing among mutually exclusive names. For taxa that were named prior to the advent of phylogenetic taxonomy and are entrenched in the systematic literature, we suggest they be redefined when necessary to be monophyletic. The new definitions should follow the intentions of the original author in terms of which taxa are critical for inclusion and exclusion. This view of taxonomic priority minimizes synonymy, provides a clearer picture of the scientific purpose and application of taxonomy and nomenclature, and lends itself to practical digital applications of taxonomy.

Technical Session IV (Wednesday, October 17, 1:45 pm)

MORPHOLOGY AND DIVERSITY OF THE MANDIBULAR SYMPHISES OF ARCOSAURUROMPHS

HOLLIDAY, Casey M., University of Missouri, Columbia, MO, United States; NESBITT, Sterling J., University of Washington, Seattle, WA, United States

Arcosauromorphs radiated into numerous trophic niches during the Mesozoic, many of which were accommodated by particular suites of cranial adaptations and feeding behaviors. The mandibular symphysis, the joint linking the mandibles, is a poorly understood cranial joint which offers significant insight into skull function and feeding ecology. Using comparative data from extant amniotes, we investigated the skeletal anatomy and ontological correlates of relevant soft tissues in a survey of archosauromorph mandibular symphyses. Characters describing degree of interdigitation, morphology of Meckel’s cartilage, and general symphyseal structure were identified using observational and imaging techniques. The evolution of these features was mapped using a current phylogeny of archosauriforms with the addition of non-archosauriform archosauromorphs. Extinct taxa with the simple Class I condition (e.g., proterochampsids, “rauisuchians”), rugose Class II (aetosaurs, protosuchids, silesaurids), and interdigitating Class III symphyses (e.g., phytosaurs) were classified with the simple condition. Finally fundamental, basal archosauriforms build the joints in expected ways, though they differ in contributions of bony elements and Meckel’s cartilage. Optimization of the different classes of symphyses across a archosauromorph clades indicate that major iterative transitions from plesiomorphic Class I to derived, rigid Class II-V symphyses occurred along the lines to phytosaurs, aetosaurs, a subset of poposauroids, crocodyliformes, pterosaurs, ornithischians, and birds. These transitions in symphseal morphology correlate with changes in dextinction (type of tooth and heterodonty), the origins of beaks, and potentially inferred diet indicating symphyses are informative characters in understanding the evolution of archosauromorph cranial evolution.

Technical Session VI (Thursday, October 18, 2:30 pm)

LIassic DAWN: PHYLETIC DIVERGENCE ANALYSIS SUPPORTS EARLY TO MIDDLE JURASSIC ESTABLISHMENT OF PRIMARY DINOSAUR DIVERSITY

HOLTZ, Jr., Thomas R., Dept. of Geology, University of Maryland, College Park, MD, United States

Recent analyses by a number of workers have yielded a significant increase in our understanding of the standing taxonomic diversity (i.e., number of taxa present per unit time) of Mesozoic Dinosauria, and these measures have been compared to changing environmental parameters (including paleogeographic and atmospheric transformations) in an attempt to study the factors which contributed to dinosaurian success. This analysis is complementary to these other efforts, enabling not only standing diversity but estimates of phyletic divergence patterns within this clade.

A set of new species-level supertrees for Dinosauria has been assembled, taking advantage of the substantial numbers and scope of recent phylogenetic analyses. Unnamed fragmentary specimens are incorporated into these topologies if they represent stratigraphic and/or biogeographic range extensions of the clade in question, and are placed on the tree at the most recent possible branching time so as to reduce the duration of ghost lineages. Alternative topologies are constructed to reflect presently unresolved issues within Theropoda and Sauropoda. Standing diversity and phyletic divergence counts are counted in 5 Myr intervals over the whole of the Mesozoic: these counts are based on both standard cladistic divergence models and on alternative anagenetic alternatives (in which congeneric sister taxa with non-overlapping known stratigraphic ranges and which inhabited the same or adjacent depositional basins are counted as a single lineage with no divergence event.)

These data are then compared to geochronology and to various paleoenvironmental factors. Time bins of the late Early and Middle Jurassic epochs stand out statistically as the primary intervals for diversification: subsequent diversions represent elaborations within major lineages established at this earlier phase. Diversification patterns do not seem to be correlated with changing oxygen or carbon dioxide levels. Weak statistical support was found for an alternation between increased levels of diversification of dinosaurs and increased sea level and decreased degree of contiguousness of depositional basins. Lagerstätten effects strongly influence estimates of divergences for eumaniraptorans (= deinonychosaur + avialan) clades, but not for other dinosaurs. Expansion of these analyses to explore patterns of phyletic divergence in other terrestrial tetrapod clades (e.g., Mammaliaformes, Crocorthorisci, Pterosauria) could be used to examine if comparable trends exist in these groups.

Technical Session XVIII (Saturday, October 20, 3:15 pm)

THE OLDEST PSEUDORHYNCOCYONIDS: THEIR BEARING ON RELATIONSHIPS OF THIS EUROPEAN STEM PLACENTAL FAMILY

HOOKER, Jerry, Natural History Museum, London, United Kingdom

Members of the family Pseudorhyncoconyidae are recorded only from France and Germany, where they are rare in faunas ranging from the middle of the Early Eocene to nearly the end of the epoch. With few exceptions, preservation types are polarized between assemblages with only one or two isolated teeth and that from Messel, with complete flattened skeletons, but whose teeth are difficult to observe. Although pseudorhynconyids are considered to be sister group to the Leptictidae, primitive members are almost unknown and consequently details of their relationships have been difficult to establish. New material in the form of isolated teeth representing numerous loci, belonging to two species from the earliest Eocene of the UK, go some way to bridging morphological gaps and resolving these relationships. In particular, similarities between one of the new species and the putative leptopectid *Palaenictos levei* from the Paris Basin Late Paleocene suggest close affinity and thus a further downward range extension for the family Pseudorhynconyidae. The character states that generated an earlier dismissal of such a relationship are mainly primitive. Other groups recently considered closely related to leptictids are palaeanodonts and pantolestes. Cladistic analysis of all available pseudorhynconyids and of primitive members of these
above, other three groups, using dental characters, has been conducted. Most results produce a monophyletic Pseudorhynchocephalida, including *P. levii* and *Diaptychodus*, which were previously regarded as European leptictids. Palaeoncodes nest within Leptictidae, whilst pantolestans are unstable in position, relating either to Leptictidae + Palaeanodonta or to Pseudorhynchocephalidae. The pattern of relationships suggests European endemicism for the Pseudorhynchocephalidae from early in the Palaeocene and a probable North American origin.

Technical Session VIII (Thursday, October 18, 2:00 pm)

**FAUNAL HETERGENEITY IN BARSTOVIAN MAMMALS OF THE NORTWEST: WHAT DOES FAUNAL DIVERSITY TELL US ABOUT TECTONICS AND HABITAT DIVERSITY?**

HOPKINS, Samantha S., University of Oregon, Eugene, OR, United States; MAGUIRE, Kathryn C., University of California, Berkeley, Berkeley, CA, United States; MCLAUGHLIN, Win N., University of Oregon, Eugene, OR, United States

The Middle Miocene contains the greatest diversity of North American mammals since the Eocene, and possibly the greatest in the history of mammals. This period has drawn extensive interest in studies of ecological evolution, of the role of climate in the generation of diversity, and of the impact of immigration events on diversity. Many of these studies, however, have focused on the taxonically quiescent Great Plains. Efforts to understand the role of tectonic activity in diversity generation have come to differencing conclusions about whether the diversity of the Great Basin is greater than the Great Plains in the Middle Miocene, confounded somewhat by differences in publication bias and sampling and in the methods applied to correcting for these biases. Our collecting and taxonomic efforts in the fossil record of Oregon have improved the completeness and consistency of sampling and taxonomy across many localities with highly divergent publication histories, so we have a superior sample with which to address the diversity of mammals in Oregon at a variety of scales. We compare all the Barstovian sites in Oregon and Northern Nevada using presence-absence and relative abundance data to determine the diversity patterns within and between collecting areas. In looking at the differences among sites, we find that the faunal heterogeneity in the Barstovian of Oregon is remarkably high, almost certainly greater (perhaps substantially so) than that found in the same time period in the Great Plains. This diversity seems to represent habitat heterogeneity in Oregon in the Middle Miocene, rather than simple isolation and local adaptation. The diversity of supported habitats is to be expected in a tectonically and topographically complex landscape, but finding fossil evidence in support of this expectation shows us the quality of the ecological samples available in this well-preserved time period. This habitat heterogeneity is visible even within a single lithostratigraphic unit, as illustrated by the diverse faunal affinities of mammals from the Mascal Formation. This result makes sense in light of the suggestions of earlier workers that the diversity of mammals in the Mid-Miocene is maintained in part by a remarkable diversity of habitats during the Barstovian.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

**NEW PERMIAN AND TRIASSIC VERTEBRATES FROM TURKEY (SE ANATOLIA)**

HOSGOR, Izzet, TransAtlantic Exploration Med. Int. Pty. Ltd. - Viking Int. Ltd., Ankara, Turkey; FORTUNY, Josep, Institut Catalá de Paleontologia, Cerdanyola del Valles, Spain

Permain and Triassic vertebrates from Turkey are poorly known. From the Middle-Late Permain actinopterygians and tetrapod footprints were previously reported whereas chorodichthytes and actinopterygians are known from the Lower Triassic. Herein, we report new material from southeastern Anatolia. Recent fieldwork in this area has provided new vertebrate remains from the Middle-Late Permin of the Tanin Group and Early Triassic of the Çiğli Group, including the first occurrence of tennospondyls in Turkey. From the Tanin Group a semi-articulated specimen is here referred to Branchiosauridae, and probably represents a new taxon. The skull proportions and the high degree of ossification of the postcranial elements are indicative of an adult specimen. This clade is well known from the Early Triassic of Central Europe and Saerdania. Early Permian Branchiosauridae from Siberia, the genus *Tungstensaurus* was described in Late Permin-Early Triassic sediments but it its affinity with Branchiosauridae is controversial. The finding of a new taxon of Branchiosauridae in the Middle-Late Permain of SE Turkey has important paleobiogeographical implications, revealing a greater distribution for branchiosaurids, and will help to understand the evolutionary history of the group.

From the Early Triassic of the Çiğli Group, several teeth were recovered, mostly assignable to actinopterygians, whereas a single tooth belongs to a hybodontiform shark (Chorodichthyce). An additional dental bone with external ornamentation is referred to an indeterminate stereospondyl temnospondyl.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**FIRST OCCURRENCES OF FELIDAE AND CANIDAE (MAMMALIA: CARNIVORA) FROM THE CHITING FORMATION (PLEISTOCENE) OF SOUTHWESTERN TAIWAN**

HU, Hua-Pin, South Dakota School of Mines and Technology, Rapid City, SD, United States; PAGNAC, Darrin, South Dakota School of Mines and Technology, Rapid City, SD, United States; MARTIN, James, South Dakota School of Mines and Technology, Rapid City, SD, United States; WU, Ming-Chee, National Cheng Kung University, Tainan, Taiwan (Republic of China); FANG, Jiann-Neng, National Taiwan Museum, Taipei, Taiwan (Republic of China)

Taiwan contains abundant, diverse, and unique Pleistocene paleofaunas that have been virtually undescribed outside of the Taiwanese, Chinese and Japanese literature. Pleistocene fossils are derived from two main sources. The “Penghu Fauna” consists of remains dredged from the Penghu Channel in the Strait of Taiwan. The “Chochen Fauna” is a diverse assemblage of mammals collected at various locations in the city of Tainan, southern Taiwan. Mammalian constituents include the families Felidae, Canidae, Rhinocerotidae, Suidae, Cervidae, Bovidae, and the orders Primates and Rodentia. Absolute dating of the Chiting Formation sediments has yet to be accomplished. Specimen NTM IT04005, a partial cranium of a large pantherine felid, closely related to *Panthera tigris*, housed at the National Taiwan Museum, was recovered from the middle Pleistocene Chiting Formation near Chochen, Tainan City, Taiwan. This specimen allows for the most complete comprehensive description of a large felid specimen from Taiwan, and is one of the most complete Pleistocene specimens from southeastern China. Specimen NTM IT04005 is characterized by overall cranial size intermediate between that of the earliest Pleistocene species *Panthera zdanskyi* and modern *P. tigris*, thereby confirming previous interpretations suggesting an increase in size within *Panthera* throughout the Pleistocene. Additional diagnostic features include a massive zygomorphic arches with pronounced, laterally extended mandibular fossa, an extremely well developed sagittal crest with a thickened anterior flare, and a slender braincase and occiput. The specimen TCTM OL 0002, housed at the Tainan City T'sai-Liao Museum, consists of an incomplete portion of the dorsal skull of *Nycytereutes*. The braincase and part of the orbital and rostral regions are preserved, including the frontals, parietals, occipitals and portions of the maxillaries. The ventral portion of the braincase is broken. The anterolateral narrowing of the orbital region, the elongate braincase, the posterior flaring and vertical posterior surface of the occipital region, and the split sagittal crest are typical of *Nycytereutes*. These carnivores no longer exist in Taiwan, and their Pleistocene record in southern China is surprisingly limited in comparison to their common appearance in northern China.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

**STURGEON DORSAL OSTEODERM ONTOGENY: A TRANSFORMATIONAL MODEL FOR MARGINOCEPHALIAN SQUAMOSAL ORNAMENTS**

HORNER, Vanessa S., Ohio State University, Columbus, OH, United States; HORNER, John R., Museum of the Rockies, Bozeman, MT, United States

The squamosal and parietal border ornaments of *Triceratops* (episquamosals and epiparietals) and *Pachycephalosaurus* (squamosal spines and nodes) are hypothesized to undergo marked changes during ontogeny that includes a period of expansion and elongation proceeded by a period of reduction and shape change. A late-stage morphological shape change of a mineralized ornamental structure is highly unusual, and has led to recent arguments suggesting *Stegomoloch* to be an unlikely ontogenetic phase of *Pachycephalosaurus*. To evaluate the possibility of such a transformation, we undertook a survey of vertebrate taxa in search of osseous ornamental structures that both expanded and reduced in height or length during ontogeny. One candidate was found, the midline dorsal osteoderms of sturgeons (*Acipenseridae*), reported to grow dorsosvertically to sharp, pointed structures in juveniles, and then flatten dorsosvertically and widen as the animals reach maturity. Osteohistologic studies were undertaken of a series of sturgeon (the extant taxon *Scaphirhynchus platorynchus* and an extinct taxon, *Acipenseridae* indeterminate from the Late Cretaceous Hell Creek Formation) dorsal osteoderms to determine the process involved in height reduction. The results indicate that osteodermal transformation in the sturgeon is similar to the processes hypothesized to alter the marginoccephalian ornaments even though the overall microstructure of these ornaments are quite different. As hypothesized for the marginoccephalip ornaments, size reduction of sturgeon dorsal osteoderms coincides with a phase of osteoclastic resorption, revealed by a scalloped texture on the external surfaces near the apex of the ornaments. These scallops match the size of osteoclast cells. As osteoclasts removed mineralized tissues from the ornament apex the tissues were apparently redistributed around the periphery of the base, essentially giving the structures a flattened appearance. This study shows that although ontogenetic ornamental height reduction is unusual, it is not unknown. As hypothesized for the marginoccephalians, the ornament height reduction phase in sturgeons most likely visually signals the onset of maturity.

**EQUUS SPECIES RICHNESS IN THE RANCHOLABREAN OF THE SOUTHEASTERN U.S. COASTAL PLAIN: A QUANTITATIVE ANALYSIS OF ISOLATED CHEEK TEETH**

HULBERT Jr., Richard C., Florida Museum of Natural History, Gainesville, FL, United States

Fossils of *Equus* are very abundant in Pleistocene deposits in the southeastern USA, but consist primarily of isolated teeth and postcranial skeletal elements, not the complete skulls and mandibles favored by equid systematists. Previous workers, using relatively small sample sizes, recognized at least two and more often three Late Pleistocene species of *Equus* differing body and tooth size throughout this region during the Rancholabrean land mammal age. To answer the most basic systematic question, how many species were present...
in this region during the Rancholabrean, standard measurements were taken on over 2000 check teeth. Univariate and multivariate statistical analyses were used to determine if either the two- or three-species hypotheses was supported, or if an alternative hypothesis best explained the results. Each of the 12 cheek teeth (P2–M3 and p2–m3) was analyzed separately. Each sample was divided into four wear-stage categories by the amount of remaining crown height on each tooth relative to unworn specimens, with boundaries at 75, 50, and 25 percent of unworn crown height. The results of the analyses support the presence of only a single morphospecies of Equus in Florida and the coastal regions of Georgia and South Carolina (FL/GA/SC) during the Rancholabrean. In this region, the coefficient of variation (CV) for tooth lengths and widths for the 12 samples range between 6 and 9, while the CVs decrease to 4–8 when the samples are partitioned into wear stages. These, along with the observed ranges of these variables, are of similar magnitude as those found in well-established extant and fossil species of Equus. With few exceptions, teeth from Louisiana and Mississippi represent a morphologically similar, but much larger taxon (by about 25%) than the one found in FL/GA/SC. Samples from the intervening area in Alabama, southwestern Georgia, and western Florida remain to be analyzed to determine if there is an east to west size gradient, or a sharp boundary of demarcation between the populations of Equus in the two regions. Further work on other systematically important elements, especially metapodials, will test this novel single-species hypothesis for FL/ GA/SC Rancholabrean Equus. Based on dental characters, such as protocone shape and relative length, shape of the metacodon-metastyle complex, and depth of the ectolophid, the FL/GA/SC taxon belongs to the cabaline species-group (i.e., Equus caballus and close relatives). These results are in broad agreement with studies of ancient DNA that a single, geographically highly variable species of cabaline Equus ranged across the Americas and Eurasia in the late Pliocene.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 10:15 am)

EVOLUTIONARY DYNAMICS OF LARGE BODY SIZE IN NON-AVIAN DINOSAURS

HUNT, Gene, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; FITZJOHN, Richard, University of British Columbia, Vancouver, BC, Canada; CARRANO, Matthew T., National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

With body masses spanning at least five orders of magnitude, non-avian dinosaurs have only recently attracted the attention of scientists interested in the dynamics of body size evolution. Using femoral length as a proxy for overall body size in dinosaurs, we apply several statistical models to explore its evolution in a phylogenetic context. Targeted comparisons of specific gait models can be used to shed light on aspects of body-size evolution, and here we focus on two issues: (1) the pervasiveness of directional trends, and (2) the presence of detectable upper limits for body size. Directionality was assessed by comparing the fit of the non-directional model of Brownian motion (BM) to a scenario of BM with an underlying trend. Results indicate support for a trend of increasing body size (“Cope’s rule”) in some, but not all dinosaur clades. To assess the macroevolutionary evidence for an upper limit to dinosaur body size we compared fit of the BM model to that of BM in the presence of reflecting boundaries that forbid body sizes larger than a specified value. This latter model was fit using a novel likelihood function, and its improvement in fit relative to BM was judged using a likelihood ratio test with the null distribution generated by simulation. These analyses have found strong evidence for an upper limit to body sizes in theropods but not sauropods or ornithopods.

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 10:15 am)

ORIGIN OF THE GREATER ANTILLEAN PRIMATE FAUNA

HUNT, Kevin D., Indiana University, Bloomington, IN, United States; KAY, Richard F., Duke University, Durham, NC, United States

The timing of arrival and means of dispersal of primates in the Greater Antilles has been the subject of continued debate, mirroring the same debates for other taxa of vertebrates. Some suggest that there was a single ancient (Oligocene-Early Miocene) vicariant arrival of primates, sloths, and rodents from South America. Others argue for an alternative scenario calling for multiple cross-water dispersal events of some or all of these taxa, not necessarily at the same time. Recovery of new cranial, dental, and postcranial specimens of Antillothrix together with added data from other Antillean taxa Paralouatta and Xenotheres prompts a revised phylogenetic analysis to explore these different models. A ‘GAARlandia’ vicariance model proposes arrival by 32 million years ago. Molecular models of extant platyrhine cladogenesis suggest that the oldest crown platyrhine lived between 21 and 24 Ma. So, if Antillean primates cluster as a clade platyrhine taxa, the vicariance model would be supported. Alternatively, if different taxa link with one or another of three crown platyrhine clades (Atelidae, Pithecidae, and Cebidae) overwater dispersal would be a more likely scenario. Our phylogenetic analysis suggests first, that the extinct Antillean taxa belong to the crown clade and, second, that they are not a monophyletic group. These finding lend support to the hypothesis that primate reached the Antilles by overwater dispersal and subsequently dispersed between the islands either overwater or by vicariance.

Technical Session IX (Friday, October 19, 11:45 am)

HOW DID BOUNDING AND GALLOPING GAITS EVOLVE IN CROCODYLOMORPHA?

HUTCHINSON, John R., Royal Veterinary College, Hatfield, United Kingdom

Some Crocodylia use asymmetrical gaits, including bounding and galloping, at near-maximal speeds. It is often hypothesized that these gaits evolved within stem Crocodylomorpha, evidenced by their typically small body size, long limbs, terrestriality and changes in axial morphology (e.g. ‘paravertebral shield’ and prococye). A size constraint of embedding asymmetrical gaits has also been assumed, but few data exist on what sizes of crocodiles do use these gaits and there has been no quantitative test of how size might mechanistically limit this usage.

To address the latter questions and move toward reconstructing the evolution of asymmetrical gaits in Crocodylomorpha, experimental data (50-100 Hz video) were collected from 189 steady state locomotor cycles of 32 individuals from 15 species of Crocodylia to quantify locomotor boundaries across a wide speed range (0.15-4.4 ms⁻¹). Size-normalized speed, duty factor (% time feet on ground), relative stride frequency and length were measured for each individual cycle and statistically compared among individuals using a mixed model with individual, species, major clade, body mass and gait as factors. Additionally, log-transformed anatomical data for each of the 78 limb muscles of 18 individuals (0.13-278 kg) from 6 species underwent regression analysis (including phylogenetically independent contrasts) to quantify size-related changes in the capacity of limb muscles (e.g. physiological areas calculated from muscle mass, pennation and fascicle length) to support asymmetrical gait usage.

Gait results show that Alligatoroidea do not use asymmetrical gait, for reasons yet unknown, whereas extant Crocodylidae experience a size-related loss (under 2-4 m long).

The polarity of the evolution of asymmetrical gaits depends on the position of Gavialis within Crocodylia but fossil outgroups are also pivotal. Yet without a clear signal of which anatomical traits indicate asymmetrical gait abilities in extinct (or poorly known extant) Crocodylomorpha, this is problematic.

Scaling analysis of alligatoroid vs. crocodyliform limb muscles demonstrates that neither clade has unusual or significantly different allometry (except in a few muscles such as elbow flectors) that might support the usage of faster, asymmetrical gaits. Hence it is possible that vertebral mechanisms are key to the evolution of extreme gait in Crocodylomorpha, although other limb-based mechanisms such as muscle moment arms or physiology have not been fully tested. Until such mechanisms are more firmly established or rejected, it remains uncertain when and how asymmetrical gait evolved in the crocoid lineage or what, if any, role body size played in that transition.

Technical Session X (Friday, October 19, 9-15 am)

BODY SIZE EVOLUTION IN PERMO-TRIASSIC EUPHERIODONT AND THE EFFECTS OF THE END-PERMIAN MASS EXTINCTION

HUTTENLOCKER, Adam, University of Washington, Seattle, WA, United States; SIDOR, Christian A., University of Washington, Seattle, WA, United States; BOTHIA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa

The “Lilliput effect,” a temporary decrease in body sizes of daughter lineages observed in post-extinction communities, may be a pervasive feature of mass extinctions. Such reductions have been identified following the end-Pernian extinction (ca. 252 Ma) in Triassic marine invertebrates and anecdotally in South African temnospondyls and nonmammalian therapsids. Here, we quantify patterns of body size evolution in Permian to early-Middle Triassic euphcriodonts, an ecologically varied therapsid clade that outnumbered contemporary dicynodont herbivores in terms of species richness during the earliest Triassic and eventually gave rise to mammals. We address the question: Were there significant body size decreases in Eutheriodontia and its subclades following the end-Pernian extinction? Basal skull length (BLS) as well as femur and humerus midshaft diameter were used as proxies for relative body size. Preliminary analysis on measurements from more than 343 euphcriodont specimens suggests large maximum body sizes (BLS > 300 mm) and increasing size disparity in Late Permian Cistoccephalus and Diacyonodon assemblage zones, followed by a decrease in cranial size disparity with smaller maximum and median sizes in the Triassic Lystrosaurus Assemblage Zone. Our findings corroborate earlier results on BLS in the Permio-Triassic (P-Tr) theropod genus Moschorkinhus, which suggested significant within-lineage cranial size reductions in a P-Tr survivor lineage. More general patterns corroborate significant decreases in BLS and limb bone dimensions in euphcriodonts as a whole. Finally, to account for the effects of longer term phylogenetic trends, it is necessary to recognize potential phylogenetic constraints on observed body size patterns. In other words, are apparent body size trends stochastic or “driven” and, if driven, are they explainable by extrinsic processes (e.g., selective pressures) acting on body size distributions during the P-T transition? We explore statistical approaches including (1) regression on dissimilarity matrices (Mantel tests) and (2) model-based tree randomization procedures in order to identify the extent to which size distributions are explainable by phylogenetic distance and tree structure. Our null prediction is that size shifts are stochastic and that the effect tree structure (i.e., closely related clades should be more similar in size than phylogenetically disparate clades). However, initial results from Mantel tests indicate that size disparity correlates poorly with pairwise phylogenetic distance within the therapsid subclade. Alternatively, if extrinsinc factors accelerated rates of life history evolution across clades, then observed size distributions should show significant anti-signal in earliest Triassic clades.
Discriminating in situ from transported eggshell assemblages furthers our understanding of nesting behaviors, and behavior-like characters and any other characters. Previous research showed that one could assess the transport of skeletal assemblages by comparing the size of associated sediment with the quartz equivalent diameters of represented fossil bones. If bones and matrix sediment share similar transport properties, they may have experienced synchronous deposition. This work explores the applicability of this approach to eggshells and their fossil assemblages. We used three models based on empirically derived sediment-transport equations to estimate flow competence for eggshell deposition, and the performance of each model was tested using repetitive laboratory flume trials. Values of critical bed shear stress at deposition ($\tau_{c}$) of chicken eggshell fragments representing 1/4 to 1/2 of the whole shell were estimated using three models. Model 1 estimates $\tau_{c}$ from eggshell volume, model 2 from eggshell density, and model 3 from eggshell settling velocity. These same fragments were released in a laboratory flume with a smooth synthetic bed and bulk flow velocity decreasing downstream (gradually varied flow). The flow depth at deposition was recorded for each fragment. After calculating $\tau_{c}$ values using the flow depth, they were compared to the $\tau_{c}$ values estimated by the models. In addition, based on the measured $\tau_{c}$, we estimated the size of calcite grains expected to be synchronously deposited with our eggshells. Estimated $\tau_{c}$ values varied from those observed by 11-91%, and models 1 and 2 (11-35% negative error) performed model 3 (71-91% negative error). The performance of models 1 and 2 improved with increasing fragment size. The results indicate that existing sediment-transport equations using shell volume and density can provide reasonable estimates of the flow competence at deposition for 1/4 to 1/2 chicken eggshells. Thus, these equations support assessment of eggshell transport by comparing estimated flow competence between matrix sediment and eggshells at least over the size range employed in this study. The measured $\tau_{c}$ values (90-111 g/cm·s²) indicate that coarse quartz sand or larger may be synchronously deposited with eggshells resembling our eggshell samples. Although these methods may be applicable to fossil eggshell assemblages, further tests under natural conditions are necessary to evaluate whether they are valid analytical tools for field research.

Technical Session IX (Friday, October 19, 9:45 am)

THE EVOLUTION OF EARLY CROCODYLOMORPH DISPARITY AND LOCOMOTOR STYLES: NEW EVIDENCE FROM THE LATEST TRIASSIC OF NEW MEXICO

IRMIS, Randall B., Natural History Museum of Utah and Dept of Geology & Geophysics, University of Utah, Salt Lake City, UT, United States; NESBITT, Sterling J., Department of Biology, University of Washington, Seattle, WA, United States

Crocodylomorphs are the only pseudosuchian lineage that survived the end-Triassic extinction. The bauplan of most early Mesozoic non-crocodyliform crocodylomorphs included an upright stance, small body size (<100 kg), and are interpreted to have been generalist faunivores. Consequently, early crocodylomorphs are often stereotyped as all conforming to these characteristics, defining a single ecological role that did not vary significantly from the Late Triassic to Late Jurassic (duration of ~100 million years). Yet, some fragmentary fossils (e.g., Redondavenator and Phyllostodontus) hint at a greater ecological disparity among early crocodylomorphs. Here, we report a largely articulated new lineage that continued well into the Jurassic.
connected to hard ductwork leading to a combination High-Efficiency Particulate Air filtered cyclone plus bag house dust collector. The flexible LEV hoods are easily positioned over the rock matrix work area for efficient removal of preparation generated particles and vapors from associated chemicals. Analysis of personal exposure (breathing zone air) samples collected during various preparation tasks indicated that use of the LEV both reduced and controlled staff exposures to silica-containing dust to within permissible exposure limits established by the U.S. Occupational Safety and Health Administration. Redesign of the ductwork is needed to reduce excessive sound pressure levels, which currently necessitate hearing protection for comfort over prolonged work periods. The use of respirators is not required when using this LEV system, although staff is still enrolled in the Institution’s respiratory protection program for use when working in field conditions or at other sites without the benefit of local exhaust.

AVIAN EGGS FROM THE EOCENE CHADRON FORMATION, NEBRASKA, AND WILLWOOD FORMATION, WYOMING

JACKSON, Frank D., Montana State University, Bozeman, MT, United States; VARRICCHIO, David J., Montana State University, Bozeman, MT, United States; CORSINI, Joseph A., Eastern Oregon University, La Grande, OR, United States

Fossil avian eggs from the Paleogene of North America are rare. We describe specimens from the lower Eocene Willwood Formation of Wyoming and the upper Eocene Chadron Formation of western Nebraska. Both egg types differ from previously described specimens and therefore represent new osseipods. Four of five egg fragments from the Willwood Formation contain avian embryonic remains. The largest fragment measures 3.0 cm long x 3.7 cm wide, which represents a minimum size for this egg type. The 600 µm-thick eggshell consists of mammillary, continuous, and outer layers. The mammillary layer varies laterally from 130-160 µm in thickness, with an abrupt transition to the overlying 380 µm-thick continuous layer. A 67 µm-thick blocky external layer overlies the continuous layer. Prisms are partially or completely obscured by squamatic texture in the continuous layer. Relatively abundant, straight and narrow pores terminate in funnel-shaped openings at the shell surface. The degree of bone ossification and presence of craterted eggshell nuclei suggest that death occurred at a relatively late stage of embryonic development. The Chadron Formation egg measures 60 mm x 44 mm. The 890 µm-thick eggshell consists of a 225 µm-thick mammillary layer, 615 µm-thick continuous layer, and a 50 µm-thick external layer. Calcite cleavage planes intersect at acute angles, producing a “spayed” appearance within the mammillary and continuous layers. Prisms of the continuous layer fan outward toward the outer eggshell surface, terminating in undulating surface ornamentation. The eggshell exhibits an abrupt transition between layers and irregularly developed squamatic texture. The microstructure of the Willwood eggshell resembles that of some modern birds such as Demissoloe Crane (Anthropoides virgo) and Wild Duck (Anas platyrhynchos). In contrast, the Chadron eggshell differs from most modern eggs, and more closely resembles that of some Cretaceous non-avian theropod eggs. Shared features include irregular squamatic texture, crystal splaying, and ornamentation. Additionally, the Chadron eggshell exhibits twice the water vapor conductance predicted for an avian egg of comparable mass. These similarities may result from the presence of archaic avian eggs in the Eocene and/or convergent evolution of eggshell structure and nesting behaviors with non-avian theropods.

DISCUSSION

exception of some highly specialized flattened aquatic forms (e.g., plagiosaurs) that may have experienced hypercapnia in deep water environments. Dermal sculpturing is reduced or lost in stem amniotes that likely had the more efficient lung ventilation mode of costal aspiration, and in small-sized stem amphibians that would have been able to use the skin for gas exchange. We consider that the multi-tetrapod limbergid was an initial adaptation for terrestrial existence via the buffering of resultant acidosis; its loss reflects the acquisition of more efficient means of carbon dioxide loss in extant tetrapods and their ancestors.

ANIMALS AND THE ENVIRONMENT: EOCENE TO PALEOCEANIC TIMES

Pleistocene faunas are characterized by massive sizes including snakes, turtles, crocodiles and marine biota. However, the lack of studies is not the product of poorly preserved fossils but rather an absence of research efforts. The current research is focused on working in seven different Neotropical localities (both Panama and Colombia), including the lower Cretaceous of Zacapata, the Maastrichtian coal mines of Guadua, the Paleoceanic coal mines of Cerrejon, the late Paleoceanic-Early Eocene Bogota formation, the late Oligocene-early Pliocene of Panama, the Middle Miocene LaVenta, and the Miocene-Pliocene Castillejas formations. The overall vertebrate fossil record indicates 1) Tropical mean annual temperature (MAT) is not stable. Estimates using both a snake paleothermometer in Cerrejon and biomarkers (TEX86) indicate that MAT during the late Paleocene was ~29 Celsius, 1.5 Celsius higher than modern tropical temperatures. 2) MAT during the Early Eocene reached ~32-33 Celsius, and yet neither the mammal fauna/flora of Bogota formation shows a collapse as some global climatic models had predicted. 3) Cerrejon Paleoceanic faunas are characterized by massive sizes including snakes, turtles, crocodiles and lung-fishes. 4) Despite years of searching, no Paleoceanic mammal has been found yet. 5) Xerophytic and savanna landscape dominates the northern region of the Neotropics today, however, that was not the case until ~3-5 My ago. Faunas from Castillejas indicate a much more humid environment, suggesting a massive transformation of the neotropical landscape during the Pliocene. 6) A weak interchange between South American and North American
mammalian faunas started at ~10 My, followed by a strong interchange pulse during the latest Pliocene-early Pleistocene. In contrast, the rich fossil record of Panama indicates an active interchange of turtles, crocodiles and Boa as early as ~22 My. The fossil record of the Neotropics is vastly unexplored. Decades of paleontological exploration are still ahead of us, but the rewards will be immense as the tropics are a constant source of evolutionary innovation.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

AN ARMADILLO AND A LEG: INFERRING BEHAVIORAL DIFFERENCES OF DASYPUS BELLUS AND DASYPUS NOVEMCINCTUS FROM MORPHOLOGY OF THE CALCANEUS

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DASYPUS BELLUS (beautiful armadillo; Xenarthra), assuming it is within Dasyus, is from the Pleistocene of North America (Rancholabrean NALMA) and has often been considered identical to the extant D. novemcinctus osteologically when disregarding size. Consequently, many behavioral interpretations for the former have been derived from the latter. By comparing the calcanea of these two dasypodids, distinct osteological differences were observed including a mediolaterally-expanded astragalar facet region, an anteriorly-elongated calcaneal head, and a ventrally-elongated calcaneal foot in D. novemcinctus. Such characters were not allometric and are believed to correlate to distinct behavioral differences. We suggest that D. novemcinctus maintains a more fossorial lifestyle due to its expanded facet areas, while the larger D. bellus was likely more terrestrial, with little digging behavior. Such a disparity in lifestyle could not only explain the osteological differences present, but also why fossils of D. bellus have been recovered farther north, particularly northeast, than the present range of D. novemcinctus. A larger, more terrestrial animal could cover longer distances during periods of warm or mild weather and become acclimated to cold weather more efficiently. The osteological variances, however, are only a preliminary look into possible differences between these dasypodids. If D. bellus did behave differently than D. novemcinctus, interpretations based on fossils of Dasyus, and the fossil identities themselves, may need to be re-evaluated to find how these two taxa are related behaviorally, geographically and temporally. Previous conclusions that D. novemcinctus and D. bellus were behaviorally and ecologically the same are possibly incorrect based on our data, and should be re-assessed. This study adds further support to the growing trend of using caution when making inferences about extinct taxa based on extant relatives.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

NEW QUATERNARY VERTEBRATE RECORDS FROM CAVE DEPOSITS IN JASPER NATIONAL PARK, ALBERTA, CANADA

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Sedimentary cave deposits in western Canada are an important source of Quaternary vertebrate remains. They are especially important because they often preserve remains of small vertebrates that are rarely recovered from other depositional settings (e.g., sand and gravel deposits). Recent paleontological reconnaissance and fieldwork at three cave localities in Jasper National Park is improving our understanding of late Quaternary faunas in western portions of Alberta. Two of the localities, Disaster Point Cave and Procrastination Pot, are situated in close proximity to one another in the Front Ranges of the Canadian Rocky Mountains. The third locality, Ice Trap Cave, is situated above tree-line in a remote region of the Canadian Rocky Mountains.

On-going reconnaissance at Procrastination Pot and Ice Trap Cave indicate that both sites preserve paleontological remains that further contribute to our understanding of post-glacial biotas in mountainous regions of western Canada. Identified surface remains preserved inside Procrastination Pot include Ursus, cf. Ovis, and cf. Marmota. Chirotepar remains are abundant at Procrastination Pot and the cave currently acts as a hibernaculum. Ice Trap Cave preserves soft tissue remains of marmots (Marmota sp.) in addition to deposits of rodent dung. Rodent dung collected near the surface of organic deposits at Ice Trap Cave was radiocarbon dated to 9600 ± 40 yr BP.

Excavation of fossiliferous sediments at Disaster Point Cave took place in 2010 and focused on an area known as the Terminal Dig. Recovered mammals include carnivorans (Mustela), rodents (Arvicolines, Muridae, Sciuridae, cf. Heteromyidae), and shrews (Sorex). Amphibians (anurans, salamanders) comprise a significant portion of the recovered fauna. AMS radiocarbon dates of 1700 ± 30 yr BP and 2650 ± 30 yr BP on charcoal collected from stratified sediments suggest a late Holocene age for the fauna from the Terminal Dig. A slightly older AMS radiocarbon date (6090 ± 40 yr BP) on bone collagen from a pelvis of Ursus americanus, provides the current known maximum age for fauna preserved in the cave.

Technical Session XII (Friday, October 19, 1:45-5:45 pm)

TWO NEW EARLY TRIASSIC MARINE REPTILES FROM CHAOHU, ANHUI PROVINCE, SOUTH CHINA

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The Xingyi Fauna is the first well preserved marine reptile fauna reported from the late Ladinian to date. Eight valid marine reptile taxa have hitherto been reported, including the thalattosauurs Anhuiosaurus wushanensis, sauropterygians Glyphodermida, Tanystropheus novemcinctus, and protorosauras Macronectes cf. M. fuyuanensis and Tanytrophos cf. T. longobardicus. However, most specimens lack exact stratigraphic and geographic data.

A scientific excavation has been carried out since August of 2011 at the Naimaig Village of Wusha District, Xingyi City, Guizhou Province and has yielded over 300 reptilian remains in the 28 layers (layer 26 to layer 53) of the 5.2m – 5.9m thick beds out of the 96m-thick Zhuganpo Member of the Faling Formation. The Xingyi Fauna is mainly represented by Keichousaurus with a continuous occurrence between layers 26 and 44. Research on the ammonoids above the fossil layer suggested a latest Ladinian age. The new findings included two ichthysaurs (Guizhouchitysaurus and Qianichthysaurus) and thalattosaurus that were collected from the upper bed of the fossiliferous layer (layer 42 to layer 53), revealing close affinity to the younger Guantling Biota (Carnian, Late Triassic). Contrarily, the sauropterygian material only appears in the lower bed of the fossiliferous level including nothosauras (layer 30), ptyostegus (layer 36) and Keichousaurus (layer 26 to layer 44), which are typical Middle Triassic members. Therefore, it is possible that Xingyi Fauna displays a transition of marine reptile faunas and will provide new information on the reconstruction of the paleoecology and paleoenvironment.

Within the Xingyi Fauna, the durophagous member Glyphodermida only represents up to 10 of 10 species while the ratio is 5 out of 15 in the Panxian-Luoping Fauna and 5 out of 9 in the Guanling Biota. The biodiversity of the Xingyi Fauna is highly in accordance with the recent hypothesis on the positive correlation between taxonomic abundance of durophages and sea level change possibly resulted from the remarkable sea level drop during the late Ladinian.
neumilleri and original descriptions, and subsequent treatments, do not support generic distinctions between H. pembinensis. Hainosaurus (upper Campanian, Manitoba, Canada) was assigned to the genus, H. pembinensis. Recent, a new species of North American tylosaurine was also assigned to Hainosaurus neumilleri. Redescription and revision of materials of H. pembinensis resulted in its generic realignment to Tylosaurus. Examination of the materials of available Belgian hainosaurs reveals that the diagnostic characters cited in original descriptions, and subsequent treatments, do not support generic distinctions between Hainosaurus and Tylosaurus. Tylosaurus neumilleri has not yet been examined by us, but if the genus is a junior synonym of Tylosaurus, as we propose, than the relevant question concerning H. neumilleri is its species level distinction within Tylosaurus. Key characters considered to support generic distinction include the position of the pineal foramen, the shape of the maxilla/premaxilla suture, and characteristics of teeth and quadrate. Our observations of these diagnostic characters do not support such distinctions. For example, we recognize variability in the position of the pineal opening within the genus Tylosaurus (e.g. T. kansanensis). T. neumilleri (723, including germain and deformed teeth) that is identical to the claims made for Hainosaurus. The maxilla/premaxilla suture seam is sinuous (zig-zagged), and the quadrate presents a prominent internal supra-stapedial process, both features being reported in genus Tylosaurus, as well. The remaining Northern and Southern Hemisphere tylosaurines have all been assigned to the genus Tanisivosaurus and are genetically distinct from either Hainosaurus and Tylosaurus.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

SHARKS FROM THE GERALDINE BONEBED, LOWER PERMIAN OF TEXAS
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The Geraldine Bonebed was discovered by A. S. Romer in 1932. It eventually yielded a large number of mostly complete skeletons of four tetrapod taxa, for which it is famous, and also a diverse flora as well as other vertebrates. It occurs in the Nocona Formation, Wichita Group, Sakmarian age. With the help of Bill May (Norman, Oklahoma), bulk samples of matrix were screen-washed and sorted to produce a variety of vertebrate microfossils, including sharks (SMU 60694, 76093-76714, 76717), especially xenacanthids. The non-xenacanth sharks are rare and include a pelodont tooth (Janassia?), Helodus sp. (2 teeth), and four partial hybodont teeth (probably representing 3 species). These are all considerably more common in the Wichita Group. Among the xenacanthids are two typically small Xenacanthus sp. occipital spine fragments, two Orcahcanthus sp. occipital spine fragments (one small, one very small) and hundreds of Orcahcanthus teeth. Orcahcanthus texensis teeth are much larger than O. texensis, and Orcahcanthus texensis teeth have been recovered in the Nocona Formation. Two complete skull and four partial hybodont teeth (75). Measurements (antemorial-posteralateral length vs. labial-lingual width of the base as seen in aboral view) of random samples of these teeth yielded the following results: for O. texensis (n = 141), mean length = 3.15 mm, mean width = 3.49 mm, with a range of 1.12-9.80 mm (length) and 1.18-11.27 mm (width); for O. platypterus (n = 35), mean length = 2.63 mm, mean width = 1.90 mm, with a range of 0.84-5.39 mm (length) and 0.72-4.49 mm (width). A linear regression analysis of these data (weight on length, with 95% confidence intervals) resulted in a slope of 0.11 ± 0.04 and y-intercept of -0.03 ± 0.13 mm for O. texensis and a slope of 0.68 ± 0.08 and y-intercept of 0.10 ± 0.23 mm for O. platypterus. Both data sets are comparable to those higher in the Wichita Group for these species. With one possible exception (the exact locality cannot be confirmed), O. texensis and O. platypterus are not known to occur below the Nocona Formation in Texas, nor are they anywhere older than Sakmarian age.

Posterm Session I (Wednesday, October 17, 4:15 - 6:15 pm)

A FUNCTIONAL INTERPRETATION OF THE CRANIAL SUTURE MORPHOLOGY IN CAPTORHINUS AGUTI (REPTILIA)
JONES, Marc E., UCL, University College London, London, United Kingdom; ZIKMUND, Tomas, Queen Mary’s School of Medicine & Dentistry, London, United Kingdom; WOOLHOUSE, Michael J., University College London, London, United Kingdom; WOOD, David, University College London, London, United Kingdom

Captorhinus aguti from Tanzania and undescribed taxa from Zambia and South Africa. Perianaptinophromorphs were geographically widespread and showed diversity in body size, skull shape, and dental apparatus. Captorhinus aguti is one of the best known representatives of the group, having been described in detail from complete skulls and partial elements. However, the detailed structure of certain cranial joints (e.g. lacrimal-prefrontal) remains poorly known and the functional implications of the overall joint arrangement has not been fully explored. We surveyed a range of cranial material from Fort Sill, Oklahoma, USA, (Arroyo Formation) referred to Captorhinus aguti using binocular microscopy, micro Computed Tomography (CT), and Scanning Electron Microscopy to examine the cranial joints in greater detail. Many of the peripheral cranial joints involve broad overlaps occasionally terminating in serrated edges whereas other joints involve more complex interdigitations such as those closer to or along the midline. The lacrimal-prefrontal joint has been considered of particular interest to the functional morphology of early amniotes because of its location above the dental arcade and in front of the orbit. When the constituent elements of Captorhinus are found in isolation the corresponding facets are invariably damaged. However, a mico CT computer model of an articulated lacrimal and prefrontal demonstrates that in this taxon the joint is more complex than previously appreciated and may have served a key role in accommodating stresses transmitted from the dental arcade to the facial bones. It involves several interdigitating plates of bone which are particularly large in the medial part of the joint. A dorsal view of the lacrimal facet shows that the plates are orientated as if to radiate from a postero-lateral to the postero-lateral corner of the nasal cavity. Any micromovement within the joint must have occurred in the dorsoventral plane (in parallel to the long axis of the plates) or these plates would be vulnerable to breakage. The successive overlaps would provide a large surface area for collagen fibres running between the facet surfaces. These would resist or dampen movement in a dorsoventral direction. A compressive loading of this kind is likely to arise during feeding when the maxillary dentition meets resistance. Comparisons with testudinids and lepidosauria show a greater overall similarity to the joint complexity of testudinids, an observation that may have implications relating to skull fenestration and muscle arrangement.

Technical Session XVII (Saturday, October 20, 2:15 pm)

TURNING IN THERIOPODS
KAMBI, Peter E., Brown University, Providence, RI, United States; GATESY, Stephen M., Brown University, Providence, RI, United States

In extant animals, maneuvering plays a crucial role in navigating complex terrain, finding food, or escaping predators; extinct theropods were likely no exception. Despite its importance, maneuvering’s complexity and intermittent nature have resulted in little study compared to steady locomotion. In this study, we used the helmeted guineafowl, (Numida meleagris) to study one type of maneuvering: turning to face a new direction while standing. We used bipolar cineradiography and radiopaque bone markers to acquire high-resolution six degree of freedom segment kinematics. Observed turns rely primarily on long axis rotation of the femur or tibiotarsus to reposition the foot medially laterally. At the hip, the antitrochanter likely limits abduction while the bicondylar shape of the knee prevents abduction/adduction. Limiting this degree of freedom requires the use of long axis rotation. Further analysis of the guineafowl hindlimb should help provide the link between joint shape and soft tissue anatomy and range of motion. For instance, relatively thin condyles and long collateral ligaments at the knee may signal large long axis range of motion. We hypothesize that almost full reliance on long axis rotation in an avian feature while extinct theropods with more erect posture used a combination of abduction/adduction and long axis rotation at the hip. Abduction/adduction at the hip is hypothesized to decrease in importance on the line from primitive archosaurs to birds. Data such as these provide the functional and mechanical perspective needed to infer the behavior of extinct theropods.

PERMIAN ORIGINS OF THE POST-EXTINCTION THERAPSID RECOVERY FAUNA
KAMMERER, Christian F., Museum für Naturkunde, Berlin, Germany; FRÖHISCH, Jörn, Museum für Naturkunde, Berlin, Germany; ANGIELCZYK, Kenneth D., Field Museum of Natural History, Chicago, IL, United States; SMITH, Roger M., Iziko, the South African Museum, Cape Town, South Africa

The Permo-Triassic mass extinction caused total reorganization of the terrestrial vertebrate fauna, with therapsids experiencing nearly complete turnover. The Early Triassic therapsid recovery fauna characterizes a brief interval dominated by highly autapomorphic clades like Lystrosauridae. Previous hypotheses for the origin of the therapsid recovery fauna supposed that these clades either originated post-extinction or invaded fossiliferous basins from elsewhere in Pangaea. Though some species must have originated post-extinction, new discoveries and reexamination of poorly-known taxa reveal that the typical clades of the recovery fauna extend well into the Late Permian. These results contradict the prevailing view of acute extinction followed by rapid recovery—Early Triassic records represent lineage survival across the boundary rather than post-extinction radiation. Four dicynodont clades are known in the Triassic: lystrosaurids and kannemeyeriiform dicynodonts and kingioids and myosaurid emydopoids. Previous research has demonstrated that two species of the quintessential therapsid disaster taxon Lystrosaurus, traditionally considered an index fossil for the start of the Triassic, appear in the terminal Permian. These species already exhibit the extreme Lystrosaurus cranial morphology, however—our research reveals an expanded Lystrosauridae stretching back to at least the Cistecephalus Assemblage Zone: Eptychognathus from Tanzania and undescribed taxa from Zambia and South Africa. These undescribed taxa are very similar to Lystrosaurus but with a narrow intertemporal bar, helping to bridge the morphological divide between other dicynodontoids and the Lystrosaurus lineage. In Emydopoida, the recent discovery of Early Triassic Kombuisia has filled the former Permian-to-Middle Triassic kingioid ghost lineage. Additionally, a new species of the enigmatic dicynodont Emydorhinus from near the Permo-Triassic boundary reveals that this taxon forms the sister-group of the Early Triassic Myosaurus. Within theriodonts, akidognathid and bauriod theropod clades include genera that cross the extinction boundary. In cynodonts, phylogenetic study of the rare Permian taxon Nanictosaurus supports its placement as an eucynodontid, dragging this predominantly Triassic group back beyond the boundary. These records show that, at least in southern Africa, the therapsid clades making up the post-extinction recovery fauna were already present but rare in the terminal Permian. Autapomorphic morphological features of these...
clades predate the extinction and thus cannot be extinction responses. Most elements of the recovery fauna do not survive beyond the Early Triassic—ancestors of the post-recovery fauna (eucyprinodonts, kannemeyeriforms) remain elusive.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

**ARTIFICAL CHEWING WITH REAL TEETH**

**KARME**, Aleksi, University of Helsinki, Helsinki, Finland; **KALLONEN**, Aki, University of Helsinki, Helsinki, Finland; **GALAMBOSI**, Szabolcs, University of Helsinki, Helsinki, Finland; **ENGSTRÖM**, Pauli, University of Helsinki, Helsinki, Finland; **FORTELIUS**, Mikael, University of Helsinki, Helsinki, Finland

In remarkable contrast to the widespread use of tooth wear in paleodiet and paleoenvironment reconstruction there has been very little experimental study of the causes of different tooth wear types. We have therefore built an artificial chewing apparatus for simulating wear on real teeth under controlled circumstances of mechanical mastication. The core design principle of the machine is repeated, full-occlusion single stroke movement. The majority of the device design was done with CAD-modelling, and the needed parts were then milled from stainless steel. The electric motor and power source were selected to be easily obtainable and affordable. An in-house designed water-cooling system for the motor was built to facilitate long-term testing and allow high number of chewing cycle repetitions. Full adjustment of the occlusion and chewing force are available for experiments. The setup is reasonably sized, weighing in total less than 5 kg, which in addition to the affordability of the component parts should allow easy and flexible use.

Teeth worn with the chewing machine were first cut straight and polished to a flat and even “occlusal” surface for the initial experiments. Horse teeth were selected for their hypodontology and compact structure, with enamel, dentine and cement almost uniformly distributed along the tooth’s height. Mastication was performed with and without abrasive substances. Mastication without abrasive substances was done in a pure water medium, whereas a viscous glycerin-based liquid was used to keep the particles in suspension when abrasive substances were introduced.

Teeth were subjected to over 200,000 chews during a time span of 60 hours. Results were estimated visually and quantitatively using 3D-scann data. Elevation, slope, aspect and facet development were quantified and estimated from the worn surface using GIS techniques. In pure attrition, tooth against tooth, facet development and differential wear to dentine, cement and enamel was observed, whereas in abrasion results were dominated by the added particles, which induced rounded wear surfaces and clear overwriting striations.

**Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)**

**LATE OLIGOCENE BEAVER (CASTORIDAE, RODENTIA) FROM WESTERN JAPAN**

**KATO**, Takafumi, Kurashiki University of Science and the Arts, Kurashiki, Japan

The late Oligocene to early Miocene rodents found in Nagasaki Prefecture, Kyushu, Japan, have been identified as belonging to the following 3 taxa: (1) *Steneofiber* sp. from the late Oligocene Sasebo Group, (2) *Youngofiber* sp. and (3) *Diatomys shantungensis* from the early Miocene Nojima Group. These Miocene species are considered endemic taxa distributed in China and Japan. In contrast, *Steneofiber* is a European genus that is not known to be from the late Oligocene in China.

Recently, additional specimens of *Steneofiber* were found in the basal part of the Fukui Formation of the Sasebo Group of Sasebo City, Nagasaki Prefecture. The fossiliferous layer is approximately 1 m thick, containing pebbly transgressive lag deposit unconformably overlying the coeval-boring non-marine shale and sandstone of the Suchiburi Formation of the Sasebo Group. The new material of *Steneofiber* is represented by seven isolated cheek teeth and seven incisors probably belonging to the same species, associated with fragmentary skeletal remains of antherocephalans, rhinocerotids, and tortoises.

The materials exhibit the following features: semi-hypsodont teeth completely devoid of cement, relatively simple enamel pattern with uncomplicated fossettes, round and broad fossettes and flexi, parastrail absent on P4, long and curved mesoflexus (or mesosoffette) almost reaching the posterior end of the crown, short and broad hypoflexus, and an additional fossette between the parafossette and the mesoflexus. These dental characters are similar to the late Oligocene species *S. dehmi* but are different from the simpler enamel pattern. These specimens might be a new species of *Steneofiber*.

During the late Oligocene and early Miocene periods, the number of Castoridae genera and species increased and became widespread in the Northern Hemisphere. The occurrence of Japanese Oligo-Miocene beavers probably reflects this episode.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**A PALEOECOLOGICAL ANALYSIS OF LATE PLEISTOCENE CERVID REMAINS FROM GUY WILSON CAVE, SOUTHERN APPALACHIANS, TENNESSEE**

**KAUFMAN**, Amanda K., East Tennessee State University, Johnson City, TN, United States; **SCHUBERT**, Blaine W., East Tennessee State University, Johnson City, TN, United States; **DESANTIS**, Larisa R., Vanderbilt University, Nashville, TN, United States

The paleoecology of late Pleistocene cervids at Guy Wilson Cave is based on 1) systematic identification of cervid material, 2) taphonomic analysis with a focus on carnivore utilization and 3) carbon isotope proxies from modern and fossil cervids and fossil herbivore tooth enamel (θ-C). Systematic identification reveals that there are four to five cervid taxa in the cave fauna based on dental remains: *Odocoileus* cf. *O. virginianus*, *Rangifer tarandus*, *Cervus*, and *Cervulae/Ales*. Taxonomic separation of *Cervulae/Ales* was not possible given the fossil material, and no dental characters were found to separate the two living species of *Odocoileus*. Taphonomic analysis of gnawing and tooth markings shows alterations consistent with a canid predator, and the overall pattern suggests full-heavy utilization and possible scavenging activity. A likely candidate for this modification is the dire wolf, *Canis dirus*, and the cave appears to have served as a den. Isotopic analysis of the community shows that taxa were feeding in a dominantly C4 environment, as all δ13C values are less than -8‰, values of *Odocoileus* (-13.6‰ to -15.4‰) also suggest a relatively dense canopied temperate forest. Even horses have isotopic values (-11‰ and -21.1‰) consistent with the consumption of primarily C4 vegetation, potentially C4 trees/shrubs or C4 grasses. Extant *Odocoileus* from Sullivan County, TN has δ13C values (-13.2‰ to -17.2‰) that are not significantly different from Guy Wilson Cave *Odocoileus*, suggesting that dietary niches in these deer may have been consistent from the late Pleistocene to today in this region. Although the maintenance of similar dietary niches from glacial to interglacial periods is in contrast to what occurs in Florida, a relatively stable forested environment in the Appalachians may be responsible for similar dietary niches in *Odocoileus* over time.

**Technical Session VIII (Thursday, October 18, 3:00 pm)**

**THE PALEOENVIRONMENT AND PALEOECOLOGY OF THE COASTAL SOUTHEASTERN SANTA CRUZ FORMATION (LATE EARLY MIocene, ARGENTINA)**

**KAY**, Richard F., Duke University, Durham, NC, United States; **VIZCAINO**, Sergio F., Museo de La Plata, La Plata, Argentina; **BARGO**, M. S., Museo de La Plata, La Plata, Argentina

The paleoenvironment and paleoecology of the Santa Cruz Formation (SCF) is summarized, combining the data from 10 field seasons with a new examination of the community structure of the vertebrate fauna using modern analogs. Emphasis is placed on the SCF outcrops along the coastal Atlantic between about 50°30' and 51°6'S and their faunas (Sanctuaricum SALMA). SCF Fossil Levels (FL) 1–7 south of the Rio Coyle range between -17.4 to 17.5 Ma and are considered analogous to a single modern fauna of limited geographic and temporal scope. As paleolatitude during Sanctuaricum times was the same as that of today, FL 1–7 was extratropical and had highly seasonal daylengths. The Andes had not yet risen to a sufficient altitude to have modulated the climate as the Atlantic coast, nor had the Middle Miocene global climatic cooling begun. Several taxa recovered at FL 1–7 or in nearby penecontemporaneous levels (e.g. palm trees, the frog *Calyptocephalella*, the lizard *Tropinambis*, the anteater *Promatamandua*, and the primate *Homunculus*) strongly indicate that the climate of FL 1–7 was much warmer and wetter than today. The overall mammalian species richness and niche composition, expressed as percentages of arboresal or scansional, frugivorous, and grazing, suggest that overall rainfall was in the range of 1000 to 1500 mm per annum. Occurrence of trees and forest-dwelling birds and mammals (porcupines, spiny rats, sloths, scansional marsupials, and monkeys) supports this conclusion. The occurrence of calcareous root casts in paleosols indicates high seasonality in rainfall with cool wet winters and dry warm summers. Grasses were also present, and a number of vertebrate taxa (giant terrestrial birds, many nontongulates, glyptodonts, and armadillos) appear to have been adapted to open environments. Sedimentology, ichnology, floral, and faunal elements taken together suggest a landscape for FL 1–7 consisting of a mosaic of open temperate humid and semi-arid forests, with ponds in some areas and seasonal flooding in others, no doubt promoting the formation of marshlands with a mixture of grasses and forbes.

**Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)**

**STYLiUS SHARPENING INSTRUMENT FOR FOSSIL PREPARATION**

**KAZUMI**, Wada, Museum of Nature and Human Activities, Sanda, Hyogo, Japan; **AIKIO**, Akiko, The Field Museum, Chicago, IL, United States

Air scribes and pin vises fitted with carbide needles are commonly used to prepare vertebrate fossils but the stylius-point becomes dull or breaks over time. Styli are traditionally sharpened manually with a hand-held or a desk top rotary tool fitted with a diamond grinding disc. These manual sharpening processes are imprecise and the resultant stylet of the newly sharpened stylius is off-center. This can cause inaccuracy and inefficiency in the preparation of fossils. To overcome the imprecision of manual sharpening processes, a stylius sharpening instrument can be custom built from locally available and inexpensive parts. The instrument is composed of two assemblies each with a variable speed hand-drill motor mounted on a base board. Three styli shaft holders that are aligned and fixed to the base board hold a stylius in a stable position. The positions of holders are adjustable depending on the length of styli. The first motor rotates the stylius through an O-ring belt connecting the motor’s main shaft to a rubber pulley which is attached to the stylius. Different sized pulleys are used according to the stylius’ diameter. The second motor powers a grinding disc, and this grinding assembly is attached to the base board with a swivel mount that allows the operator to pivot the assembly freely. The grinding assembly has two operator handles to enable the operator to sharpen the stylius to a desired angle. Preparators in the Dinosaur Laboratory of Museum of Nature and Human Activities use a 3/4 inch 400 grit double-sided diamond cut-off wheel.
for sharpening styli, but grinding discs of various grit size and diameter can also be mounted on this assembly. The motors are powered by rechargeable batteries so that the instrument is portable in the laboratory and at excavation sites. A plexiglass cover is mounted over the grinding parts for safety. This instrument allows preparators to easily and safely sharpen styli with precise, centered points.

Preparators’ Session (Thursday, October 18, 8:00 am)

FEATHERING DINOSAURS
KEILLOR, Tyler, University of Chicago, Chicago, IL, United States

Recent fossil discoveries have amplified our knowledge of varied dinosaur integument. Preserved scales, filaments and feathers have supplied a wealth of reference that artists endeavor to incorporate into reconstructions of new specimens. A variety of techniques have been employed to create sculptural flesh-models with unusual integumentary coverings. Coats of feathers and feathers can be sculpted in relief, creating hard models of these soft features. Alternatively, feathers, flocking, and other delicate mixed media, such as acrylic sheets and nylon monofilament can be used to create the coverings for a life reconstruction. A survey of the methods and materials currently used by a variety of artists and technicians will be presented.

Technical Session XIV (Saturday, October 20, 11:30 am)

A NEW LOWER TRIASSIC ICHTHYOPTERYGIAN FAUNA FROM FOSSIL HILL, NEVADA
KELLEY, Neil P., University of California, Davis, Davis, CA, United States; MOTANI, Ryosuke, University of California, Davis, Davis, CA, United States; EMBREE, Patrick G., Orangevale, CA, United States

Beginning with discoveries in the 19th Century, Nevada has been an important source of Triassic ichthyopterygian fossils. However, to date it was not known whether ichthyopterygians were present in the region in the Early Triassic, during the earliest phase of ichthyopterygian evolution. We investigated Lower Triassic rocks at the famous Fossil Hill locality in Pershing County, Nevada and identified a previously unrecognized ichthyopterygian fauna. The Anisian (Middle Triassic) Fossil Hill Member of the Prida Formation in the Humboldt Mountain Range, and stratigraphically equivalent horizons in the Favret Formation in the adjacent Augusta Mountain Range, are characterized by a rich marine reptile fauna comprising the ichthyosaurs genera Cymbospondylus, Mixosaurus and Phalarodon together with the saurichthyan Augustasaurus and the enigmatic reptile Onchopristis as well as some amphibians and other vertebrates. Recent fragmentary ichthyopterygian fossils have been discovered in the lowest levels of the Prida Formation at the historic Fossil Hill locality. These levels are Spathian (Lower Triassic) in age based on invertebrate index fossils and sit stratigraphically below the diverse Anisian assemblage of the Fossil Hill Member and above microbialite dominated facies typical of the “delayed recovery interval” that characterizes the earliest Triassic. Although all specimens collected to date are fragmentary, distinctive tooth morphologies indicate that multiple species of ichthyosaur were present and permit comparison to known Lower Triassic ichthyopterygian taxa. The presence of an *Uratessaurus*-like form, and a *Chaoshaurus* / *Grippia*-like form suggests faunal similarity with Lower Triassic assemblages from Canada and to a lesser extent, Spitsbergen, Japan and China. Taken together, these comparably aged localities indicate biotic dispersal of relatively small-bodied ichthyopterygians across northern Panthalassa during the earliest known phase of their evolution, shortly after the recovery of marine ecosystems from the end-Permian mass extinction. Further work in this and other Lower Triassic localities will provide important opportunities to better understand early ichthyopterygian evolution and potentially pinpoint the stratigraphic, paleogeographic and paleoecological context of their origin.

Technical Session IV (Wednesday, October 17, 2:15 pm)

NEW EVIDENCE ON THE PTEROID ARTICULATION AND ORIENTATION IN PTEROSAURS
KELLNER, Alexander W., Laboratory of Systematics and Taphonomy of Fossil Vertebrates, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; COSTA, Fabiana R., Laboratory of Systematics and Taphonomy of Fossil Vertebrates, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; RODRIGUES, Taissa, Departamento de Medicina Veterinária; Universidade Federal do Espírito Santo, Alegre, Brazil

The pteroid is a long, rod-like element whose position, function and orientation have been much debated without reaching a consensus. These debates are focused mostly on whether or not this bone supports the propatagium by being directed forward during flight in an anterior orientation or being medially oriented in a more parallel position to the edge of the wing. These hypotheses are mainly based on indirect anatomical evidence and aerodynamic models of performance. The first hypothesis leads to a broad forewing acting as a leading edge flap, suggesting a higher aerodynamic efficiency, while the second one implies a narrower forewing. Paramount to this question is the articulation of the pteroid to the carpals that has been the subject of debate. A long-held view suggests that this bone articulates with the distal fovea of the preaxial carpal. An opposing interpretation argues that the pteroid was articulated to the lateral side of the preaxial carpal, with a small semiasidium filling out the fovea carpalis. An alternative proposal followed, in which the pteroid would actually articulate with the proximal syncarpals, but this remained controversial and was not universally accepted. The main problem is that this bone is normally found disarticulated and displaced from its natural anatomical position. New exquisitely preserved specimens from the Romualdo Formation (Albian) of Brazil can settle this question. Some show a distinct articulation surface on the dorsal region of the proximal syncarpal, close to the articular facet for the radius. This feature is observed in both anhanguerids and tapejarids and is the strongest candidate for the articulation of the pteroid. Among the most interesting material is a specimen that represents the almost complete wings of an anhanguerid individual and possesses the pteroid directly in articulation with the proximal syncarpal. As the proximal carpalis are fused into a proximal syncarpal in osteologically mature specimens, this position constrains the pteroid to a more medial orientation regarding the edge of the wing, avoiding subjecting this bone to heavy loads if it would have been projected anteriorly.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

IS MODAL BODY SIZE AN EVOLUTIONARY ATTRACTION? ANOLIS AS A CASE STUDY
KEMP, Melissa E., Stanford University, Stanford, CA, United States; HADLY, Elizabeth A., Stanford University, Stanford, CA, United States

Many explanations for patterns of body size diversification exist; principal among them is the idea of modal body size acting as an evolutionary attractor. The speciose lizard genus *Anolis* serves as an exemplary system to test this hypothesis and investigate whether the biotic environment affects the ability of taxa to converge on modal body size. We focus on anoles restricted to the Lesser Antilles that have a modal body size corresponding to the purportedly optimal solitary status, in addition to two other size classes that are found when species co-occur. We use phylogenetic independent contrasts to reconstruct body size for ancestral lineages and infer directionality of size evolution. While the distributions of these three size classes are significantly different from one another, we find that the Lesser Antillean anoles are not evolving towards the modal body size even when we account for competition. However, body size appears to be constrained by the modal size even though large lineages get larger and small lineages get smaller. These data suggest an important role for competition in driving macroevolutionary trends in body size, in addition to other forces operating at higher taxonomic levels.

Technical Session III (Friday, October 19, 4:15 - 6:15 pm)

A GEOMETRIC AND KINEMATIC BACKBONE MODEL OF THE CHEATAH, ACINONYX JUBATUS, AND ITS APPLICATION TO UNDERSTANDING THE SPINAL KINETICS OF MIRACINONYX TRUMANI
KIMBERLEY, Natalia K., University of California, Los Angeles, Los Angeles, CA, United States; BHATT, Roopak, University of California, Los Angeles, Los Angeles, CA, United States

Cheetahs are the fastest land animals, partly due to their spinal flexibility. Surprisingly, there has never been a detailed study of the musculoskeletal anatomy and function of its vertebral column despite the obvious contributions it makes to cheetah speed through extreme flexion and extension. Using anatomical data, radiographs, and 3-D laser scanning, a geometric and kinematic computer model of the vertebral column of the cheetah was produced. This model allows a clearer understanding of the spinal flexibility of the cheetah, as well as which specific areas are fundamental in providing the vertebral column flexibility necessary for fast running.

Based on 3-D scans of fossils, the model will be modified to investigate the flexibility of the spine of an extinct North American cheetah-like cat, *Miracinonyx trumanii*. This will demonstrate whether there are short, specific areas of the vertebral column that serve as indicators of overall spinal flexibility. If so, this would allow paleontologists to infer the spinal flexibility, and by extension speed and paleoecology, of extinct felids with only a few vertebrae. This technique will allow for more information to be gleaned from those incomplete specimens than was previously possible.

Technical Session XVI (Saturday, October 20, 11:30 am)

ISOTOPIC DIETARY SIGNALS IN MURINE ROBENTS FROM THE NEOGENE SIWALIK GROUP LAGS LARGE MAMMALS BY ONE MILLION YEARS
KAKAD, A., Yuri, Southern Methodist University, Dallas, TX, United States; UNO, Kevin T., University of Utah, Salt Lake City, UT, United States; CERLING, Thure E., University of Utah, Salt Lake City, UT, United States; PATNAIK, Rajeev, Panjab University, Panjab, India

The Neogene Siwalik formations of northern Pakistan and India comprise a long depositional sequence of fluvial deposits and contain vertebrate fossils ranging in age from 18 to less than 1 Ma. Carbon isotopes of soil carbonates and large mammal teeth from this interval document an ecological shift from C3-dominated woodlands to C4-dominated grasslands between 8.5 and 6.0 Ma. Here we compile carbon isotope data of true mice and rat (Rodentia) teeth, using laser ablation GC-IRMS, from northern Pakistan (13.8 Ma to 6.5 Ma), northern India (2.5 to 2 Ma), and Recent species of both regions. This study relates carbon isotope ratios with morphological traits in murine molars. Because Siwalik murine diversity primarily resulted from in-situ evolution in northern Pakistan rather than immigration, we tested the hypothesis that murines shifted dietary niche in response to a change in food source in a pattern similar to that of large mammals. Alternatively, the small home range of mice may have enabled them to persist in fragmented patches of desirable vegetation during the transition from a C3 to a C4 ecosystem. In this case, an expected dietary shift indicated by isotopes would be delayed in comparison to large mammals.
Carbon isotope data obtained from more than 70 lower first molars were associated with dental measurements. Preliminary results show: (1) the carbon isotope record of murines differs from that of large mammals in that the carbon isotope values become abruptly more positive with a broader range at 7.4 Ma, whereas large mammals began the shift at 8.5 Ma, (2) larger murine species generally have more positive carbon isotope values than smaller species between 9.2 and 6.5 Ma, (3) the difference in isotope means of pre-defined taxa at a given locality are statistically significant at 8.2 Ma and increase in value at 7.4 Ma. They indicate that differences in diet in Siwalik murines can be recognized by 9.2 Ma, but that the major shift attributed to C4 vegetation occurs later in murines than in large mammals.

In addition, the pattern of isotopic change in murines is more similar to that seen in Siwalik palaeoelaphs than in large mammals, suggesting that like palaeoelaphs, which reflect overlying vegetation, the small home range of murines results in more precise resolution of past ecological conditions than large mammals.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

PHYLLOGENETIC PLACEMENT OF PANTHERA ATROX BASED ON CRANIAL MANDIBULAR CHARACTERS

KING, Leigha M., East Tennessee State University, Johnson City, TN, United States; WALLACE, Steven C., East Tennessee State University, Johnson City, TN, United States

Over the past twenty years both morphological and molecular phylogenies have been proposed for extant and extinct members of the family Felidae. However, there remain several discrepancies, particularly within the genus Panthera, likely due to the very recent diversification within the family. One example that has received recent attention is the phylogenetic placement of P. atrox. These inconsistencies suggest the need for further analysis and perhaps even different methodology to truly understand pantherine evolution. Consequently, morphologic characters from the skull and dentary were analyzed within Panthera (including all extant, and one extinct, taxa) to gain a better understanding of pantherine phylogeny. To increase confidence in the results, multiple specimens of each taxon were analyzed and scored. Extant taxa included: P. leo (African lion), P. tigris (tiger), P. onca (jaguar), P. pardus (leopard), Uncia uncia (snow leopard), and Neofelis nebulosa (clouded leopard). The latter two taxa are considered pantherine, though not in the genus Panthera, due to their consistent placement in various phylogenetic trees as falling just outside the Panthera group. Four outgroups were used; Crocuta crocuta, Metatheria sp., Proaiaurus lemanensis, and Pseudoaelurus validus. From each phylogeny created, despite the outgroup, apparent grouping between Panthera leo, P. tigris, and P. atrox was present. Therefore, P. atrox is likely more closely related to the African lion and the tiger than the jaguar, in contrast to what has been recently suggested. Moreover, gross morphological similarities between P. atrox and P. onca are likely the result of convergent hunting styles and/or prey selection, rather than phylogenetic affinity.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

A COMPARISON OF THE MICROVERTEBRATE FOSSILS FROM THE GARDEN PARK FOSSIL AREA IN COLORADO AND THE LITTLE HOUSTON QUARRY NEAR SUNDANCE, WYOMING (BOTH LATE JURASSIC, MORRISON FORMATION)

KING, Lorin R., Western Nebraska Community College, Scottsbluff, NE, United States; FOSTER, John R., Museum of Western Colorado, Grand Junction, CO, United States; HECKER, Andrew B., Appalachian State University, Boone, NC, United States

The Garden Park Fossil Area and the Little Houston Quarry have yielded abundant large dinosaurs, including a relatively “typical” Morrison Formation fauna consisting of the theropod Allosaurus and sauropods such as Camarasaurus, Apatosaurus and Diplodocus. The Garden Park quarries (Jennings and Johnson Location, Cleveland Quarry, Small Quarry and Green Acres Location) have also produced some identifiable, albeit fragmented, small vertebrate remains. The rare, smaller non-dinosaurian vertebrates include pterosaurs, turtles, crocodyliforms, and lungfish fossils, as well as specimens of the mammals Docodon and Amblytherium, plus the sphenodontian Apatosaurus and the mammals Docodon, Psalodon, and an indeterminate dryolestid. At Garden Park, like most Morrison Formation fossil quarries in the western United States, small vertebrate specimens are not as common as the larger dinosaurian material, but at the Little Houston Quarry the total number of bones and minimum numbers individuals of small vertebrates is higher than that of dinosaurs. Importantly, even at Garden Park, the microvertebrate fossils, while not frequently recovered and relatively non-diagnostic, still record a greater diversity of taxa (at higher taxonomic levels) than do the more frequently collected large dinosaur elements.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)


KEMP, Addison D., University of Texas at Austin, Austin, TX, United States; KIRKLAND, James I., Utah Geological Survey, Salt Lake City, UT, United States; SIMONS, Elwyn L., Duke University, Durham, NC, United States; SEIFFERT, Erik R., Stony Brook University, Stony Brook, NY, United States

Afraedapis is a large (2-3 kg) adapiform primate known from the early late Eocene BQ-2 locality in the Fayum Depression, Egypt. Here we report the discovery of two isolated petrosals from BQ-2 that are referable to Afraedapis based on size and morphology. Because petrosals preserve portions of the canals for the facial nerves and branches of the internal carotid artery, the position of the posterior carotid foramen is indicated by the presence of a lemur-like posterior septum that shields the facia cochleae and cochlear fossa in ventral view. As in other adapiforms, the internal carotid enters the middle ear posterolaterally near the stylomastoid foramen, and the stapidal and promontory canals divide on the promontorium in close proximity to the facia cochleae. The stapidal and promontory canals are nearly equal in diameter and the promontory canal follows the “transpromontorial” route that is probably plesiomorphic for crown primates. In these features, Afraedapis is similar to many adapiforms and omnomyiforms but differs from crown haplorhines. The preserved portions of the facial canal are unremarkable except in one respect: the hiatus Fallopii (intracranial exit for greater petrosal nerve) is very large, exceeding the diameter of the facial canal by 30-50%. It is likely that the geniculate ganglion was lodged in this large opening, as occurs in 5% of humans. This peculiar morphology is consistent with its previous placement as a derived adapiform stem Afradapis, but it is preserved in both known specimens, but is not seen in other adapiforms. Both specimens also demonstrate that the mastoid was heavily pneumatized, as in adapines and Maharagia. Mean semicircular canal radius of curvature is small relative to estimated body mass, suggesting comparatively low sensitivity to angular accelerations. This finding is consistent with astragal morphology indicative of slow, cautious arboreal locomotion. Mean cochlear volume is 17.5 mm3, similar to other mammals of comparable body mass with unspecialized hearing abilities. Comparative data linking cochlear volume with both the high and low frequency limits of hearing suggest that Afraedapis had a range of hearing (~80 Hz to 43 kHz) similar to that measured for Eulemur fulvus (72 Hz to 43 kHz; thresholds at 60 dB SPL). The anatomy of the petrosal and inner ear of Afraedapis is consistent with its previous placement as a derived adapiform stem strepsirrhine, and provides no evidence for a phylogenetic link with anthropoids.
theropods *Utahraptor* and *Nedocolbertertia*, a basal macronarian sauropod, and the brachiosaur *Cedarsaurus* characterizes the YC above the calcare. The discovery of a distinct fauna below a medial Yellow Cat ‘caprock’ near Green River, Utah, characterized by a giant polacanthine, the basal therizinosaur *Falculator*, a primitive troodont *Geminiraptor*, and the large basal iguanosaur *Gastonia* suggests the presence of dinosaur fauna perhaps older than that of the *Gastonia* fauna. The correlation of this ‘caprock’ with the calcarete cannot be proven. Forty miles east, a multitaxic, Cretaceous dinosaur fauna is preserved below the calcarete in the Doellings’ Bowl Bonebed (DB). The occurrence of this new dinosaur fauna raises the possibility of testing the hypothesis that the calcarete, although not representing the J/K unconformity, at minimum represents evolutionary time as dinosaur taxa turned over fairly rapidly, on the order of every 1–2 million years. This hypothesis may be tested by examining related species in different dinosaur clades occurring above and below the calcarete. 

Still under study, the iguanodont material includes many dentaries that lack teeth of a larger adult animal. Much of the skeleton is preserved, including skull material, pelvic elements, limb bones, an articulated pes and lower leg, and most of the vertebrae column including the semi-articulated terminal 10 procoels vertebrae of the tail. Brigham Young University is researching external material from more than a dozen individuals of a closely related basal macronarian sauropod found with *Gastonia* at the Dalton Wells Quarry north of Moab, Utah. Differences between these sauropods provide an additional test of our hypothesis.

Preparators’ Session (Thursday, October 18, 11:00 am) 

**MAPPING AND LAB PREPARATION OF A CRETACEOUS (CENOMANIAN) TURTLE FROM THE WOODBINE FORMATION OF NORTH TEXAS:**

**THE UNUSUAL CHALLENGES OF THE FLYING TURTLE PROJECT**

**KLINE, Patrick,** University of Texas at Arlington, Arlington, TX, United States; **KLONE,** Margie, University of Texas at Arlington, Arlington, TX, United States; **MAIN,** Derek J., University of Texas at Arlington, Arlington, TX, United States

In the Fall 2010 field season, a complete turtle carapace and plastron, along with disarticulated postcranials, was discovered by a local student, excavated, and removed. This discovery comes from the Arlington Archosau site (AAS) which is a diverse fossil locality from the Late Cretaceous (95 Mya) Woodbine Formation of north Texas. The AAS occurs in an ancient delta plain that was situated along the southeastern interior seaway. The A.S.P has recovered in a stratigraphic gap between the Woodbine and Palo Duro formations, consisting of miliolids, crocodyliforms, dinosaurs (ornithopod and theropod), carbonized logs, and turtles. This specimen was embedded in a matrix of hardened, stratified peat with gypsum and carbonized wood integrated throughout. During transport to the fossil lab at the University of Texas at Arlington (UTA), this turtle, wrapped in a plaster jacket but not secured to the truck bed, was ejected (launched) from the bed of the transporting truck landing ‘pancake-style’ on the roadbed below. The turtle was substantially damaged, but recovered and returned to the UTA lab. This incident became known as the ‘Flying Turtle.’ Once safely located in the lab at UTA, the plaster jacket was removed and an assessment of the external damage could be started. Due to the impact, several fissures had been opened on the exposed shell that demonstrated a downward and outward separation. The right side of the specimen, which possessed pre-discovery crushing damage, was further compromised and shattered. It was determined that the criteria for preservation should be systematically, accurately plotted, and completed with a goal of reconstruction of all of the elements of the specimen. Four planes of reference were established: the carapace, internal skeletal, plastron, and surrounding matrix. Lacking sophisticated equipment, the project proceeded using hand tools and dedicated volunteer effort. The resulting grid-coordinate mapping method devised for each plane as well as the fossil sorting and storage using commonly available materials represents a creative approach to preserving smaller complete specimens.

**3D RECONSTRUCTIONS OF THE BRAIN ENDOCAST AND INNER EAR OF A TITANOSAUR (SAUPODA: TITANOSAURIA) FROM THE LATE CRETAUCEOUS OF SPAIN**

**KNOLL, Fabien,** Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain; **WITMER, Lawrence M.,** Ohio University, Athens, OH, United States; **RIDGEY, Ryan C.,** Ohio University, Athens, OH, United States; **ORTZEL, Francisco,** Universidad Nacional de Educación a Distancia, Madrid, Spain; **SANCZ, Jose Luis,** Universidad Autónoma de Madrid, Madrid, Spain

Titanosaurs were a flourishing group of sauropod dinosaurs during the Cretaceous. Fossils of titanosaurians have been found on all continents (including Antarctica) and their remains are abundant in a number of Late Cretaceous sites. Nonetheless, the cranial anatomy of titanosaurians is still very poorly known. We studied an incomplete but relatively well preserved titanosaurian braincase from the locality of ‘Lo Hueco’ (Fuentes, Spain) in the Villalba de la Sierra Formation of the Late Campanian-Early Maastrichtian. The specimen, which is small but similar to sauropod standards, resembles the braincase of *Amelosaurus atacis* from France. Based on CT scanning, digital 3D renderings of the brain endocast and endoosseous labyrinth of the inner ear were generated. The endocast has moderate pontine and cerebral flexures (about 40º). In contrast with sauropods for which the endocranial anatomy is well known (such as *Spinosaurus*, *Diplodocus*, and *Camarasaurus*), the cranial region of the specimen is not dominated by any remarkable dural expansion. However, we suggest that there remain paired longitudinal dural venous sinuses that, as in some other sauropods, course dorsolaterally through the cerebral region. The cleft between these pronounced venous swellings is very deep and it is suggested that the two cerebral hemispheres were very little inflated and must have been extremely modest. As in other non-avarchosaurians, in general, the midbrain and hindbrain are relatively poorly defined in the endocast due to former meningeal coverings and apparently substantial dural venous sinuses, which obscure details of the optic lobes and the cerebellum. The cranial nerves present roughly the configuration seen in other sauropods although there are derived features that appear to characterize titanosaurians. For example, the abducens nerve passes lateral to the pituitary fossa in most other titanosaurians but is entering it, which is unique among all other sauropods. Likewise, the hypoglossal nerve exits the skull via a single foramen. This feature is observed in other titanosaurians, but is at variance with most saurischians, including *Giraffatitan*, which is a basal titanosauriform. In contrast with *Spinosaurus* and *Giraffatitan* but similar to other titanosaurians, the labyrinth shows a dramatic reduction of the magnitude of the vestibular system such that the rostral semicircular canal is much shorter and comparable in size to the caudal canal. As in most but not all sauropods, the lagenae is relatively short. Our investigation highlights that, although titanosaurians are derived sauropods with a successful evolutionary history, they present a remarkably modest level of paleoneurological organization.

Technical Session II (Wednesday, October 17, 10:30 am) 

**ORNITHISCHIAN-LIKE DENTAL ARRANGEMENT IN A BASAL THERIZINOSAUR DINOsaUR FROM NORTHEASTERN CHINA**

**KOBAWASHI, Yoshitsugu,** Hokkaido University Museum, Hokkaido University, Sapporo, Hokkaido, Japan; **LU, Junchang,** Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; **PU, Hanyong,** Henan Geological Museum, Zhengzhou, Henan, China; **XU, Li,** Henan Geological Museum, Zhengzhou, Henan, China; **WU, Yanhua,** Henan Geological Museum, Zhengzhou, Henan, China

A basal therizinosaur dinosaur from the Lower Cretaceous Yixian Formation of Jianchang County, western Liaoning Province, was reported previously. It was suggested that it differs from *B. inexpectus* in *B. inexpectus* in its phylogenetic status which has never been determined. Its anatomy and phylogenetic status are examined in this study. A strict consensus tree places it as a basal therizinosaurian and a sister taxon to the Therizinosauroidae (the clade of *B. inexpectus* and higher taxa), confirming that it is a different taxon from *B. inexpectus* despite both being known from the same formation. This therizinosaur is unique mainly in features of the skull, vertebrae, and pelvis, suggesting that it is a new taxon. This new taxon fills the morphological gap between *B. inexpectus* and *B. inexpectus*, in characters related to feeding behavior (downturned anterior end of dentary with a gap, and inset anterior teeth with a shelf). Derived features in the skull of the new therizinosaur, but primitive features in the postcrania (especially pelvis and hindlimbs), suggest that adaptations for herbivory in cranial morphology evolved before changes in the postcrania, as seen in ornithomimosaurians and pterosaurs.

The most striking feature of this taxon is its dental arrangement in the middle and posterior dentary. Middle and posterior dentary teeth (posterior to the seventh tooth) are offset medially from lateral border of the dentary by a shelf, and these crowns show reversed tooth morphology (concave labial side and convex lingual side), whereas the crowns of all maxillary teeth and six anterior dentary teeth have the normal condition (convex labial side and concave lingual side). The anterior portion of the upper jaw was covered by a rhampheotheca, and that of the lower jaw is down-turned with normal tooth morphology. The anterior jaws might have functioned to pluck food (e.g., plant material), and the posterior portions, where dentary and maxillary teeth have an opposite arrangement (where the tips of the upper and lower teeth abut one another to maximize biting stress) to cut plant fibers, which is an arrangement similar to ornithopods and ceratopsians. This line of evidence suggests that this taxon was adapted for herbivory in a different way from any other therizinosaur.

Technical Session III (Friday, October 19, 3:30 pm) 

**HYPOTHETICAL MODEL FOR THE EVOLUTION AND DIFFERENTIATION IN PEDAL DISTAL PHALANGES OF PRIMATES**

**KOENIGSWALD, Wighart V.,** University of Bonn, Paleontology, Bonn, Germany

Pedal distal phalanges are more morphologically diverse in primates than in most other mammals. The occurrence of claws or even grooming claws in various groups has prompted discussions about the primitive condition. The question of whether the Eocene adapoid *Darwinius* had a grooming claw or not, initiated an extensive survey of pedal distal phalanges among primates. The morphology of the modified distal phalanx as well as its specific position among the five digits must be considered. The grooming claws and claws of the various groups differ in morphology and position indicating occurrence of parallel evolution. Accepting this, a fairly simple hypothetical model can be advanced for the evolutionary modifications of the pedal distal phalanges, fully independent from that of the hands. Starting with laterally compressed claws as in *Tupaias* and *Plesiadapis*, the first step was the differentiation of the first toe as an opposing hallux. The bone is scutiform and has a flat nail. This structure of the hallux was retained throughout most of the primates. As a second step the remaining distal phalanges, most probably, evolved a columniform shape with a small nail, as is preserved in several anthropoids. From such a structure all...
further modifications can easily be deduced. In lemuroids the second toe was separated as a grooming claw, while the lateral distal phalanges became scutiform. However, this is significantly different in shape and position, thus not homologous. Among anthropoids columnar distal phalanges with flat nails on the lateral toes are widespread. This has to be regarded as the primitive condition for ceboids and cercopithecids. In ceboids the callicranchiines evolved claws but the hallux retained its scutiform shape. Aotus has a grooming claw like structure. In the cercopithecine and hominoid clades the columnar distal phalanges were mostly preserved as in, e.g., Cercopithecus, Macaca, and Pan. Only in humans the distal phalanges were modified to have very irregular distal tuberosities. This hypothesis postulates several cases of parallel evolution, but no evolutionary reversals and loss of specialized structures are required.

Technical Session XII (Friday, October 19, 2:30 pm)

A NEW RECONSTRUCTION OF THE HIP IN HYDROPEDAL MOSASAURS (SQUAMATA, MOSASUROIDEA): FROM ATTACHED TO DETACHED KÔNISHI, Takuya, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada
A pelvic girdle maintaining the symphysis articulation between ischia is preserved on the recently described specimen of Prognathodon prorovanni (Mosasauridae, Mosasaurinae). TMP 2007.03.0001. This, along with comparison of the specimen to other aquatic tetrapods allows the position of the pelvis in this animal to be re-evaluated. Using the articulated ischia, the maximum distance between the acetabula of this specimen is 24.5 cm. If the ilia are distally connected with the vertebrae, the circumference of the space surrounded by the pelvic girdle and the vertebra is estimated to be 85 cm, or only 15% of the total body length at this mosasaur at 6 m. With respect to the posteriorly tapering (i.e., streamlined) torso hypothesized for hydropedal (derived) mosasaurs, this suggests at least three possibilities: (1) given that mosasaurs utilized their muscular tails as a main means of underwater propulsion, only the base of the tail of this mosasaur was abruptly constricted to become 15% of the body length in circumference; (2) the maximum girth of the tail was not significantly greater than 15% of the body length, showing an abrupt decrease in circumference at the posterior end of the animal’s trunk; and (3) the tail attained its maximum girth at the base at a much greater dimension than 15% of the total body length, more or less continuous with the posterior trunk region in dimensions. The third scenario is preferred, as the first two imply a hydrodynamically less efficient body outline by creating turbulence at the tail-body interface. The second scenario also indicates that the total tail muscle mass would be insufficient to provide and maintain propulsion strong enough for a 6-m animal. At the same time, in order to achieve the third condition, the pelvic girdle in mosasaurs must be free of ilio-vertebral articulation so as to position it further ventrally, a view contrary to the long-standing hypothesis that the biphone in these large seagoing lizards contacted distal ends of the transverse processes on the first caudal vertebra. Further osteological support for the new hypothesis constitutes: (1) the notable absence of articular facets at distal ends of any transverse processes in the caudal series; (2) the lack of changes in orientation of the transverse processes near the base of the tail unlike in sauropterygians, where a group of transverse processes on each side of the sacral vertebrae converge distally to meet at a point of ilio-vertebral articulation; and (3) the simple rod-like morphology of the ilium. These features found in hydropedal mosasaurs are shared with derived ichthyosaurs, which are reconstructed to show separation between the pelvis and the vertebral column. Based on those lines of evidence and comparison, I conclude that pelvic girdles in hydropedal mosasaurs most likely lacked direct contact with the axial skeleton.

Technical Session VII (Thursday, October 18, 3:15 pm)

RESOLVING THE HOMOLOGY AND MIXED EMBRYONIC ORIGIN OF A MAMMALIAN SKULL BONE: THE IDENTITY OF THE INTERPARIETAL BASED ON PALEONTOLOGICAL AND DEVELOPMENTAL DATA KOYABU, Daisuke, University of Zurich, Zurich, Switzerland; MAIER, Wolfgang, University of Tubingen, Tubingen, Germany; SANCHEZ-VILLAGRA, Marcelo R., University of Zurich, Zurich, Switzerland
The mammalian interparietal is a dermal bone situated between the parietal and supraoccipital. Its presence, development, terminology and homology across living and fossil synapsids are yet poorly known and largely undocumented, with contradictory statements in literature. Furthermore, the interparietal is a critical and problematic element of fossil synapsids are yet poorly known and largely undocumented, with contradictory statements in literature. Furthermore, the interparietal is a critical and problematic element of fossil synapsids. Our four-element view for the interparietal provides a synthetic understanding of the dermal skull roof of mammals and hints at a possible bridge between paleontology and developmental biology. Recent experimental study on the derivation of the mammalian skull reported a dual origin for the interparietal: the medial portion being neural crest cells derived and the lateral portion mesoderm derived. This suggests that the two medial interparietal elements are developmentally derived from the neural crest cells and the lateral elements from the mesoderm. If this is the case, the dual origin found for the mammalian interparietal could be regarded as the evolutionary consequence of the fusion between the crest derived “postparietal bones” and the mesoderm derived “tabular bones”.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

BODY MASS AND SHEARING QUOTIENTS OF MICROSYOPIDAE (MAMMALIA, PRIMATES) FROM THE EARLY EOCENE, BIGHORN BASIN, WY (WASATCHIAN, NALMA): PALEOECOLOGICAL IMPLICATIONS FOR DIET KRISTJANSON, Heather L., University of Toronto, Toronto, ON, Canada; PRUFROCK, Kristen A., University of Toronto, Toronto, ON, Canada; SILCOX, Mary T., University of Toronto, Scarborough, Toronto, ON, Canada
The Microsyopidae are extinct mammals from North America and Europe usually considered stem primates (“plesiadapiforms”). Large collections of the family are known from the Willwood Formation, Bighorn Basin, Wyoming (Early Eocene, Wasatchian North American Land Mammal Age). A well-documented mammalian faunal turnover event (Biozone A), associated with an increase in mean annual temperature (MAT), has been suggested to mark a considerable degree of change in the body mass of microsyopsids. Previous work has shown an existing relationship between body mass and the dietary adaptations in extant primates. Here we investigate the shearig potential of a sample of Willwood microsyopsids to see whether there is an association between adaptation and diet. We use a method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone. We have used a new method of measuring the shear potential of an animal that can only be done on the dry bone.
A. However, SQ values derived from lower second molars did not change significantly in this interval. The pattern in body mass and SQ in upper second molars is consistent with that observed in the lowers, although the relationship between SQ and diet is more ambiguous in the upper dentition. Collectively, SQ values from the upper and lower second molars suggest that microsyopid diet did not change in Biohorizon A despite changes in body mass. This suggests that with the increase in MAT more insect resources might have been available for exploitation by insectivorous stem parrots, allowing for body mass increase.

Technical Session XVII (Saturday, October 20, 3:15 pm)
FLYING ROCKS AND FLYING CLOCKS: EXPLAINING DISCREPANCIES BETWEEN FOSSIL AGES AND MOLECULAR DATES IN BIRDS
KSEPKA, Daniel T., North Carolina State University, Raleigh, NC, United States; WARE, Jessica L., Rutgers University, Newark, NJ, United States; LAMM, Kristin S., North Carolina State University, Raleigh, NC, United States

Major disparities have been recognized between molecular divergence dating estimates and ages provided by the fossil record for critical nodes in the Tree of Life, but broad scale patterns and underlying drivers remain elusive. We harvested 268 molecular divergence estimates for 67 major clades within Aves using the online database TimeTree. We also collected the ages of the oldest fossil occurrence for each of these clades, taking into account the age of fossils from sister taxa where relevant. Molecular dates were on average more than 1.5 times older as the age of the oldest fossil record in these 67 clades, extending the estimates for targeted divergences by an average of approximately 25 million years per terminal branch. This resulted in molecular divergence estimates for 40 avian clades with earliest fossil records restricted to the Cenozoic being pushed into the Mesozoic by molecular estimates, implying a wave of mass survival across the K–Pg mass extinction for which fossil evidence is currently lacking.

Several pervasive patterns were observed. Mitochondrial genes yielded older dates than nuclear genes for an overwhelming proportion of targeted divergencies. Disparity between molecular divergence estimates and the fossil record was substantially higher for divergences within major clades (crown divergences) than for divergences between major clades (stem divergences). The first pattern may be attributed to higher rates of substitution, compositional bias, and site saturation in mitochondrial versus nuclear genes. However, the second pattern is less easily explained because the quality of the fossil record is expected to increase towards the present. The basal crown divergences within a given clade by definition must have occurred more recently than stem divergence between that clade and its sister clade, so an explanation of the bias towards relatively older crown dates versus stem dates must be sought elsewhere. We identify some proposed effects of calibration strategy that may explain the patterns observed in birds, and more broadly result in systematic overestimates in molecular divergence estimates for other clades such as insects.

Technical Session XI (Friday, October 19, 3:45 pm)
A NEW ABELISAURID (THEROPODA: CERATOSAURIA) SKELETON FROM THE UPPER CRETACEOUS BAJO BARREAL FORMATION OF CHUBUT PROVINCE, ARGENTINA
LAMANNA, Matthew C., Carnegie Museum of Natural History, Pittsburgh, PA, United States; CASAL, Gabriel A., Universidad Nacional de la Patagonia San Juan Bosco, Comodoro Rivadavia, Argentina; MARTINEZ, Ruben D., Universidad Nacional de la Patagonia San Juan Bosco, Comodoro Rivadavia, Argentina

Abelisaurids were the most diverse and abundant large-bodied theropods in the Gondwanan landmasses at the end of the Cretaceous. Nevertheless, the initial stages of this carnivorous dinosaur radiation remain insufficiently understood, with most Early and ‘middle’ Cretaceous abelisaurids being represented by fragmentary or only briefly described fossils. We report a new abelisaurid partial skeleton (Universidad Nacional de la Patagonia San Juan Bosco Paleontologia de Vertebrados [UNPSJB-PV] 1003) from southern Chubut Province in central Patagonia, Argentina. Recovered from the Cenomanian–Turonian Lower Member of the upper caudal half of the skull, both dentaries, isolated teeth, the partial sacrum, 23 caudal vertebrae, at least two dorsal ribs and 15 lateral arches, the left scapula, and much of the right tarsus and pes. Within Abelisauridae, the new skeleton probably pertains to a basal member of the clade, as evidenced by its retention of multiple plesiomorphic character states e.g., minimal cranial ornamentation; fenestrae between lacrimal, postorbital, and frontal; dorsoventrally thin frontal; lack of awl-like, proximally-directed projection at lateral end of proximal caudal transverse process; mediolaterally slender metatarsal III). Furthermore, the specimen exhibits a number of probable autapomorphies (rounded prominence bordered caudally by mediolaterally-oriented groove on caudal lateral part of dorsal surface of frontal; low, acute caudomedial tuberosity on dorsal surface of frontal bordering ‘caudal median fossa’; and proximal caudal transverse processes abruptly expand in proximodistal dimension well medial to their lateral extremes), suggesting that it belongs to a previously- unrecognized taxon. The abelisaurid Xenotarsosaurus has already been reported in the Bajo Barreal Formation; unfortunately, however, no elements of the only known specimen overlap with UNPSJB-PV 1003, precluding direct comparisons between them. The proximal-most preserved caudal vertebra of the new specimen does differ in several regards from that of another abelisaurid partial skeleton previously described from this geologic unit. The vacuum and metatarsus III of the new skeleton are marked by shallow, subparallel grooves that probably correspond to feeding traces left by other archosaurs. Given that most of the shed tooth crowns discovered at the UNPSJB-PV 1003 site are referable to Abelisauridae, it is possible that this individual was scavenged by other members of its clade, and perhaps even cannibalized. UNPSJB-PV 1003 therefore sheds light on the sequence of character acquisition in abelisaurid evolution, and may also lend insight into the paleoecology of basal members of this important group.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)
APPLICATIONS OF ELECTRON BACKSCATTER DIFFRACTION ON FOSSILIZED AND MODERN EGGSHELL
KRUK, Brett, Montana State University, Bozeman, MT, United States; SUSORNEY, Hannah, Montana State University, Bozeman, MT, United States; JACKSON, Frankie D., Montana State University, Bozeman, MT, United States; SHAW, Colin, Montana State University, Bozeman, MT, United States; VARRICCHIO, David J., Montana State University, Bozeman, MT, United States

Electron backscatter diffraction (EBSD) provides high resolution information on crystal orientation. EBSD is routinely used in material science, but has only recently been applied to study the crystallography of fossilized and modern eggshell. This technique allows the study of the microstructure of fossilized dinosaur eggshell from the Cretaceous Tiantai basin, Zhejiang Province, China, fossilized turtle eggshell from the Kaparovitz Formation of Utah, and modern avian eggshell. The samples used in this study were cut radially and micro-polished for mapping. The EBSD detection on a scanning electron microscope was used to map pixel by pixel, the average orientation of the crystals. The orientations were then identified using the pixel data and displayed in maps and stereographic pole figures to show the preferred orientation and spatial arrangement of individual crystals. Details of calcite and aragonite structure of the eggshells, (i.e., preferred orientation, misorientation between adjacent shell units, lattice distortions, and sub-grain structure), were then observed and quantified. Avian eggshell was previously mapped and will be used to compare its structure to the fossilized dinosaur eggshell, thereby showing possible morphologic differences and effects of diagenesis. The turtle eggshell was mapped to show both preferred orientation and location of possible calcite replacement of the original aragonite. This technique allows the microstructure of fossilized and modern eggshell to be studied at high resolution and could be used for morphological and diagenetic studies.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)
The first radiometric dates for the Wayan formation of Idaho, stratigraphic placement of fossil localities, and regional correlations
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Recent work in the Cretaceous Wayan Formation of eastern Idaho provides the first radiometric ages, provides the first indication of marine influence, and places some vertebrate fossil localities in a stratigraphic context. Idaho’s Wayan Formation consists of a thick suite of pedogenically imprinted fluvial deposits deposited in a rapidly subsiding foreland basin associated with early tectonic activity in the Sevier Foreland Basin. It crops out east and southeast of Idaho Falls near the median fossa; and proximal caudal transverse processes abruptly expand in proximodistal dorsoventrally thin frontal; lack of awl-like, proximally-directed projection at lateral end of proximal caudal transverse process; mediolaterally slender metatarsal III). Furthermore, the specimen exhibits a number of probable autapomorphies (rounded prominence bordered caudally by mediolaterally-oriented groove on caudal lateral part of dorsal surface of frontal; low, acute caudomedial tuberosity on dorsal surface of frontal bordering ‘caudal median fossa’; and proximal caudal transverse processes abruptly expand in proximodistal dimension well medial to their lateral extremes), suggesting that it belongs to a previously- unrecognized taxon. The abelisaurid Xenotarsosaurus has already been reported in the Bajo Barreal Formation; unfortunately, however, no elements of the only known specimen overlap with UNPSJB-PV 1003, precluding direct comparisons between them. The proximal-most preserved caudal vertebra of the new specimen does differ in several regards from that of another abelisaurid partial skeleton previously described from this geologic unit. The vacuum and metatarsus III of the new skeleton are marked by shallow, subparallel grooves that probably correspond to feeding traces left by other archosaurs. Given that most of the shed tooth crowns discovered at the UNPSJB-PV 1003 site are referable to Abelisauridae, it is possible that this individual was scavenged by other members of its clade, and perhaps even cannibalized. UNPSJB-PV 1003 therefore sheds light on the sequence of character acquisition in abelisaurid evolution, and may also lend insight into the paleoecology of basal members of this important group.

The Wayan Formation has long been regarded as middle–late Albian in age. Our radiometric detrital zircon dates yielded a peak age of 99.3 + 2.5⁄−2.3 Ma 120 m above the base of the formation, indicating the formation can be no older than the Albian/Cenomanian stage boundary. An Oryctodromeus locality in the middle of the formation yielded an age of 96.5 ± 3.1 Ma from the youngest crystal and a peak age of 99.1 ± 1.5⁄−1.3 Ma. Newly recovered palynomorphs independently corroborate a mid-Cretaceous age of the formation and provide the first evidence for marine influence in the Wayan fluvial systems. A major finding of this study is that the Wayan Formation of Idaho and the Blackleaf Formation of Montana are synonymous based on age, lithology, stratigraphy, fauna (including Oryctodromeus), and structural trends. These formations are simply different areas of the same depositional basin or basin system, and their equivalence was not previously noted because the middle of the Wayan-Blackleaf basin is covered by Snake River Plain volcanics. Finally, the radiometric ages indicate the Wayan is coeval with the uppermost unit (Mussentuchit Member) of the Cedar Mountain Formation of Utah and the member’s fluvial facies, the Dakota Sandstone, which was traditionally considered a discrete stratum.
Sunziphius in the light of numerous recent discoveries and other archaic beaked whales. The evolutionary history of the family Ziphiidae (Cetacea, Odontoceti) is a species-rich clade of medium to large size odontocetes (toothed whales). In most extant species the dentition is drastically reduced, a feature interpreted as related to suction feeding. Only one or two pairs of mandibular teeth are usually retained, transformed in tusks in adult males. Shared with sperm whales, the habitat of ziphiids can be described as extreme; several species have been recorded performing feeding dives at depths greater than 1000 m, locating their prey in the darkness using their sonar. Sunziphius platyrostris has long been considered as the best-known fossil ziphiid, based on the holotype, a skull from the early Pliocene of Peru with associated ear bones, mandible, and several postcranial elements. However, the poor preservation of the left side of the skull differs from other contemporary species in the SeUs. This may reflect the lack of wood data in most floral reconstructions. Climate simulations, the presence of hummocky-beded sands, and localized sand lenses entrained within the Mooreville Chalk Formation indicate the occurrence of paleo-hurricanes. A hurricane/fire regime may explain the prevalence of conifers, although data reflect knowledge only of coastal areas. Flooding, drowning and/or flotation may explain the presence of a high concentration of associated dinosaur carcasses in the study area. Dinosaur carcasses are concentrated near barrier island inlets, and storm runoff may explain how dinosaur carcasses and eggs are transported across the high-energy shore-face to be deposited in shallow marine chalca. Dinosaur bone preservation is strongly controlled by bottom water oxygenation.

Technical Session VII (Thursday, October 18, 2:00 pm)
TOWARD A QUANTITATIVE WAY TO IDENTIFY ANCESTORS IN THE FOSSIL RECORD: A BAYESIAN APPROACH
LAMM, Kristin S., North Carolina State University, Raleigh, NC, United States
The only direct evidence of the diversity of life through geologic time is contained in the fossil record, and this record is biased and incomplete. Fossils provide information that cannot be obtained from studying living organisms alone, but they bring with them unique methodological challenges. When a fossil lineage is densely sampled through time and sufficiently accessible to morphometric analysis over time. When an unbroken transition in morphology is observed between older and younger forms, it can be argued that the stratigraphically older fossils represent ancestors and the younger fossils their descendants. However, the fossil record rarely provides the kind of evidence needed to make a strong argument for an ancestor-descendant relationship. Moreover, fossils must be treated as terminal taxa in order to be included in phylogenetic analyses. For this reason, they are considered to represent extinct species that are morphologically diverse through time. When fossils can be sampled from lineages that lead to other fossil or living taxa, this study presents a novel quantitative approach toward evaluating the ancestral status of a fossil taxon. Birth-death processes provide a natural, tractable and formal framework for modeling a wide variety of biological processes. Consider such a process with constant birth rate λ, constant death rate μ, beginning with a single lineage at time 0 and ending with at least one lineage at time T. In this context, we express the probability that a single fossil selected at random from among the last ten descendants of each taxon at time T can be sampled.

Technical Session XII (Friday, October 19, 4:00 pm)
TOOTH VARIATION IN VARANUS KOMODOENSIS AND IMPLICATIONS FOR INTRASPECIFIC VARIATION IN EXTINCT XIPHODONT CARNIVORES
LARSON, Derek W., University of Toronto, Toronto, ON, Canada; EVANS, David C., Royal Ontario Museum, Toronto, ON, Canada
Understanding the range of intraspecific variation of taxonomically informative characters is essential when recognizing species based on morphological characters, particularly in the fossil record. In fossil datasets, this information is often lacking due to small sample sizes, with many fossil vertebrate taxa known only from single specimens. Varanus komodoensis, the largest extant lizard and the largest living terrestrial animal with xiphodont (laterally compressed, serrated) teeth, has often been used in palaeobiological studies as a model for theropod dinosaur feeding behaviour and tooth and jaw biomechanics. Here we use V. komodoensis to illustrate variation in the teeth of an extinct xiphodont faunivore. Fifteen skulls of adult V. komodoensis were measured in order to quantify morphological variation of the dentition present in the species. Three gross tooth measurements, as well as mesial and distal tooth denticle size, were measured for each of ten teeth across the tooth rows. The number of tooth positions varies little between specimens; maxillary and premaxillary tooth counts remain identical in all specimens, but the smallest specimens have one fewer denticular position than the largest skulls. Denticular size and tooth width in regionally equivalent teeth also remain essentially constant (negative allometry) across the size ranges even though tooth length and height increase isometrically with respect to skull size. These findings suggest that the denticular size and shape of teeth are remarkably consistent between individuals and robust to differences in body size. Data from multiple individuals and comparison to other varanids indicate the potential of diagnostic characters in teeth. These results have implications for understanding the diversity of small theropods, as extensive information on their abundance and diversity is derived from isolated teeth. Comparison with specimens of the dromaeosaurids Atrocaptor marshalli, Bambiraptor feinbergi, and Dromaeosaurus albertensis indicates that the standard deviation of denticular size is similar (~0.2–0.4 μm) to that of individual specimens of V. komodoensis, showing that within-individual denticular size is consistent. However, comparison to the large number of isolated teeth referred to these same species shows much greater disparity than would be expected from intraspecific variation in V. komodoensis. This suggests that hidden ontogenetic or taxonomic factors are likely contributing to fossil tooth disparity. Although ontogenetic variation of teeth is not well understood in theropod dinosaurs, these results are consistent with a growing body of evidence that alpha diversity of small theropods is underestimated.

Symposium: Vertebrate Palaeontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 8:15 am)
The Cretaceous Neotropics: Colombian Vertebrates at the Boundary of Shifting Environments and the Mesozoic Marine Interchange
LARSSON, Hans C., McGill Univ Redpath Museum, Montreal, QB, Canada
Jurassic and Early Cretaceous times in northwestern South America witnessed dramatic geographic changes. The Tehuys seaway penetrated southwestern through present day Colombia to unite with the Pacific Ocean. This seaway expansion would mark the separation between North and South America for the next 150 million years. Fossil marine invertebrates of this region have seen much attention to models of biogeographic interchanges and local
endemisms. However, the paucity of vertebrate fossils has made the inclusion of this clade difficult. A new marine and terrestrial vertebrate fauna from the upper Valanginian (ca. 138 Ma) is presented. The age is constrained by the presence of the small ammonite Saynocras verrucosum. The fauna is composed of chondrichthyans, actinopterygians, testudines, a plesiosaur, a crocodyliform, a possible pterosaur, and a dinosaur. These are interpreted in the context of the biogeographic interchange that would have dominated faunal dynamics in the region during this time.

Technical Session I (Wednesday, October 17, 10:45 am)

A BIOMECHANICAL MODEL OF ERLIKOSAURUS ANDREWSI (DINOSAURIA: THERIZINOSAURIA) WITH IMPLICATIONS FOR CRANIAL FUNCTION AND DIETARY PREFERENCES

LAUTENSCHLAGER, Stephan, University of Bristol, School of Earth Sciences, Bristol, United Kingdom; RAYFIELD, Emily J., University of Bristol, School of Earth Sciences, Bristol, United Kingdom; WITMER, Lawrence M., Ohio University, Department of Biomedical Sciences, College of Osteopathic Medicine, Athens, OH, United States; ALTANGEREL, Perle, National University of Mongolia, Ulaanbaatar, Mongolia

Theropod dinosaurs have historically been regarded as an exclusively carnivorous and predatory group. However, recent analyses have suggested that herbivory may have been more widespread amongst the different theropod clades than previously thought, leading to far-reaching ramifications for the evolution of dietary specialisations in theropods. Therizinosaurus represents one such herbivorous clade and their highly unusual anatomy has led to a variety of dietary assumptions. These range from piscivory and insectivory to various forms of herbivory, whereas the edentulous tip of the snout has been regarded as evidence for the presence of a keratinous beak. However, these assumptions have not been subjected to a more rigorous, biomechanical analysis.

We analysed the biomechanical behaviour of the skull and lower jaws of Erlikosaurus andrewsi – the only therizinosaur preserving a nearly complete and articulated skull. Using information derived from computed tomography (CT) scanning, the complete skull of Erlikosaurus was digitally reconstructed. The three-dimensional model subsequently served as a foundation for the detailed reconstruction of the adductor musculature, thus allowing for the estimation of individual muscle and bite forces. The latter were calculated for different positions in the skull and lower jaws: the edentulous tip of the snout, the first tooth position and the posteriormost tooth position. The estimated bite forces for Erlikosaurus are relatively low, both in actual numbers as well as in comparison to other theropods in relation to its body size (ca. 20 kg). Different finite element (FE) models were created, incorporating muscle and bite force estimates, to test the mechanical capabilities of Erlikosaurus. Two hypothetical models were further tested, which contained a keratinous sheath or beak, covering the edentulous premaxilla and partly the maxilla.

The results of the finite element analysis demonstrate that even the comparably low bite forces would cause increased stress values in the skull of Erlikosaurus, in particular when applied to the posterior teeth. The addition of a keratinous beak on the skull and lower jaws considerably reduces the generated stresses for the anterior bite scenarios. The lack of wear facets, tooth occlusion and the possible presence of a large gut to process plant material, further suggest that the available bite force would not have been used for extensive mastication and chewing processes. This supports a hypothesis that Erlikosaurus would use the edentulous snout (potentially covered by a keratinous sheath) and anterior teeth to procure plant matter by branch-stripping and cropping of soft vegetation.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

THE BRAINCASE AND ENDOCRANIAL SPACE OF THE IGUANODONTIAN LURDUSAURUS ARENATUS

LAUTERS, Pascaleine, IRSNB, Brussels, Belgium; TÀQUET, Philippe, MNHN, Paris, France; VERCAUTEREN, Martine, ULB, Brussels, Belgium; GODEFROIT, Pascal, IRSNB, Brussels, Belgium

Lurdusaurus arenatus is a heavily built iguanodontian discovered in the Aptian (Early Cretaceous) of Gadoufoua, Niger. Since its first descriptions in 1988 and 1999, L. arenatus remained poorly known and its endocranial region was not studied. Information on the structure of its brain is presented based on a silicone endocranial cast. The endocast of L. arenatus shows several peculiar features not observed on the endocasts of other iguanodontians. The olfactory lobes are comparatively small, suggesting that the sense of smell was less developed than in the other ornithopods observed by the authors. The cerebral hemispheres are narrow and oval in shape. Despite the large size attained by L. arenatus, the putitary body, responsible of the production of the growth hormone, was small. The position of the inner ear is not marked by a profound constriction, contrary to what is observed in other ornithopods. With its straight endocranial cavity, L. arenatus is in the derived condition observed in Iguanodon bernissartensis and in hadrosaurids. The most likely causes of variation in the angles of the primitive flexure pattern are absolute skull size and reduction of body size are thus correlated with the expansion of variation in the distal regions of the pedal phalanges of tetrapods. Polytomies, an archosaurian clade is resolved containing both a crocodilian clade as well as an avian clade. This suggests that egg and eggshell characters are not phylogenetically adequate for distinguishing among chelosaur taxa; however, these characters are phylogenetically significant and significant for differentiating Chelonia from non-turtle taxa.

Technical Session XI (Friday, October 19, 2:00 pm)

PEDAL DIGIT IV PROPORTIONS REVEAL BODY-SIZE ASSOCIATED CONSTRAINT ON DINOSAUR FOOT MORPHOLOGY

LEARY, Brian, University of Massachusetts Dartmouth, North Dartmouth, MA, United States; KAVANAGH, Kathryn, University of Massachusetts Dartmouth, North Dartmouth, MA, United States

The proportions of the pedal phalanges of tetrapods have been found to correlate with foot function. Plotting the phalangeal proportions of birds in morphospace not only allows us to discriminate functional groups, but also reveals a restricted range of variation in which many potential morphologies are unrepresented. Additionally, we observed some striking examples of convergent evolution. In previous studies, digit III of the foot was used to infer function as it was hypothesized to be the most functionally significant. However, we found that digit IV is more effective in discriminating functional groups in birds. We applied this insight to the pedal phalanges of 30 non-avian theropods and bipedal ornithischians to identify functional groups and compare the range of variation in the ancestors of modern birds. Using Principal Component Analysis and Generalized Linear Modeling, we have shown that (1) the phalangeal proportions of all dinosaurs sampled fall within a subset of the range of variation observed in birds, (2) ornithischian dinosaurs fall exclusively within the range of terrestrial, non-perching birds (e.g., running, walking, swimming), exhibiting in most cases, extreme proximodistal gradient patterns, (3) non-avian theropods fall within a range spanning from terrestrial birds to highly arboreal taxa, but extreme raptorial morphologies are conspicuously absent, and (4) the phalanx proportions of non-avian theropods are strongly correlated with body length. Extreme distal elongation does exist in the forelimbs, but not hind limbs, of some non-avian theropods. Since body length is not predictive of body plan or the proportion of hind limb proportions, it may only exist at the extreme body sizes found in large dinosaurs. The evolution of flight and reduction of body size are thus correlated with the expansion of variation in the distal phalanges of the avian lineage.

Technical Session XIV (Saturday, October 20, 8:00 am)

DENTAL HISTOLOGY OF DIAEOMATOMORA AND THE EVOLUTION OF CEMENTUM AND ALVEOLAR BONE WITHIN ANNIOTA

LEBLANC, Aaron R., University of Toronto Mississauga, Mississauga, ON, Canada; REISZ, Robert R., University of Toronto Mississauga, Mississauga, ON, Canada

Recent studies of tooth implantation using histological methods in squamates and other diapsid reptiles have led to a novel hypothesis for the homology of amniotic tooth tissues. These studies have demonstrated the presence of alveolar bone, cellular and acellular cementum, and periodontal ligaments in squamates, ichthyosaurs, and crocodilians, which is similar to the condition in mammals. The presence of these tissues in distantly related

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reptiles suggests that this characterizes tooth implantation for Amniota instead of being unique to mammals. To test this hypothesis, thin sections were made of the marginal dentition of diadectids from the Lower Permian of Texas. Diadectids are suggested to have been the first high fiber herbivores in terrestrial communities, and also occupy an important position in amniote phylogeny as stem amniotes. As such, diadectids are important subjects for the identification of primitive conditions of tooth implantation in Amniota. Histological examination of the marginal dentition of Diadectes shows for the first time that plicidentine (dentine infolded towards the pulp cavity) was present in Diadectidae, but does not significantly contribute to an increase in surface area for attachment of the teeth to the jaws. Instead, the teeth are set in deep sockets lined with alveolar bone that was shed with each tooth replacement event. Although no periodontal ligament is preserved, the teeth appear to be anchored to the alveolar bone via a network of thick Sharpey’s fibers that insert into cellular and acellular cementum coating the root of the tooth. The carnivorous basal diadectomorph *Limnoscelis* also possesses deep roots lined with alveolar bone and roots coated with cementum, suggesting that these features are not associated with high fiber herbivory in this clade. The presence of these tissues indicates that the potential to produce theocodontoid periodontal tissues is present in these stem amniotes and may be primitive for Amniota.

**Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)**

**NATIONAL PARK SERVICE VERTEBRATE COLLECTIONS AT THE SMITHSONIAN: COLLABORATION TO SUPPORT SCIENCE AND STEWARDSHIP**

LESSER, Samantha, Geological Society of America, Rochester, NY, United States; SANTUCCI, Vincent L., National Park Service, Washington, DC, United States; JORSTAD, Thomas, Smithsonian Institute, Washington, DC, United States

The Smithsonian Institution’s National Museum of Natural History maintains paleontological collections from approximately fifty units of the National Park System. A large percentage of these fossil specimens were collected prior to the area being administered by the National Park Service. Therefore a database does not currently exist that enables efficient searches for NPS fossil specimens. In 2012, the National Park Service worked with staff from the Natural History Museum to begin a pilot project to inventory and photograph these fossil collections. The initial work focused on three specific inventories: Charles Gilmore’s Paleozoic vertebrate ichnofossils from Grand Canyon National Park; Remington Kellogg’s Pleistocene vertebrate fossils and coprolites from Rampart Cave, Grand Canyon National Park; and, Lloyd Logan’s Pleistocene vertebrate fossils from Musk Ox Cave, Carlsbad Caverns National Park. Each of the collections was inventoried, photographed and any archival information and associated field notes were scanned and entered into the Museum’s collection database. Historic images were also scanned for each collection. The information obtained is being used to support research, resource management and curation at the respective parks. This pilot work is the foundation of much more extensive collaboration to inventory other National Park Service paleontological resources in the Smithsonian’s collections.

**Technical Session XV (Saturday, October 20, 11:00 am)**

**VARIATION IN CERATOPSIAN HISTOLOGY AND GROWTH: NEW DATA FROM SOUTHERN LARAMIDIA AND IMPLICATIONS FOR PALEOENVIRONMENTAL DIFFERENCES**

LEVITT, Carolyn G., Natural History Museum of Utah, Salt Lake City, UT, United States

Ceratopsid dinosaurs from western North America (Laramidia) were one of the most diverse dinosaur clades during the latest Cretaceous. Previous histology studies investigated several basal ceratopsians and centrosaurine ceratopsids (e.g., *Centrosaurus*, *Pachyrhinosaurus*, *Einiosaurus*), but chasmosaurine ceratopsids have yet to be sampled. I conducted histological analysis on the limb bones of the chasmosaurine ceratopsid *Kosmoceratops richardsoni* and *Utahraptor* from the late Campanian Kaiparowits Formation of southern Utah, and also reexamined the long-bone histology of *Ptiacosaurus mongoliensis*, *Protoceratops andrewsi*, and *Centrosaurus apertus*. I compared these data with those of centrosaurine ceratopsids from Alaska and Alberta, examining annual lines of arrested growth (LAGs), and vascular canal orientation and density, to see how growth strategies differed taxonomically and geographically across Laramidia.

Basal ceratopsians grew more slowly than the large quadrupedal ceratopsids, as evidenced by a generally higher number of definitive growth lines prevalent throughout development. Basal ceratopsians had a generally higher number of definitive growth lines prevalent throughout development. Although fossils relevant for understanding this radiation are globally distributed, Early Cretaceous Enantiornithes are best represented in the Xixian and Jiufotang Formations of northeast China. In the fauna known from these Formations, the Jehol Biota, the diversity of Enantiornithes greatly exceeds that of other groups of birds (e.g., Ornithurae, or more basal avialans). However, only a handful of Jehol taxa have been proposed as basal parts of Enantiornithes (e.g., *Protognathosaurus*, *Pengornis*, and *Keonanornis*). Globally this early part of the lineage is poorly sampled, and early arising synapomorphies for the group are still not fully understood. Here, we describe a new large-bodied species of basal enantiornithine bird from the Early Cretaceous of China that sheds light on both morphological variation and ecological specialization in the clade. The new specimen, a complete skeleton with a well-preserved skull, shows a unique combination of characters for basal avialans: reduced nasals and maxillae with dentary with smaller, peg-like premolars; teeth in the posterior sternal midline and lateral trabeculae approximately equal in posterior extent; a flat to sub-concave lateral margin of the coracoid with a small lateral process; abbreviated rod-like hypocoelum on the furcula, an extremely robust sub-rectangular acromion process on the clavula; a small metacarpal I with a weakly-bowed anterior margin; and, markedly elongate, recurved pedal unguals. The body size of the new species is only slightly smaller than *Pengornis*, the largest described enantiornithine taxon, and is larger than all other Early Cretaceous Enantiornithes. Based on the novel combination of both cranial and pedal attributes we propose the new species may have had a raptor-like ecology. By providing new insight into character evolution and ecological range in basal Enantiornithes, the reported taxon improves our understanding of the early part of a key Mesozoic radiation.

**Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)**

**USING STABLE ISOTOPE ANALYSIS OF COPROLITES TO DETERMINE PALEODIET OF LATE PLEISOCENO-MAMMALS**

LIGHTNER, Erik, University of Wyoming, Laramie, WY, United States; CLEMENTZ, Mark T., University of Wyoming, Laramie, WY, United States; FOX-DODBS, Ksenia, University of Puget Sound, Tacoma, WA, United States; MINCKLEY, Thomas, University of Wyoming, Laramie, WY, United States; KORNFIELD, Marcel, University of Wyoming, Laramie, WY, United States

Stable isotopic analysis has contributed to reconstructions of paleoecological and palaeodiet of fossil taxa across glacial intervals during the Late Pleistocene-Holocene. Yet, few Pleistocene studies have examined δ13C and δ15N values in coprolites. Stable isotopic analysis of coprolites can aid in dietary reconstruction of fossil consumers, but only after diet-fece discrimination, taphonomic effects, and past environmental conditions (e.g., variation in the δ13C of atmospheric CO2) have been taken into account. To test the degree of influence of these factors on δ13C and δ15N values, we analyzed rodent (*Neotoma* sp.) and sheep (*Ovis* *canadensis*) coprolites from the Last Canyon Cave rockshelter in southern Montana. These coprolites form a continuous record spanning the last 40 ka, and occur in association with well-preserved pollen and mammal fossils, which provide an independent record of paleoenvironmental information for this deposit. Coprolite δ13C and δ15N values varied with depth and age within the measured section. δ15N values of coprolites were higher in both *Neotoma* sp. and *Ovis canadensis* than would be anticipated for terrestrial consumers, with some values exceeding 20‰. This reflects the combined effects of 1) enrichment due to microbial activity, 2) possible evaporative enrichment prior to burial, and 3) an assumed diet-fece discrimination of 2.1‰ for *Neotoma* sp. and 3.1‰ for *Ovis canadensis*. Mean (± 1 s.d.) δ13C values for *Neotoma* sp. (-25.7 ± 1.0‰) and *Ovis canadensis* (-26.5 ± 0.8‰) were not as enriched in 13C as compared to δ15N values, which is consistent with results from modern soils. This suggests that δ13C values in coprolites are a more reliable indicator of palaeodiet. Thus, the seemingly stochastic variations through time in our results could be explained by changes in individual foraging preferences, possibly by switching between gymnosperm and angiosperm plant types, or by variation in cactus consumption over time.
used to derive estimated ages for the individuals. All three processes produced convergent results, with the rank order of specimens derived from cranial elements tallying with the order of the postcranially-based size estimates (ranging from 8.0-16.5 metres), which in turn agreed with the estimated ages derived from annular counts of the meristic elements (ranging from 21-45 years). Alternatively, examination of further material is necessary for the detailed resolution of growth rate, in particular in the first years of life, this technique has importantly demonstrated a consistent pattern of size and age among different specimens of Leoceldichthys from three differing areas of their skeletal remains. The size and age estimates are compatible with what is known of the growth of large modern-day oceanic suspension-feeding chondrichthylans.

**Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)**

**BODY SHAPE DIFFERENCES BETWEEN NORTH AMERICAN AND ASIAN FOSSIL CATOSTOMIDS AND ONTOGENETIC CHANGE IN EARLY CYPRINIFORMS**  
LIU, Juan, University of Alberta, Edmonton, AB, Canada; TSENG, Zhijie J., Natural History Museum of Los Angeles County, Los Angeles, CA, United States; WILSON, Mark V., University of Alberta, Edmonton, AB, Canada; MURRAY, Alison M., University of Alberta, Edmonton, AB, Canada

The most studied early fossil catostomid Amynon aggregatum (Cypriniformes, Catostomidae), recorded from the early Eocene of Canada, was highly variable in its meristic and metric characters. Measurements and meristics of two other well-known species of Amynon overlap with this species. One of these, A. gosaitense from the Green River Formation, has been considered by some to be a junior synonym of A. aggregatum. The other, A. humanense, from southern China, is difficult to distinguish from A. aggregatum based solely on meristic and metric characters. To examine body shape differences of early catostomids and shape change through ontogeny of early cypriniforms, geometric morphometric analyses were performed on three early catostomid species, as well as on the Eocene Jianghanichthys hubeniensis, a putative basal cypriniform. Anatomical landmarks were digitized in two dimensions on complete fossil specimens preserved on slabs. First, principal component analysis (PCA) shows that the body shape of Jianghanichthys differs from that of all included species of Amynon, and that a difference between North American and Asian catostomids is also apparent within the body shape morphospace. The Asian species possess a comparatively shorter head, caudal peduncle, and dorsal fin base, a more caudally placed anal fin, and a deeper body. Second, regression analysis of shape changes with size shows a parallel pattern of body shape change through ontogeny in all tested taxa. General shape changes with growth include: skull, caudal peduncle, and anal fin base shorter, body deeper, dorsal fin base extended further anteriorly and posteriorly, and pectoral fin originating more anteroventrally. Interestingly, PCA performed on the residuals of the body size and shape regression analysis (to remove size effects) showed that the body shapes of tested taxa became less distinct from one another when compared with the residuals of analysis prior to size correction; this holds true even between Amynon and Jianghanichthys. This indicates that comparisons among species should concentrate on individuals of similar body size. The size-corrected morphospace nevertheless shows Amynon having a shallower body and longer head than Jianghanichthys. Discriminant function analysis of both datasets returned negligible errors in correct identification of species based on body shape, but these results were statistically significant (p<0.0001) only between genera. In conclusion, body shape changes indicated by geometric morphometrics analysis has the potential to improve diagnosis of closely related fossil catostomids, as well as to illuminate inter-specific differences in morphological shape that become more pronounced after ontogeny (as measured by body size) has been taken into account.

**TESTING LATE CRETAEOUS LARIMID PALEOBIOGEOGRAPHIC HYPOTHESES: EVIDENCE FROM THE EVOLUTION OF BAENID TURTLES**  
LIVELY, Joshua R., University of Utah, Salt Lake City, UT, United States

Recent discoveries demonstrate that Campanian dinosaur assemblages across the western North American sub-continent (Laramidia) exhibit basin-scale endemism, with each sedimentary basin possessing its own unique assemblage, and an apparent higher-level biogeographic boundary between northern and southern Laramidia. Subsequently, during the Maastrichtian, most taxa are present in multiple basins, with some forms, such as Alamosaurus, Edmontosaurus, and Triceratops, supporting the presence of distinct northern/southern provinces, whereas others are more cosmopolitan (e.g., Tyrannosaurus rex). Despite these dinosaur biogeographic data, little attention has been paid to other vertebrate groups. To test these biogeographic hypotheses, I examined the paleobiogeography of the paracryptodiran turtle clade Baenidae using a newly-generated species-level phylogeny. Baenidae were one of the most diverse and abundant turtle clades during the Late Cretaceous, are restricted to North America, and have a well-sampled fossil record, making them an ideal study system for examining Laramidian paleobiogeography. To reassess the phylogeny of Baenidae, I revised and expanded the character and taxon sampling of previous studies, with 106 characters and 32 baenid taxa (the pleurosternid Glyptopus plicatus was the outgroup), including adding three new taxa from the middle Campanian Kaiparowits Formation of southern Utah. These are two new, large-bodied species of the genus Neuranaksylus and a taxon closely related to Hayemys latifrons from the Maastrichtian Lance Formation of Wyoming. I also added new morphologic data from known taxa, such as the previously undescribed skull of Denazemys nodosa. Based on
occurrences alone, Campanian baenid assemblages display distinct northern and southern provinces with no taxonomic overlap. To investigate the evolutionary patterns of this biogeographic signal, I applied a dispersal-extinction-cladogenesis model to the strict consensus tree and three randomly selected most parsimonious trees (out of a total of 18) from my phylogenetic analysis. For each tree, I computed both smoothed and strict temporal calibrations. My analysis reveals that the ancestral ranges for basal baenid branches cosmopolitan across either Laramidia or all of North America. More derived baenids (i.e., sub-clade Baenoddda) possessed ancestral ranges in the area of Montana, Wyoming, and the Dakotas; the analysis reconstructs multiple individual lineages then dispersing to southern Laramidia and Alberta.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 9:00 am)

CONFIDENCE INTERVALS ON NODE AGE ESTIMATES IN VERTEBRATE PHYLOGENY

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Palaeontology and biology are increasingly converging on common goals and methods, particularly in the region of fossil ages and related measures. Herein, we present a relatively recent adoption of Phylogenetic Comparative Methods (PCM) by palaeontologists has exposed a hitherto unrecongnised problem in how fossil trees are dated. Specifically, the approach of dating each node using its oldest descendant means at least of half of all branches have a duration of zero – an untenable and unrealistic result. Previous solutions to this problem have been somewhat arbitrary in nature, for example: adding a million years to each node. Here we use a novel approach that takes as its input the topology, tip ages and, critically, outgroup ages for a given clade. All internal nodes are then dated by either a probabilistic- (where specific requirements are met) or randomisation-approach. The method then returns a distribution of ages for each node, allowing for median and 95% confidence estimates. Exploratory application of this approach to a 554-taxon phylogeny of placental mammals gives a median age for the origin of the clade as 84.28 Ma with 95% confidence intervals of 71.32–106.04 Ma. Comparison with a recent molecular clock analysis shows that for all comparable nodes (Carnivora, Ceratomorpha, Perissodactyla and Placentalia) the 95% confidence intervals comfortably overlap. Thus, explicitly taking into account the uncertainty implied in the fossil record indicates a greater congruence between fossil and molecular results than previously suggested.

Beyond cross-correlation between dating methods future applications of this approach include: 1) leveraging more fossil data than merely the oldest crown-group occurrence for a clade to provide better calibration dates for molecular clock approaches, 2) providing more accurate branch-length estimates as input data for PCM approaches such as trait evolution and, 3) establish non-minimal backward range extensions for analyses of diversity, origination and extinction.

Technical Session I (Wednesday, October 17, 9:00 am)

THE EARLY EVOLUTION OF TYRANNOSAURID DINOSAURS: NEW ANATOMICAL, PHYLOGENETIC AND BIOGEOGRAPHIC EVIDENCE

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Recent descriptive and phylogenetic work over the past decade has identified an increasing number of Middle-Late Jurassic and Early Cretaceous small theropods that may be early representatives of Tyrannosauroidea, a clade that includes the Late Cretaceous radiation of western North American and Asian tyrannosaurids. However, the interrelationships of these early small-bodied forms, and the taxonomic composition of Tyrannosauroidea, remain controversial. To elucidate the early evolution of tyrannosaurids, we conducted a phylogenetic analysis of 57 taxa and 501 characters, with both increased character sampling as well as critical reexamination of existing character definitions and codings. This analysis also includes a broad sampling of neotheropod and coelurosaur outgroups to ensure proper character polarization. In conjunction with this analysis we re-examined material assigned to the Late Jurassic theropod species Leptonychus clevelandi, from the Cleveland-Lloyd-Dinosaur Quarry in the Upper Jurassic Morrison Formation of central Utah.

Re-analysis of theropod materials from the Cleveland-Lloyd bonebed resulted in the identification of significant new early tyrannosaurid material. These remains enhance the known morphology of Stakesosaurus and permit detailed comparisons with other early members of Tyrannosauroidea. Among the elements that can now be referred to Stakesosaurus are a premaxilla, maxilla, complete braincase, two ilia, and two ischia. The cranialfacial elements are morphologically similar to other early tyrannosaurids, including Dilong, Guanlong, Proceratosaurus and Kileskus. Particularly notable, the ilia of Stakesosaurus are very similar to Juratyrant, Eotyrannus, Ichthyosaurus and Yutyrannus in possessing a dorsocaudally inclined supracoccygeal crest, a rounded dorsal outline and a peg-and-socket ischial suture. The ischium of Stakesosaurus is similar to Juratyrant. The results of the phylogenetic analysis dramatically enhance our understanding of the early history of the clade between 170 and 120 Ma, demonstrating a close link between most early tyrannosaurid taxa and Stakesosaurus. In contrast, the Early Cretaceous taxa Dilong, Eotyrannus and Yutyrannus represent more derived tyrannosaurids more closely related to Tyrannosauroidea, indicating an independent radiation of basal tyrannosaurids in the Late Jurassic. This new information suggests that early tyrannosaurids had a widespread Laurasian distribution during the Late Jurassic and Early Cretaceous, potentially indicating repeated dispersal events between Europe, Asia, and North America.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

HIGH OBSERVER VARIABILITY IN DENTAL MESOWEAR ANALYSIS OF AN EXTREME GENERALIST CORMOHIPPARION EMSLIEI FROM FLORIDA: CAUTIONARY LESSONS LEARNED FROM INTEGRATING GEOCHEMICAL AND DENTAL MESOWEAR DATA

LOFFREDI, Lucas F., Vanderbilt University, Nashville, TN, United States; DESANTIS, Larisa R., Vanderbilt University, Nashville, TN, United States

Dental mesowear is an inexpensive and quick method used to assess the average diet of herbivorous mammals. In contrast to dental microwear that captures dietary abrasion produced via abrasive food material during the last few weeks of an animal’s life, mesowear captures wear produced over the lifetime of the animal by both attrition and abrasion. Most mesowear methods focus on qualitatively categorizing cusps shapes as high, round, or blunt (also noting high or low relief), or categorizing teeth into numerical categories (typically 0 to 6, from sharp to blunt) that integrate these variables. As mesowear requires an observer to make subjective judgments as to tooth categories, we aim to assess observer variability similar to what has been done with other observer reliant methods such as dental microwear. Additionally, we integrate carbon isotope geochemistry with mesowear data in a generalist herbivore Cormohippipharion emsli to assess if mesowear similarly records average dietary information. Stable carbon isotope samples from C. emslii of the Bone Valley (~5 Ma) were analyzed and added to previously published data, yielding a δ13C range of 13.7‰ (-12.9 to 0.8‰). These geochemical data suggest extremely generalized diet behavior ranging from primarily browsers to grazers. Mesowear data collected by experienced individuals and minimally trained individuals are significantly different from one another, with experienced individuals assigning lower average shape categories (e.g., assigning blunt over round; p<0.001) and lower relief categories (e.g., assigning low over high relief; p<0.024), while assigning higher numerical categories (p<0.01). Furthermore, multiple linear regression models of shape and relief categories significantly predict assignments of 0-6, while experienced individuals have higher R² values than novices (R²=0.95, R²=0.81, respectively). All shape and relief categories were assigned to 83% and 100% of teeth sampled (n=23), respectively. Despite these differences, average mesowear values of all teeth sampled are ~4.0 (on a 0-6 scale) for both observers and consistent with a mixed diet. However, stable carbon isotope and mesowear data for identical specimens are not significantly related, with Δ13C extremes (-12.9 and 0.8‰) yielding mesowear values only 0.7 apart (4.9 and 4.2), based on experienced classifications. Collectively, these data demonstrate that mesowear data is highly variable and should not be interpreted as identical to geochemical data.

Unpublished data presented by the first author is included in this analysis.

A NEW SPECIES OF ICHTYSOlaus FROM THE LOWER JURASSIC (PLIENSBAChIAN) OF WEST DORSET, ENGLAND

LOMAX, Dean R., Doncaster Museum and Art Gallery, Doncaster, United Kingdom; MASSARE, Judy A., Earth Sciences Dept., SUNY College at Brockport, Brockport, NY, United States

A new species of Pliensbachian ichthyosaur from the Stone Barrow Marl’s Member (Charmouth Mudstone Formation) of Dorset, England is recognized. The species is assigned to Ichthyosaurus on the basis of humerus, forefin, and pectoral girdle morphologies. Diagnostic features of the new species include a long, fairly robust snout, moderate to small orbit, short stout humerus, and very small femur (and hindlimb) relative to the humerus (and forefin). Two specimens are known, the proposed holotype and a nearly complete skeleton of a juvenile, possibly from Lyme Regis (stratigraphy unknown). According to current criteria for assessing the maturity of ichthyosaurs, it appears that the holotype is at least a sub-adult. The new species brings the diversity of Pliensbachian ichthyosaurs to at least three and possibly as many as five species, representing three genera: Ichthyosaurus, Leptonectes, and Temnodontosaurus.

Technical Session II (Wednesday, October 17, 9:15 am)

A PECULIAR TETRAPODOMORPH FISH FROM THE MIDDLE DEVONIAN OF LOMAX, Dean R., Doncaster Museum and Art Gallery, Doncaster, United Kingdom; HOLLAND, Timotho, Museum Victoria, Melbourne, Australia; YOUNG, Gavin C., Australian National University, Canberra, Australia

A new tetrapodiform fish (Osteichthyes; Sarcopterygii) from the late Middle Devonian (late Givetian) Harujica Sandstone member of the Amadeus Basin, central Australia, is represented by several near complete skulls and much of the body and postcranial skeleton. It has been studied from latex casts made from detailed sandstone impressions. It had a long parietal shield relative to its postparietal, a posteriorly broad postparietal shield, very small orbits and broad, triangular extratemporal bones, allowing confident phylogenetic placement within the caniniformid clad, as shown by a new PAUP analysis of tetrapodomorph fishes. Our analysis also questions the long held position of Rhizodontida at the base of the
clade containing total group Tetrapodomorpha minus Kenichthyas. Caninowindrioids are an endemic clade of tetrapodomorph fishes only known from the Middle-Late Devonian of Australia and Antarctica. This new form shows greater morphological disparity and reveals new points of anatomy not previously known for the group, such as the structure of the palate and paraconid, which is v-shaped posteriorly. It is also unusual in having large open spiracles on top of the head, cheek plates tightly integrated anteriorly to the skull roof, and large lateral extrascapulars that almost meet mesially. The significance of the large spiracles, also seen in the late Devonian Gogonasus andrewsi, hinges on the fact that the new genus is older than Gogonasus, well before the period of anoxia in the Devonian reef previously thought to be a possible explanation for these structures being developed for accessory air-breathing. The new find suggests that large spiracles appear at different times and at widely differing nodes in the stem tetrapod radiation so were most likely a convergent feature that did not become phylogenetically significant until established as a robust character in the more derived elpistostegalians, and later transformed in early tetrapods into the tympanum.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

MULTIPLE INTERCONTINENTAL DISPERSALS OF THE RHIZOMYINAE (SPALACIDAE, RODENTIA)

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The Subfamily Rhizomyinae is known from the late Oligocene to the present. Today, this group comprises only six species, which live in southern Asia and eastern Africa: Rhizomys sinensis, R. prainensis, R. numeratus, Cannomys badius, Tachyoryctes splendens, and T. macrocephalus. However, the rhizomyines were more diverse and had a much wider distribution in Asia and Africa in the past. Thus far, 33 fossil species can be referred to this group: Rhizomy (Brachyrhizomyziforms) shanxi, R. (Brachyrhizomyziforms) shajius, Miorhizomys nagrii, M. micrus, M. blaci, M. pilgrimii, M. harrii, M. tachyrhachu, M. choristus, Prokansamyctes tatroi, P. nukoka, T. plicaeacens, T. konjii, Rhizomyides svalenis, R. punjabensis, R. cartonnelli, R. platymyrtos, Kainamys indicus, R. nagri, K. svalensis, K. potvarenisi, Eicooryctes kaulialensis, Anepirkizomyziforms spkyeki, A. pinicrus, Pronakalimys andrewsi, Nakalimys lavocati, Prokansamyctes kowalskii, P. arifi, P. benjasvnti, P. major, P. sp. from Libya. A cladistic analysis involving fossil and living species has been carried out. The most basal representative of the subfamily Rhizomyinae belongs to Prokansamyctes and the crown-group is formed of two clades: Tachyoryctini and Rhizomyini. This analysis provides information about the origin of the African rhizomyines and allows inference of multiple dispersal phenomena from their Asian center of radiation to Africa at different times during the Miocene. Thus, a first geodispersal of Prokansamyctes from Pakistan to East Africa would have taken place at the beginning of the early Miocene. From this first event Prokansamyctes sp. from Jebel Zelen would have originated. The second and third geodispersal events took place probably not earlier than 18 Ma and would have given rise to the middle Miocene Pronakalimys and to the late Miocene Nakalimys. With respect to the late Miocene Prokachrycties malouka and the African Tachyoryctes, two unidirectional dispersal events from southern Asia to Africa took place in the late Miocene (not earlier that 8.2 Ma). The first involved the origin of Pronakalimys nukoka, whereas the derivation of the African Tachyoryctes (Tachyoryctes spp) would have come from an independent entry into this continent.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

PATTERNS OF ENCEPHALIZATION IN THE EARLY EVOLUTION OF PRIMATES

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Ancestral state reconstruction techniques are widely used to estimate character states at widely differing nodes in the stem tetrapod radiation so were most likely a convergent feature that did not become phylogenetically significant until established as a robust character in the more derived elpistostegalians, and later transformed in early tetrapods into the tympanum. Posters on this topic will discuss the ancestral state reconstructions of absolute and relative brain size (encephalization quotient; EQ) on key nodes related to Primates, including Euarchoonta, Primates sensu lato (including "Plesiadapiformes"), Eupratimiformes (Plesiadapidae + Eupratimates), Eupratimates, Strepsirrhini, and Haplorhini. Two ancestral state reconstruction methods were used: Bayesian Markov Chain Monte Carlo, using a random walk model, and square-change parsimony. We examined data for brain size and EQ values for 37 species of extant primates (including 612.0x792.0, 130 © 2012 by the Society of Vertebrate Paleontology
from the same Arikareean beds in Wyoming. These identifications extend the geographic range of these previously rare and badly misunderstood canals from a limited area of eastern Wyoming to the Pacific Coast.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

NEW SPECIES OF THE ENIGMATIC ARCHOSAURIFORM DOSWELLLIA FROM THE UPPER TRIASSIC BLUEWATER CREEK FORMATION, NEW MEXICO, USA

LUCAS, Spencer G., New Mexico Museum of Natural History, Albuquerque, NM, United States; HECKERT, Andrew B., Dept. Geology, Appalachian State University, Boone, NC, United States; SPIELMANN, Justin A., New Mexico Museum of Natural History, Albuquerque, NM, United States

The occurrences of doswelliid archosauriforms from the Upper Triassic Chinle Group of the American Southwest are based on incomplete material, principally osteoderms. Here, we document a new species of the doswelliid archosauriform genus Doswellia based on an incomplete, but associated, skeleton from NMMNH (New Mexico Museum of Natural History and Science) locality 5700 in the Upper Triassic Bluewater Creek Formation of the Chinle Group in central New Mexico, U.S.A. The new specimen, NMMNH P-61909, differs from D. kaltenbachi Weems, the type and only known species of Doswellia, in its larger size, higher tooth count and greater heterodonty, possession of keels on the cervical centra, and the presence of discrete knobs or spines on some osteoderms. Our reconstruction thus shows a more complex snout shape, with terminal nares, but also multiple lateral bulges reminiscent of phytosaurs, albeit with greater heterodonty in that the teeth in the bulges are much larger than those between them. Other preserved elements, such as the quadrate and surangular, are extremely similar to the type of D. kaltenbachi, so we do not consider the Sixmile Canyon material a distinct genus. The cervical centra are particularly distinctive, being strongly laterally compressed such that they are nearly x-shaped in cross-section with prominent keels on the anterior and lateral faces. Most of the osteoderms are indistinguishable from those of D. kaltenbachi, but some possesses a distinct spike projecting from the dorsal surface.

This is the fourth occurrence of Doswellia and only the second occurrence of a Doswellia skull. The Sixmile Canyon material includes portions of both the premaxilla and maxilla (which were previously unknown) and therefore the best upper dentition, and also has the best-preserved cervical vertebrae. Although it adds to our knowledge of the anatomy of Doswellia, this new information does not alter previous concepts of the phylogenetic relationships of the doswelliid genera, largely because they are so poorly known anatomically. The genus Doswellia is known from the Newark Supergroup in Virginia, and the Chinle Group in Texas, New Mexico and Utah, in strata of Osichilkian-Adamanian age. Because of the strong similarity of most osteoderms of both the new taxon and D. kaltenbachi, records of Doswellia based on osteoderms can only be referred to Doswellia sp., although they are distinct from the other named doswelliids Archeopelta and Tarajid. NMMNH locality 5700 is approximately 43 m stratigraphically below a bed from which U-Pb dating of detrital zircons by multiple techniques yields a maximum depositional age of ~220 Ma, so this is a reasonable approximate upper limit for the numerical age of NMMNH P-61909.

Poster Session II (Wednesday, October 17, 4:15 - 6:15 pm)

NEW CENTROSAURINE CERATOPSID MATERIAL FROM THE MIDDLE CAMPAIGNAN WAHWEAP FORMATION OF SOUTHERN UTAH

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The Upper Cretaceous (middle–late Campanian) Wahweap Formation of southern Utah contains the oldest diagnostic evidence of ceratopsids (all centrosaurines) in North America, with a number of specimens recovered from throughout a unit that spans between 81 and 77 Ma. To date only one single specimen has been named, Diabloceratops eatoni, from the middle member of the formation. The phylogenetic affinities of other Wahweap Formation ceratopsids remain ambiguous, due in part to the recovery of incomplete specimens. The new centrosaurine material (Utah Museum of Natural History VP 20550) reported herein derives from the upper member of the Wahweap Formation and lends insight into ceratopsian diversity in this formation. UMNH VP 20550 represents a single individual recovered from a calcareous mudstone and consists of: two curved and elongate orbital horncores, a left horncore from the upper member of the Wahweap Formation and lends insight into ceratopsian middle member of the formation. The phylogenetic affinities of other Wahweap Formation or (2) a distinct centrosaurine ceratopsid in the upper member of the Wahweap Formation.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

NEW INSIGHT INTO THE LOCOMOTOR BEHAVIOR OF THE GIANT SHORT-FACED BEAR, ARCTODUS SIMUS, REVEALED BY 3D LANDMARK MORPHOMETRIC ANALYSIS OF THE FORELIMB

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Researchers have long been aware of the characteristic skeletal morphology displayed by the Pleistocene giant short-faced bear, Arctodus simus ( Ursus, Tremarctinae), but none have confidently interpreted the functional implications of those features that set it apart from the rest of the Ursidae. One hypothesis is that A. simus filled a similar niche to the extant African lion, Panthera leo, using its shortened rostrum for a more powerful bite and its relatively long legs for more cursorial locomotion, but more recent studies have proposed alternative interpretations. A. simus is reconstructed as a high-speed predator, long-distance scavenger, specialist herbivore, or generalist omnivore depending on the researcher asked. Most comparative studies aimed at recreating the paleobiology of this species have focused on craniodental features or basic postcranial indices, and none have studied the finer details of shape between elements and muscle attachment sites within the appendicular skeleton of A. simus. This hypothesis, because it is based on the forelimb and is produced in a through-feeding ecology and locomotion, follows that a detailed analysis of the major elements of the forelimb will shed light on the elusive behavior of the giant short-faced bear. Such an endeavor was here pursued using traditional and three-dimensional landmark morphometrics and represents one of the first 3D landmark analyses of whole postcranial elements. Previous observations of the scapula, humerus, radius, ulna, scapholunar, magnum, and third metacarpal are confirmed, and while overall gross morphology and proportions are quite bear-like, a trend of reduced abductor-adductor/supinator-pronator musculature, more restricted parasagittal joint motion, increased stride length, and lighter, more packed distal elements is suggested. These trends agree with the hypothesis that A. simus represents a bear in the early stages of cursorial evolution and was likely capable of efficient, high-speed, straight-line, long-distance locomotion.
RECONSTRUCTION OF INACCESSIBLE ANATOMY FROM AN EARLY PERMIAN LANTHANOSUCHOID (AMNIOTA: PARAREPTILIA), AND A NEW PHYLLOGENETIC ANALYSIS OF THE PARAREPTILIA

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One of the newest parareptiles to be described from the Richards Spur locality of Oklahoma consists of an exquisitely preserved small, triangular skull (total skull length ca. 25mm) with both rami of the mandible in perfect articulation. Several important areas of the holotype and only known specimen are inaccessible to detailed anatomical study, and cannot be observed through direct visual examination. These areas include the tooth-bearing surfaces of the dentaries, portions of the palate that are covered by supportive matrix and other elements, and parts of the braincase that are covered by the skull roof. The skull has been scanned using computed tomography (CT) because these regions of the skull are critical for detailed phylogenetic analysis of parareptile interrelationships. The resulting data have been used in conjunction with imaging software to produce three-dimensional models of the obscured elements of the skull. Reconstruction of the dentaries reveals that the dentition of the mandibles is very similar to that of the maxillae, with the presence of recurved, unicuspids. Each dentary also exhibits the presence of two large caniniform teeth, much larger than the other marginal teeth of the dentaries. Reconstruction of the palate allows for the lateral portions of the palatal surface, obscured in this specimen by supportive matrix and the mandibular rami, to be seen in four dimensions. A new phylogenetic analysis including this new taxon revealed that it was a member of the parareptilian clade Lanthanosuchoidae. A new analysis incorporating the anatomical data revealed by this study, together with the addition of other recently recovered Richards Spur parareptiles further solidified the position of the new taxon as a lanthanosuchaid and revealed that the newly added parareptiles were also members of the Lanthanosuchoidae.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

THE NEW WORLD TROPICS AS A CRADLE OF BIODIVERSITY DURING THE EARLIER MIocene: CALIBRATION OF THE CENTENARIO FAUNA FROM PANAMA

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New excavations along the Panama Canal have yielded a growing Miocene vertebrate assemblage referred to as the Centenario Fauna. Despite its proximity to South America, the mammals of the Centenario Fauna have entirely North American affinities. The Centenario Fauna, which is distributed throughout a ~115 m stratigraphic interval encompassing the upper portion of the Panama Basin, is the best-preserved, largest, and most diverse assemblage of late Miocene terrestrial mammals from the Americas. A new phylogenetic analysis of the three size classes of North American Land Mammal Ages (NALMAs) as these are defined from the Miocene of South America, i.e., the Arikareean, Hemingfordian, and Barstovian. This new analysis indicates that the taxa of different NALMAs exist at the same horizons, nor by reworking (REE analyses refute this explanation), and thus we assert that these associations are biologically meaningful. Previously published age determinations using Sr-ratio and U-Pb methods constrain the age of the lower limit of the Centenario Fauna to no younger than ~19 Ma, but the upper limit has remained problematic. A fresh exposure of the Cucaracha tuff, which is demonstrably interbedded within the principal reference section measured at Centenario Bridge, has yielded two new radioisotopic ages: (1) a Ar/Ar weighted plateau age of 18.94 +/- 0.83 Ma; and (2) a U-Pb zircon age of 18.81 +/- 0.30 Ma. Given these geochronological and paleomagnetic constraints, the age of the Centenario Fauna from the Bridge section occurs within the 0.27-Myr interval of chron C5Er. This essential correlates to the late Arikareean NALMA (Aar) interval during the early Miocene. These results have significant ramifications for biogeographic history of Barstovian, and possibly Hemingfordian, mammals. The ancient New World tropics during the early Miocene apparently supported a cradle of diversity from which numerous taxa subsequently dispersed northward, accounting for their better-known distributions in temperate North America.
vertebrate taxa from the type Laventan are widespread across northern equatorial South America, Amazonia and along the Andes from Ecuador and Bolivia to as far south as Chubut Province in Patagonia. Older and younger faunas are known from both the Miocene lowland and highlands of equatorial South America. The faunal sequence in southern Ecuador includes the Miocene. Mammalian faunas spanning the interval from the early Miocene to 11.2 megamammals. Argon/Argon age and faunal content reveals pre-Laventan, Laventan, and younger levels. Associated crocodilians, turtles, and leaf morphology indicate a temporal progression from lowland humid tropical to submontane and montane habitats between sea-level and 2000 (+/-500) meters elevation. Rank correlation and multivariate partial constrained ordinations of modern faunas along altitude gradients in the tropics indicate that altitude influences faunal composition through temperature and moisture (dry season) effects by increasing proportions of grazers (p<0.01), fossorial (p=0.05), and terrestrial (p=0.001) mammals. Applying these results to the paleofaunas of southern Ecuador, pre- and post-uplift faunas have fossorial taxa indicating annual rainfall <2000 millimeters (consistent with results from leaf morphology), and higher crowned rodents and toxodonts appear in the post-uplift fauna. Shared mammal taxa suggest orographic continuity extended southward at least to Bolivia. The post-uplift mammal assemblage differs in characteristics of ecological morphology that suggest dryer, more open or mosaic habitat. By analogy with modern vegetation, such environments at the equator would require an orographic rainshadow. However, leaf morphology shows no significant change in valley bottom vegetation during the interval of uplift. Neither canopy continuity nor upland vegetation are yet sampled, although a pilot study confirms the presence of well-preserved phyloliths in the San Cayetano and Lettero formations (pre- and post-uplift). Forest indicator phyloliths (palms and bamboo) dominate the assemblages and indicate mostly closed habitats.

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

USING PALEOSOLS TO IDENTIFY NICHE PARTITIONING IN MIOCENE EQUIDS OF CENTRAL OREGON

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In Miocene deposits throughout North America, several genera of equids are frequently found co-occurring. Here I test whether these co-occurrences are consistent with niche partitioning as detected through environmental proxy data. Although equid niches traditionally are inferred based on morphology, the sedimentary record, especially that of paleosols, provides an independent second line of evidence to characterize the niche occupied by a given taxon. I used information from paleosols to characterize niche-space of equids at the level of genus, focusing on Barstovian deposits that commonly contain equid fossils in Central and Eastern Oregon. There are the three dominant genera are Archaeohippus, Desmatippus, and Merychippus. The general tooth morphology in tooth row height, length and size and on that basis it has been suggested that they occupy different dietary niches and environments. I tested this hypothesis by using the paleosol record to reconstruct precipitation values for the environment with which each genus is associated. Paleosol samples were taken from Bw and Bt horizons in which specimens of each genus were found: these span the Barstovian deposits of the study area both spatially and temporally. The bulk geochemistry was analyzed using X-ray fluorescence (XRF). Paleoprecipitation was calculated using a published relationship between the chemical index of alteration without potassium (CIA-K). Preliminary results indicate the early Barstovian was wetter than the Arikareean, Hemingfordian and Clarendonian in concordance with the mid-Miocene climatic optimum. Archaeohippus specimens are associated with deposits that have the highest calculated precipitation values, consistent with its low crowned molars that suggest it was most likely a browser in densely vegetated areas. Merychippus specimens, in contrast, are associated with the lowest precipitation values, consistent with their high-crowned molars that suggest a full grazing diet in grasslands. Precipitation results are less clear for Desmatippus; which is inferred to have had a diet consisting of more grassy vegetation than Archaeohippus based on its more complex and hypsodont tooth morphology. These results are the first to provide paleoprecipitation data for Barstovian deposits in Oregon, and demonstrate how the sedimentary record can be utilized as a second line of evidence in reconstructing ecological niches.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleocology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 11:15 am)

WILDFIRE PALEOECOLOGY FROM THE CRETACEOUS COAST OF SOUTHWEST APPALACHIA AT THE ARLINGHAM ARCHOSAUR SITE, TEXAS

MAIN, Derek J., University of Texas, Arlington, TX, United States; NOTO, Christopher R., University of Wisconsin-Parkside, Kenosha, WI, United States; SCOTICE, Christopher R., University of Texas, Arlington, TX, United States; WEISHAMPPEL, David W., Johns Hopkins University School of Medicine, Baltimore, MD, United States

The Arlington Archosaur Site (AAS) is a diverse fossil locality from the Cretaceous (Cenomanian; 95 Mya) Woodbine Formation that occurs within the Dallas–Ft. Worth Metroplex of North Texas. The paleogeographic setting is a coastal plain that stretched across a peninsula along the southern interior sea of southwest Appalachia. The climate in this part of Appalachia during the Cenomanian was moist, with a distinct dry season. The beginning of the wet season may have begun with intense tropical storms that sparked wildfires via lightning strikes. The AAS offers a unique chance to study southern Appalachian paleoecology and the effect of seasonal disturbance on an ancient coastal ecosystem.

The AAS fossil exposures occur within a 2 m section of peat and paleosol. The peat is fossil rich and contains numerous, well preserved vertebrates including fish, amphibian, mammal, turtle, crocodiliform and dinosaur (theropod and ornithopod), as well as the remains of numerous trees. The crocodiliform recovery from this bed consists of remains from an interesting new taxon. Overlying the peat, is a paleosol sequence containing dinosaur, crocodiliform, and fish. The dinosaur material recovered to date consists of remains from a new taxon of basal hadrosaurid. The paleosol contains two distinct horizons. The upper is mottled and well-rooted with numerous calcareous concretions, within which are preserved charcoal, from individual fragments to large stumps and root systems. The lower horizon is a gray mudstone lacking root traces and preserving the majority of the fossils. Concretions formed during the dry season, where the water table dropped to the level of the lower horizon, which remained waterlogged year round.

Alternating seasons brought the threat of wildfires, as shown through abundant charcoal found throughout the site. Charcoal conglomerate beds and numerous fragments are visible throughout the outcrop, occurring below, within, and above the vertebrate fossil horizons. The presence of charcoal conglomerates is typical of coastal, deltaic systems where burned materials were transported by river channels. We suggest that periodic wildfires were influential in driving the high diversity preserved at the AAS and provide a unique opportunity to study the Intermediate Disturbance Hypothesis (IDH) in a coastal Cretaceous ecosystem. The IDH states that diversity is highest in environments experiencing moderate levels of disturbance, such as those experiencing seasonal storms. Wildfires are not geographically random, but occur within specific paleoclimate zones that are predisposed to fires. Continued study of wildfires may elucidate links between paleoclimate and biodiversity in coastal Cretaceous ecosystems.

Technical Session XV (Saturday, October 20, 11:15 am)

EOLUTRONIC TRENDS IN THE SHAPE OF THE SQUMOSAL IN CERATOPSIS DINOSAURS

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The well documented Late Cretaceous Ceratopsidae had one of the highest rates of dinosaur speciation, as documented by the rapid variation in their diagnostic cranial ornamentation, including that on the nasal, postorbital, and parietosquamosal frill. To investigate shape change across the two main ceratopsid clades, Chasmosaurinae and Centrosaurinae, we applied geometric morphometrics (GM) using a 22 landmark configuration for 74 squamosals, including juveniles, subadults, and adults (juveniles only in centrosaurines sample), of 25 ceratopsid species (11 Centrosaurines and 14 Chasmosaurines). Principal Component Analysis indicates that centrosaurines have a uniform squamosal shape, with the exceptions of the basal centrosaurines Diabloceratops eatoni and Avaceratops lammeri, and the more derived Spinops sternbergorum. A Mantel test between a phylogenetic covariance matrix and a Procrustes distance matrix demonstrates that disparity in the ceratopsid squamosals is highly constrained by phylogeny. An evolutionarily significant allometric signal exists between the two clades (Chasmosaurinae and Centrosaurinae), but not within clades. Even when accounting for phylogeny (Phylogenetic Generalized Least Squares), the relationship between squamosal shape and size is significant. Phenotypic evolutionary rate analysis revealed a significant phenotypic shift in shape at the node for Diabloceratops and a smaller shift at the node for Chasmosaurus. Mapping of the ceratopsid phylogeny, we estimated ancestral shapes at nodes using squared change parsimony. From root to tips, centrosaurine squamosals were found to be conservative, but exhibit a slight dorsoventral expansion and a narrow angle between the infratemporal process and the caudoventral margin in more derived taxa. Chasmosaurines, compared to centrosaurines, show a derived morphology with a trend towards being more strongly expanded dorsoventrally and a narrower angle between the infratemporal process and the caudoventral margin. In this study GM allowed us to analyze quantitatively squamosal shape across different ceratopsid clades and to reveal previously unquantified phenotypic shifts and different shape patterns between clades through time.

Technical Session XV (Saturday, October 20, 11:30 am)

CERATOPSID CLADOGRAMS DIDN'T JUST GET BIGGER: EVIDENCE FOR DWARFISM IN PSEUTACOSAURUS

MAKOVICKY, Peter J., Field Museum of Natural History, Chicago, IL, United States; ERICKSON, Gregory M., Florida State University, Tallahassee, FL, United States; GAO, Xe-Qin, Peking University, Beijing, China; ZHOU, Cheng-Fu, Paleontological Museum of Liaoning, Shenyang, China

Over large evolutionary and temporal scales, Dinosauria and its major constituent clades exhibit an increase in average body mass, although this may reflect passive rather than active processes. Ceratopsians follow this general pattern and increase in body size through both time and evolutionary history. Proposed instances of evolutionary size reduction, such as the small ceratopsid Brachylophosaurus, may represent juvenile specimens and are thus inconclusive evidence for shifts in life history strategy.

Joint expeditions to Liaiyang, Shandong Province, China by Peking University and the Field Museum of Natural History in 2005 and 2007 resulted in the collection of over a dozen specimens of the small ceratopsian Psittacosaurus sinensis. Histological analysis of hind
Dietary Niche Partitioning as a Means for the Coexistence of Megaherbivorous Dinosaurs from the Dinosaur Park Formation (Upper Cretaceous) of Alberta, Canada

Mallon, John C., University of Calgary, Calgary, AB, Canada

During the Late Cretaceous, megaherbivorous dinosaurs flourished in the western interior of North America (Laramidia). At any one time, there were typically two ankylosaurs (one ankylosaurid plus one nodosaurid), two ceratopsids (one centrosaurine plus one chasmosaurine), and two hadrosaurids (one hadrosaurid plus one lambeosaurine) living in sympathy. This diversity exceeded that seen in megaherbivorous mammal communities, which are only rarely observed in the mammalian fossil record. Opinions differ about how this diversity was achieved. Some have argued that megaherbivorous dinosaurs thrived because of their low metabolic rates, or because of high primary productivity during the Late Cretaceous, implying that food resources were not limiting. It is also possible that predation pressure kept megaherbivores populations from fully exploiting the available resources. Others have argued that dietary niche partitioning played an important role in the coexistence of these animals, with each species consuming a different plant resource than the next, thereby minimizing interspecific competition.

This study uses the megaherbivorous dinosaur assemblage from the upper Cretaceous Dinosaur Park Formation (DPF) of Alberta, Canada as a model to test the dietary niche partitioning hypothesis by examining several aspects of ecomorphology known to relate to the procurement and mastication of food. These include feeding height, skull and beak morphology, jaw mechanics, and tooth morphology and wear. Evidence is sought for taxonomic separation in ecomorphospace between coexisting species, which is known to reflect niche relationships with reasonable fidelity.

Although sympatric taxa are better discriminated by some features than others, consideration of the total evidence supports the dietary niche partitioning hypothesis, as even the most closely related sympatric taxa are better discriminated according to ecomorphology. Whether these dietary niche relationships arose as a result of long-term competition, or whether they evolved allopatrically is not clear. However, the fact that conspecific species coexistence was uncommon—and when it did occur, was either short-lived or involved only rare species—implies that the structure of the megaherbivorous dinosaur assemblage from the DPF was at least partly influenced by competitive interactions.

The evolution of titanosauriform sauropods

Mannon, Philip D., Imperial College London, London, United Kingdom; Upchurch, Paul, University College London, London, United Kingdom; Barnes, Rosie N., University College London, London, United Kingdom

Titanosauriforms represent the most diverse clade of sauropod dinosaurs, with over 90 distinct species, a global distribution and a temporal range extending from the Middle or Late Jurassic through to the end-Cretaceous. However, the interrelationships of this clade are poorly understood, and most previous work has focused on the less inclusive clade of derived titanosaurians. Here we present a new species-level phylogenetic analysis focused on elucidating the evolutionary relationships of basal titanosauriforms. We analyzed a new dataset of over 260 characters for 7 outgroups and 56 putative ingroup titanosauriforms. Many of these characters are heavily revised or novel to our study, and a number of ingroup taxa have never previously been incorporated into a phylogenetic analysis. In addition, we treat quantitative characters as discrete and continuous data in two parallel analyses. Although we recover monophyletic brachiosaurids and somphiphodymbelidan sister clades within Titanosauriformes, their compositions are strongly affected by our differing treatment of quantitative data, suggesting that the decision to draw arbitrary boundaries between character states is problematic and may lead to incorrect tree topologies. Several characters traditionally considered titanosauriform synapomorphies (e.g. the lateral bulge and medially deflected proximal femur) instead characterize the less exclusive macrorian clad. A number of taxa are recovered outside of Titanosauriformes, with the putative earliest titanosaur Janenschia positioned as a basal macrornian. This removes any ambiguous pre-Cretaceous body fossil record for Titanosauria, although ghost lineages, trackways and paleoecological analyses suggest that their Jurassic absence can be accounted for by a taxonomic turnover in the absence of suitable environments. Phylogenetic diversity estimates suggest that titanosauriforms were diverse by at least the late Oxfordian, which indicates that this was not a depauperate time interval as proposed by previous analyses, but instead suggests that it is extremely poorly sampled and/or that many Late Jurassic outcrops might be inaccurately dated. Diversity increased throughout the Late Jurassic, and titanosauriforms did not undergo a severe extinction across the Jurassic/Cretaceous boundary, in contrast to didelphodons and non-neo-sauropods. Titanosauriforms of low diversity and reduced abundance, coupled with a rarity in preserved body fossils, likely represent a faunal turnover whereby basal titanosauriforms were replaced by derived titanosaurs, although this transition occurred in a spatiotemporally staggered fashion.

Using Mammalian Ungulates of North America

Marcot, Jonathan D., University of Illinois, Urbana, IL, United States; Glynn, Amanda, University of Illinois, Urbana, IL, United States

Ecological communities can be characterized by distributions of the functional roles among their constituent taxa. Changes in the functional distributions reflect reorganizations of ecological communities and ecosystem functioning. Such changes are driven by both ecological and evolutionary processes. Ecological processes change communities through differential sorting of taxa with stable functional roles. Examples of ecological processes include the addition or subtraction of taxa from a community due to either migration or interspecies interactions (e.g., predation and competition). On the other hand, even when the taxonomic composition of the community is relatively stable, community change can occur if the constituent taxa themselves evolve and their functional roles change. While numerous studies have documented ecological change due to both ecological and evolutionary processes, the relative role of each in long-term ecological change is not clear.

In this study, we use phylogenetic comparative methods to estimate the rates of character change over time, and compare these changes in the distribution of the same characters among coeval members of the herbivorous mammalian ungulate guild. If lineage evolution contributes strongly to community change, we expect rates of character evolution to be highly correlated with changes in functional distributions. We characterize species within the North American ungulate guild using ecologically relevant measurements of their dentitions. We compiled published measurements of tooth sizes from the literature, and supplemented these with novel data from museum specimens. The final data set includes more than 134 samples.
3799 specimens of 802 artiodactyl and perissodactyl species. We determine major axes of variation of dental measurements with principle components analysis (PCA). We estimate body mass for each species using published regression equations. We then determine the distributions of PC scores and taxon body size within 1.5My time intervals between 55 and 5Ma. We estimate changes between distributions in subsequent intervals using the Bray-Curtis distance. We reconstruct ancestral states of the same PC scores and body mass on a composite phylogeny, then calculate the rate of change along branches within each of the 1.5My intervals. Finally, we determine the correlation of these rates with interval-to-interval changes in the distributions.

We find no significant correlation between the dissimilarity between distributions in subsequent intervals and the rate of evolution for either the PC scores or body mass. These results suggest a relatively minor contribution of within-lineage evolution to paleoecological change among ungulates, and that ecological sorting is a dominant influence.

Technical Session XIX (Saturday, October 20, 2-00 pm)
AT THE BEST ANGLE: INCREASED INCISOR PROCUMBENCY ALLOWED POCKET GOPHERS (THOMOMYS BOTTAE) TO CLAIM CLIMATE-HARDENED SOILS
MARCY, Ariel E., Stanford University, Stanford, CA, United States; HADLY, Elizabeth A., Stanford University, Stanford, CA, United States; FENDORF, Scott, Stanford University, Stanford, CA, United States

 Morphology, changing environmental factors, and competition mediate the unique allopatric distribution of northern Californian pocket gophers (Thomomys spp.). While all gophers in the genus use claw-digging, subgenus Megascapheus gophers display a range of additional tooth-digging adaptations. GIS analysis of species localities mapped on NRCs physical soil maps demonstrates that percent soil clay, bulk density, and shrink-swell capacity separate species with different digging strategies. Clay and bulk density stay constant for 1000s of years, however, low precipitation and high temperatures can rapidly produce shrink-swell behaviors in reactive soils. These climate-hardened soils favor Megascapheus, suggesting a mechanism for a gradual adaptation event during the Pleistocene-Holocene transition. During this period of increasing aridity, T. Megacapheus botaee gophers expanded northward and displaced an exclusive claw-digging species. Geometric morphometric data from 450 adult female crania demonstrate that Megascapheus gophers with the largest angle of procumbency tend to occupy the hardest soils. We hypothesize that the expanding populations of T. botaee increased incisor procumbency through rostra remodeling as the climate hardened soils. The strong yet underestimated interaction between soil and moisture on this major vertebrate group is rarely considered when projecting species responses to climatic change. Understanding how the environment impacts gopher digging efficacy has pinpointed key climatic and associated morphological changes most likely to have influenced past populations of gophers. Given current climate trends and California’s abundant shrink-swell soils, these findings could inform distribution predictions for any organism that is dependent on a stable soil structure.

Poster Session III (Friday, October 19, 4-15 - 6:15 pm)
WHAT DOES THE LIFE HISTORY OF A FOSSIL BOVID TELL US ABOUT PALEOENVIRONMENT?
MARIN-MORATAULLA, Nekane, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain; JORDANA, Xavier, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain; GARCIA-MARTINEZ, Rubén, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain; MONCUNILL-SOLÉ, Blanca, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain; KÖHLER, Meike, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain; MARÍN-MORATALLA, Nekane, Institut Catalá de Paleontologia, Cerdanyola del Vallès, Spain

Life history traits are shaped by environmental conditions, specifically by extrinsic mortality and resource availability, and may shift in one or the other direction when these conditions change, leading to a complex adaptation of an organism’s life cycle termed its ‘life history strategy.’ Here, we aim to draw inferences on life history and paleoenvironment of Tragoparont gaudryi, an Upper Miocene small to medium sized bovid from Torrent de Traginers (Vallés-Penedès Basin, NE Iberian Peninsula). This bovid has been suggested to have dwelled in habitats with humid wood and very soft ground. We compared the life history traits, specifically age at sexual maturity, of this fossil bovid with that of two extant bovids of the same family. We counted the presence of top predators such as Stenailurus (Felidae) at this site. A higher mortality through higher levels of predation pressure would have led to compensatory changes in the timing of life-history events such as age at sexual maturity, and concomitantly cause a shift towards the fast end of the slow-fast life-history continuum.

Technical Session XIV (Saturday, October 20, 8:30 am)
FINALLY GROWN UP: IS THIS WHAT A MORPHOLOGICALLY ADULT LISSAMPHIBIAN LOOKS LIKE? NEW DATA FOR ONTOGENICS AND PHYLGENETICS FROM AN OLIGOCENE NEWT (SALAMANDRIDA: PLEURODELINAE)
MARIJANOVIĆ, David, Museum für Naturkunde, Berlin, Germany; WITZMANN, Florian, Museum für Naturkunde, Berlin, Germany

Lissamphibians, especially caudates, share features with immature and neotenic tennoospondyls and seymouriamorphs (lepospondyl ontogeny being largely unknown). This fact features prominently in the discussion about the origin of Lissamphibia. Paedomorphosis has also been a common mechanism of evolution within Caudata. Pleurodelina salamandrids (news), particularly the extant Tylototriton and Echinotriton and the Eocene to Pliocene Chelotriton and Brachycormus, show peramorphic features: sculpturing on the skull, long ribs, presacral neural spines ending dorsally in flat sculptured surfaces that articulate with each other, and contacts of the maxilla to pterygoid and quadrate. In some pleurodelins, the jaw joints lie level with the occiput (slightly caudal in some Chelotriton specimens), farther caudal than in any other caudates or even some lepospondyls. Yet, unlike the terrestrial Tylototriton and Echinotriton, Chelotriton and Brachycormus were aquatic as shown by their hyobranchium and their ribbon-like tails.

MB.Am 45.1 (Museum für Naturkunde) is a late Oligocene natural mold of an articulated presacral skeleton in dorsal view. While likely referable to Chelotriton, it is more peramorphic and larger than all previously known specimens. The jaw joints lie so far caudal to the occiput that the squamosals are inclined rostromedially to caudolaterally, unlike in any other caudate. The ribs are longer than three vertebrae, and at least some of them are curved ventrally; both features are unique among lissamphibians. Carpus and hyobranchium are at least partly ossified. Most of the skull (like the neural spine tables) bears pustular sculpture; the maxilla is honeycombed. The squamosal is uniquely so broad that the neural spine tables articulate with each other. Most of the skull bears pustular sculpture; the maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). Most of the skull (like the neural spine tables) bears pustular sculpture; the maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). The maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). The maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). The maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). The maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates). The maxilla is honeycombed. The squamosal is unusually broad rostromedially (compared to other caudates).
identified as one on a label; but features like the frontosquamosal arch and the craniodorsally directed rib spines show unambiguously that MB.Am 45.1 is a pleurodont as identified by others, there is no trace of any bones absent in other caudates but present in temno- or most lepospondyls, and the matrix fits only the site stated on the back side of the specimen (Onsberg near Erpel, western Germany).

To test whether the peramorphic reversals of MB.Am 45.1 have an impact on the phylogenetic position of caudates or modern amphibians in general, we added it to a large analysis of tetrapod phylogeny that contains *Gerothorax*, an amphibian expected to pull Caudata if not Lissamphibia into Temnospondyli. Still, MB.Am 45.1 emerges as a caudate; Lissamphibia is monophyletic; to move Lissamphibia from Lepo- to Temnospondyli requires 14 extra steps, diphyly 17.

**THE TAXONOMIC CHALLENGES OF UNDERSTANDING PHENOTYPE IN THE FOSSIL RECORD**

MARGUARD, Chloé, University of Cambridge, Cambridge, United Kingdom

The reliable identification of ‘true’ species in the fossil record has proven seriously problematic for palaeontologists over the years. This has been compounded by neontologists shifting from a morphological species concept to definitions using amino acids or genomics that are not available to palaeontologists.

Although phylogenetic methods are undeniably useful for exploring evolutionary signals and differentiating homoplasy from homology, the trees generated are only as good as their underlying matrices. An alternative approach is to investigate how morphological variation manifests itself in extant populations and how this compares to fossil deposits. This approach facilitates estimation of whether particular morpho-characters can be accurately observed in a fossil population, and identifies sources of error that may obscure their recognition.

Morphometric methods allow quantitative assessment of variability, but are not frequently applied to species recognition. A study of extant *Caiman* crocodilians was undertaken to test whether differences between species, subspecies, and sexes could be better distinguished across discrete populations. Results demonstrate that although statistically significant results are frequently obtained, their phenotypic manifestation is not always clear-cut and may be indistinguishable qualitatively. It also shows that the most distinctive phenotype in an analysis is not necessarily the furthest removed taxonomically. Additionally, traits likely to typify differences between species are also likely to be highly variable within populations, making it challenging to differentiate between inter- and intraspecific variation. This suggests that while morphometrics is a useful tool for understanding shape variation in a population, a qualitative understanding of phenotype is also needed to evaluate the significance of these differences.

As fossils were once living members of populations of species, every deposit represents a snapshot of a sub-section of a species at a moment in time. If we want to truly understand what a morphological species ‘is’ from a biological perspective and understand the constraints imposed by taphonomy on these samples, we need to study them as Operational Taxonomic Units before coming to any conclusions about their taxonomic structure. By using populations as the OTU we can compare groups through time and use the changes between these to understand which features (genetically variable in early populations) have become ‘fixed’ in later ones and extract a genuine evolutionary signal. It is hoped further advances in developmental plasticity research will give us a far better understanding of what phenotype is and what mechanisms allow it to vary.

**COMBINING MECHANICAL PREPARATION AND X-RAY COMPUTED TOMOGRAPHY TECHNIQUES TO VISUALIZE OBSCURED MORPHOLOGY IN A BASAL SAUROPODOMORPH DINOSAUR**

MARSH, Adam D., The University of Texas at Austin, Austin, TX, United States; BROWN, Matthew A., The University of Texas at Austin, Austin, TX, United States; COLBERT, Matthew W., The University of Texas at Austin, Austin, TX, United States; ROWE, Timothy B., The University of Texas at Austin, Austin, TX, United States

The use of X-ray computed tomography (CT) in the study of fossil material has increased significantly in the last decade, and has augmented or even supplanted conventional mechanical preparation techniques in vertebrate palaeontology laboratories. CT is dependent upon X-ray contrast between matrix and fossil material, and allows palaeontologists to study otherwise unobservable morphological features in specimens. The articulated left forelimb and manus of the basal sauropodomorph dinosaur *Sarahsaurus aurifontanalis* presents a unique opportunity to combine CT and standard laboratory techniques. This specimen, found in the Kayenta Formation of Arizona, represents the third described basal sauropodomorph taxon from North America. Standard mechanical preparation was performed until further preparation would have required the disarticulation of the specimen. This left several phylogenetically informative characters obscured by matrix on the palmar surface of the manus, including the presence of collateral ligament fossae, the angular offset of distal condyles, and phalangeal formulae. Because the specimen was left in articulation, articular surfaces of the carpus, metacarpus, and phalanges were also obscured. The specimen was scanned at the University of Texas High Resolution X-Ray Computed Tomography Facility (UTCT) and volumetric CT data was processed by digitally removing the mudstone matrix from each individual bone surface. Digital surface files were then generated for each element and printed in acrylic and water-soluble wax by a 3D prototyper at Innovation Park at The University of Notre Dame. These high-quality 3D replicas of the individual bones of *Sarahsaurus* reveal detailed articular surfaces of the elements in the manus, allowing thorough description of the entire specimen and aiding interpretations of the extent of the range of mediolateral compression of the fossil. Finally, the individual replicated elements were molded and cast using standard techniques, a process that would have been impossible with the original articulated specimen. Although pouring plastic casts is currently less expensive than digitally prototyping replicas, the cost of this technology is decreasing, and it is possible that future fossil preparation laboratories may have the capability to generate wax, plastic, or even bronze replicas of important fossils. Most importantly, the complementary nature of CT and mechanical preparation techniques may increase specimen longevity and avoid destructive techniques, therefore preserving a larger number of valuable morphological and contextual information. Similarly, these methods allow an opportunity to verify interpretations of previously ambiguous or unobservable character data.

**DENs OF THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) AS TRACES AND THEIR PREDICTIVE VALUE FOR FINDING LARGE ARCHOSAUR BURROWS IN THE GEOLOGIC RECORD**

MARTIN, Anthony J., Emory University, Atlanta, GA, United States; PAGE, Michael, Emory University, Atlanta, GA, United States; SKAGGS, Sheldon, Georgia Southern University, Statesboro, GA, United States; VANCE, Robert K., Georgia Southern University, Statesboro, GA, United States

Large archosaur burrows are rarely interpreted from the geologic record, a circumstance that may be attributable to a lack of search images based on modern examples, rather than actual rarity. To test this idea, we measured, imaged, and mapped den structures of the American alligator (*Alligator mississippiensis*) on St. Catherines Island (Georgia, USA). St. Catherines is an undeveloped barrier island on the Georgia coast, consisting of Pleistocene and Holocene sediments. Alligators dug most dens along the edges of freshwater pond in loosely consolidated Holocene or Pleistocene sand. Adult female alligators use dens to protect offspring, but burrows also aid in thermoregulation or serve as refugia for alligators during droughts and fires. Some dens are evidently reused and modified by different alligators after initial construction. Drought conditions along the Georgia coast have exposed many abandoned dens, thus better allowing for their study while increasing researcher safety. Den entrances have half-moon cross sections, and based on one sample (n = 20), these range from 22-115 cm wide (mean = 63 +/- 23 cm) and 14-55 cm high (23 +/- 9 cm). In addition to field descriptions, we applied geographic information systems (GIS) and ground-penetrating radar (GPR) to help define the ecological context and subsurface geometry of these structures, respectively. GPR gave spatial data relatable to alligator nesting and activity, substrate conditions, and proximity to potential nest sites. GPR produced subsurface images of active dens, which were compared to abandoned dens for a sense of taphonomic history. Most den entrances are square-sided, with tunnels dipping to the northwest or northeast. From entrances, tunnels slope at about 10-15°, turn right or left within a meter, and lead to enlarged turn-around chambers. Collapsed dens in formerly ponded areas (secondary-succession marine waters) provided further insights into subsurface forms of these structures. These features are found in very shallow (<35 cm) and in depth just below the surface (<35 cm), the latter of which appears to be the most common. This study shows that burrows may provide valuable information on denning activities, and could be used as a predictive tool for finding future large archosaur burrows in the geologic record.
and growth profiles, with no statistical difference, but Morphotype I grew to significantly larger sizes at age three in stratigraphically higher localities, whereas Morphotype II showed no change in size through the section. The relative abundance of each morphotype was different at numerous localities falling outside the 99% confidence intervals to indicate that Morphotype I was found at stratigraphically higher or lower locations compared to Morphotype II. It was initially hypothesized that the morphotypes would be attributable to the genera *Hipparion* and *Amia*. However, we reject that hypothesis as centra of Morphotype I are present in both Mesozoic and Cenozoic *Hipparion* and extinct and extant species of *Amia*. Morphotype II is not present in these genera, and thus represents a poorly known lineage currently represented by isolated elements that extend at least to the K-P boundary. The presence of two amines in the mid Campanian of Alberta suggests that amiids had a more complex evolutionary history in the Cretaceous of North America than had been previously recognized.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

**PALEOHISTOLOGICAL ANALYSIS OF METAPODIAL BONES OF MIOCENE *HIPPARION CONCUDENSE* FROM SPAIN**

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The life history of extinct animals may be assessed through the study of their hard tissues. During life, bone microstructure is influenced by internal and external factors such as developmental processes, environmental or seasonal factors, life style adaptations, and biomechanical function. Several works have shown the relationship between these aspects of life history and bone histology. In this work, we analyzed the microstructure of metapodial bones of the extinct redtoothed *Hipparion* to provide data about its development, biomechanics, and palaeoecology. The genus *Hipparion* is recorded in Eurasia from the Upper Miocene to the Plio-Pleistocene boundary. These fossil horses represent an intermediate stage in horse evolution towards higher crowned molar, larger size, and reduced autopodials. *Hipparion* horses present an autopod composed of a major central toe and two reduced lateral ones. Previous analyses from a systematic, evolutionary and palaeoecological point of view have suggested that body size and morphological variability are related to environmental conditions and ground characteristics. However, no histological studies have been performed on these skeletal elements. Here, we studied the *Hipparion concudense* species from two basins of the Late Miocene of Spain with different environmental conditions: the Turolian site (Concaud, Teral) and the Vallesian site (Valles de Fuentidueña, Segovia). Transverse ground sections from the midshaft of central and lateral metapodia were taken, stained with safranin and fast green, and examined under a microscope to identify the presence of growth and juvenile histological structures in the bones. Histological data show changes throughout the development that allowed identification of ontogenetical stages and biomechanical changes. Secondary osteons in the central metapodial bones of young individuals occur in the area associated with lateral metapodials, which show remodeled bone in the region close to central metaphyseal. These histological data confirm that lateral metapodials are involved together with the central metapodial bone in the biomechanical processes of these three-toed horses. We compared these histological data between the two *Hipparion* samples to analyze how these changes in the bone microstructure are related to different environmental conditions.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

**PRELIMINARY DATA ON THE NEW PARTIAL CARCASS OF THE WOOLLY MAMMOTH, *MAMMUTHUS PRIMIGENIUS*, FROM YAKUTIA, RUSSIA**

MASCHE, Eugene, British Paleontological Association, Russian Academy of the Sciences, Moscow, Russia Federation; POTAPOVA, Olga, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States; BOESKOROV, Gennady, Metals Geology Institute, Siberian Branch of Russian Academy of Sciences, Yakutsk, Russian Federation; PLOTNIKOVA, Valery, Olga Republic (Yakutia) Academy Sciences, Yakutsk, Russian Federation; AGENBROAD, Larry, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States

A partially frozen and mummified carcass of Woolly Mammoth, *Mammuthus primigenius*, was found in the southwest of the Russian Laptev Straight on the Yuka peninsula in northern Russia in 2009. The carcass (72°40´ N 142°50´ E) was discovered in the rich bone-bearing Late Pliocene deposits of the Chukchi Peninsula (Pile-Kleistocene). In 2010, the carcass was put in place to encourage families to spend more time together enjoying their natural surroundings. What better enticement to go outside and get excited about science than to experience paleontological resources found on America’s Public Lands? A relatively new tracksite has been managed and developed for the benefit of the public, establishing opportunities and providing information about paleontology in accordance with current paleontological legislation (PRPA). The Moccasin Mountain Tracksite (MMT) is located in southern Utah on land managed by the Bureau of Land Management’s Kanab Field Office. The MMT reveals multiple fossil footprint levels in the Navajo Sandstone (age ~185 million years) in a slick rock sandstone area covering about 1,000 m². Over the past four years, the MMT has received funding from AGO and TTO to produce a variety of educational materials, including a brochure, explorer vests, interpretive signage, and a podcast. Families can visit the Kanab Field Office and check out an explorer vest equipped with a digital camera, GPS unit, measuring tape and other equipment for documenting and measuring the tracks at the MMT. A brochure containing photographs and descriptions of the diverse ichnofauna (Grallator, Eubrontes, Onychom, Batrachopus and Brachilichnium) and a map lead “Early Jurassic Explorers” on a self-guided tour to the location of select fossil footprints. The MMT is a relatively new tracksite that has been managed and developed for the benefit of the public, establishing opportunities and providing information about paleontology in accordance with current paleontological legislation (PRPA).
footprints, encouraging the discovery and documentation of other tracks at the site. Signs to be installed on site will follow the theme of exploration, providing basic information on the MMT and complementing the brochure. As this tracksite is surrounded by prime OHV recreational areas, signage will not only help interpret the area to outdoor enthusiasts, but also discuss the conservation and management of the MMT, as well as encourage local stewardship of these valuable paleontological resources. The podcast (available for download) briefly discusses track and trackway formation, as well as highlighting technology used at the site. In 2008, close-range photogrammetric documentation of the MMT was conducted using both ground-based and low-altitude aerial imagery. Digital terrain data and ortho-imagery (at a variety of scales) were integrated into a real-world coordinate system. These images and 3D data not only form the basis for maps of the site, but also enhance the interpretation by providing virtual renderings of footprints and trackways in the podcast. This cadre of educational and interpretive materials provides an effective tool for presenting the uniqueness of the MMT to the public and encourages children of all ages to explore the paleontological wonders of America’s Great Outdoors.

Technical Session XIV (Saturday, October 20, 12:00 pm)

CHANGES IN ICHTHYOSAUR BODY SIZE DURING THE EARLY TORDIAN EXTINCTION EVENT

MAXWELL, Erin E., Staatliches Museum für Naturkunde, Stuttgart, Germany; VINCENT, Peggy, Staatliches Museum für Naturkunde, Stuttgart, Germany

Extinction events have a characteristic effect on the taxonomic composition, species diversity, and abundance in both marine and terrestrial ecosystems. Body size, both within species and within a fauna, is thought to decrease following an extinction event. Taxonomic diversity is also assumed to decrease, but the abundance of opportunistic species increases. In this study, we examined body size changes in the Lower Jurassic ichthyosaur Stenopterygius quadriscissus, the body size distribution of Posidonia Shale ichthyosaur fauna, to test if the early Toarcian extinction event had an ecological effect on large marine vertebrates.

Six elements, two from the skull and four from the postcranium, were measured for adults of S. quadriscissus (N=26). The individual score on the first axis of a principal component analysis was used to condense these measurements into a single multivariate size metric. This metric was then plotted against stratigraphic occurrence, based on regional zonation of the Posidonia Shale in the Southwest German Basin. A resampling analysis was designed to examine whether the largest individual for a stratigraphic interval was smaller than expected based on the data and the sample size for that interval. We also divided the ichthyosaur fauna into small (adult body length equal to or less than 4m; Stenopterygius, Hauffiopteryx) and large genera (Tennodontosaurus, Euthistosaurus, Suevoleviathan), and examined the stratigraphic abundance of specimens in each size class. We report a significant increase in size in S. quadriscissus following the extinction interval, but size remained constant during the survival interval. Following a similar pattern, the ichthyosaur faunas during the extinction interval showed high abundance of S. quadriscissus, but low taxonomic diversity (80% of all recovered specimens belonged to the aforementioned species). Large genera were absent from the fauna. Immediately following the extinction interval, large genera gradually became proportionately more abundant, and S. quadriscissus steadily declined.

The intraspecific body size, abundance, and generic size distribution of early Toarcian ichthyosaurs follows the classic pattern for a fauna suffering from post-event syndrome. However, this pattern occurred during the extinction interval, not following the interval as in benthic marine invertebrates. These observations suggest that large ichthyosaurs may have been more strongly affected by adverse environmental conditions from the onset of the extinction event, rather than by the final extinction pulse related to global warming and oceanic anoxia, and that conditions in the nentonic realm rapidly ameliorated at the end of the extinction interval.

Posters Session IV (Saturday, October 20, 4:15-6:15 pm)

TRACKS IN THE ARCTIC: A DINOSAUR ICHNOFOSSIL ASSEMBLAGE FROM THE UPPER CRETACEOUS PRINCE CREEK FORMATION, NORTHERN ALASKA

MAY, Peter, Research Casting International, Trenton, ON, Canada; FAIR, Matt, Research Casting International, Trenton, ON, Canada; CRAWFORD, Brett, Research Casting International, Trenton, ON, Canada; MAY, Amelia, Research Casting International, Trenton, ON, Canada; MACLEOD, Mike, Research Casting International, Trenton, ON, Canada

Three different specimens were used to develop the first skeletal mount of the giant titanosaur from the late Cretaceous of North America, *Alosaurus*. The individual elements of all three skeletons were laser scanned, creating digital files of all of the bones necessary to develop a complete skeleton. The individual bones were then manipulated by scaling for size, and if the opposite side was missing a mirror image was made. Once the complete skeleton was digitally developed, it was physically created using 3D printers and a 5 axis router. The specimen from University of Texas, Austin was originally collected in 1973 and consisted of the bones of a single specimen, including femur, humerus, hip and articulated dorsal series through to the first cervical. It had only been partially prepared. In all, 13 unprepared blocks consisting mainly of the hip and dorsal series were prepared for this specimen. The specimen from the Smithsonian was collected in Utah in 1946. It consists of approximately 30 articulated caudal vertebrae and a front forelimb. The Perot specimen was collected in 1997, and consists of nine articulated cervical vertebrae. Each specimen preserves elements that overlap with the other specimens, and that could be scaled for the reconstruction of the skeleton. The sheer size of the skeleton ruled out 3D printing of the entire skeleton from the original scanned data, due to the restrictive size of the 3D print envelope. The point cloud data generated by laser scanning had to be transferred to CAM files so tool paths could be created for a 5 axis router to carve out the replicated bones from two-pound density polystyrene blocks.

Technical Session XII (Friday, October 19, 3:45 pm)

A NEW OPHIDIOFAUNA FROM THE LATE Oligocene NSUNGWE FORMATION OF TANZANIA AND THE RISE OF COLOBROID SNAKES (REPTILIA, SERPENTES)

MCCARTNEY, Jacob A., Stony Brook University, Stony Brook, NY, United States; STEVENS, Nancy J., HCOM and Center for Ecology and Evolutionary Studies, Ohio University, Athens, OH, United States

An active field program in the late Oligocene Ngungwe Formation in the Rukwa Rift Basin of southwestern Tanzania has begun to shed light on faunal dynamics during the Oligo-Miocene transition on continental Africa. Groups recovered to date include a rich assemblage of mammals, birds, crocodylians, lepidosaurs, anurans, and fishes as well as multiple invertebrate clades. Among the Ngungwe Formation discoveries is a diverse collection of snake vertebrae. The sample (n = 23) can be sorted among four primary morphotypes: a booid of uncertain affinities, a boid, and two colubroid snakes. All of the snake specimens are small, likely representing individuals that did not exceed a meter in total length. The booid morphotype reveals important ecological insights, preserving vertebral features typical of burrowing snakes. The colubroid material strikingly dominates the ophidiofauna, comprising almost 70% of the snake specimens collected to date. This stands in stark contrast to contemporaneous faunas known from Europe and North America, both of which are dominated by booid snakes. In these regions colubroids diversified in the early Miocene, likely as a result of aridification and a spread of grasslands that favored more active predators. Sedimentological interpretations from fossiliferous Ngungwe Formation localities indicate a seasonal environment with perennial availability of water in the form of nearly fluid and shallow lacustrine settings. The early dominance of colubroids in the Ngungwe Formation may reflect seasonally drier habitats and a more ephemeral environment with new open environments in the region. Because of the lack of diverse conomoparous African faunas for comparison, it is unclear whether this fauna reflects local conditions or a continent-level pattern. Regardless, the Ngungwe Formation fauna illustrates that the pattern of ophidiofaunal turnover in Africa may be more complex than that characterizing the northern continents, either occurring earlier or in a patchier manner than has been documented for Europe and North America.
**October 2012—PROGRAM AND ABSTRACTS**

**THE COLLABORATION OF INSTITUTIONS, AGENCIES, AND VOLUNTEERS FOR A “PAINLESS” EXCAVATION OF A LARGE Glyphothium FROM THE LATE BLANCAN OF THE SAN SIMON VALLEY IN SOUTHEASTERN ARIZONA**

MCCULLOUGH, Gavin, Arizona Museum of Natural History, Mesa, AZ, United States; WALTERS, Tim, Arizona Museum of Natural History, Mesa, AZ, United States; GILLETTE, David D., Museum of Northern Arizona, Flagstaff, AZ, United States; WHITE, Richard, International Wildlife Museum, Tucson, AZ, United States; THRASHER, Larry, Bureau of Land Management, Safford, AZ, United States

In 2010 a partial carapace and associated skeletal elements of the glyptodont *Glyphothium texanum* were discovered in the late Blancan fossil beds of southeastern Arizona. Glyptodonts are very common megaфаuna found in these highly productive fluvial-lacustrine-paludal deposits, yet the variable nature of their occurrence means that each excavation can present unique problems requiring novel solutions. This new specimen provided the opportunity for a highly successful excavation combining the skills and energies of many institutions, organizations, and individuals from across the state. The fossils were found in a relatively flat area near an unimproved road, allowing vehicle access. They were partially excavated, covered with a protective plaster cap, and reburied during excavations over the previous two years in preparation for a final large-scale extraction in March of 2012. For the final extraction, volunteers were assembled from the Southwest Paleontological Society, Northern Arizona University’s Geology Department, Museum of Northern Arizona, Bureau of Land Management, and local community. The division of labor was such that work was available for volunteers of all skill levels, including pick-and-shovel digging, jackhammering, structural carpentry, and plaster jetting. The first priority was to remove the backfill dirt and rock that had been used to conceal the *Glyphothium* from view. Then, the depth and width of the trench surrounding the large (6’ x 5’ x 3’) block were increased, creating a navigable workspace and a ramp for vehicular access. Lumber and custom-bent rebar were incorporated into the plaster jacket to bolster its strength. A crude/sledded balet from 4’ x 4’ and 4’ x 6’ lumber was set beneath the jacket through cross-tunnels and the block was locked into place with lumber shims. The sled facilitated removal of the pedestal and eliminated the need to flip the jacketed block. Matrix exposed from the pedestal removal was covered with plaster belly bandages slung along the underside to prevent material from falling out of the bottom of the block. An A-frame gantry was erected and fitted with a chain hoist, and the sled-borne block was carefully lifted away from the ground in preparation for final loading. Local volunteers donated their time and a semi tractor-mounted forklift to lift the block up and out of the pit, and onto a flatbed truck for transportation to the Arizona Museum of Natural History. Upon arrival at the paleontology laboratory, the two-ton block was lowered onto a custom-made metal-wheeled dolly with an industrial fork-lift.

**Preparers’ Session (Thursday, October 18, 11:30 am)**

**ONTOGENY AND PHYLOGENY OF TEMNOSPONDYL AMPHIBIANS, A WINDOW INTO TERRESTRIAL ECOSYSTEMS DURING THE PERMOTRIASSIC MASS EXTINCTION**

MCHUGH, Julia, University of Iowa, Iowa City, IA, United States

Temnospondyls are an abundant fossil group across the Permo-Triassic boundary (PTB), the point of the largest mass extinction in the Phanerozoic. Temnospondyls is a long-lived lineage, spanning the Middle Mississippian to Early Cretaceous, crossing the PTB and ranging from the tropics to high latitudes. Although previous work has examined their diversity and evolution during this interval have been limited by the incompleteness of available phylogenetic hypotheses. To alleviate this and provide better understanding of evolution in this widespread group, a comprehensive species-level phylogenetic dataset was constructed for 99 ingroup taxa and 297 morphological characters with *Greererpeton burkei* as the outgroup. The resulting phylogeny was used to estimate ghost lineages and range extensions, and to calculate speciation and extinction rates, using raw occurrence data and incorporating ghost lineages. The PTB globally and locally in the South African Karoo Basin. This phylogeny also provided the framework to test changes in bone microstructure across the PTB. Thin-sections were taken from multiple postcranial elements of five temnospondyl taxa, spanning the middle Permian to Early Triassic of the Karoo Basin. Permian specimens show slow, zonal growth in long-lived, medium-to-large aquatic stereospondyls; earliest Triassic temnospondyls show azonal, sustained growth in small-to-medium terrestrial forms. Global extinction and speciation rates for temnospondyl lineages are elevated across the PTB; however, extinction and speciation rates derived from only occurrence data are highly correlated with the number of sampled localities, both per geologic stage and normalized per million years. Thus, extinction rate and speciation rate (from only occurrence data) cannot be differentiated from rock record bias at the PTB. Conversely, speciation rate derived from occurrence data and inferred ghost lineages is not strongly correlated with the number of sampled localities; however, both those at the PTB are predominantly the result of the basal radiation of a major subclade (*Stereospondyli*), and it is unclear how large of an effect can be ascribed to selective pressures during the massive extinction event, or to what degree this radiation is simply coincidental with the PTB. Regardless, these data indicate a Permiano-Triassic world favorable to rapidly speciating lineages, as well as individual growth in amphibians, whether long-lived and ecyctal or sustained. Temnospondyls may have behaved as disaster taxa, quickly evolving to fill vacant niches in the Early Triassic. This suggests that flexibility in growth and rapid evolution may be key characteristics to not only surviving, but also proliferating through a mass extinction event.

**Technical Session VIII (Thursday, October 18, 12:30 pm)**

**RECONCILING FAUNAL AND FLORAL CLIMATIC INTERPRETATIONS ACROSS THE EARLY BARSTOVIAN OF THE NORTHWEST U.S.A.**

MCLAUGHLIN, Win N., University of Oregon, Eugene, OR, United States; HOPKINS, Samantha S., University of Oregon, Eugene, OR, United States

Numerous proxies exist for reconstructing past climates, ranging from stable isotopes to sedimentological characteristics. While many more sophisticated tools exist, the most common tools rely on analysis of the fossil flora and fauna. However, these important signatures of past ecosystems must be used with caution given potential biases, and are best when verified by comparison with other independent evidence of climate. Our need to strongly reconstruct past environments in light of issues such as anthropogenic climate change, demanding realanalysys of past times of climatic change, such as the Mid-Miocene Climatic Optimum. Measuring past biotic responses to climate change is necessary for lending predictive power to models of future climatically-driven biotic reactions. We examine four Early Barstovian sites from the northwest U.S. Three classic vertebrate faunas, the Sucker Creek in southern Oregon, the Mascall Formation of north-central Oregon, and Virgin Valley in northern Nevada, and a new locality, Hawk Rim of central Oregon, provide a basis for examining the concordance of climatic proxies. All these sites offer a basis for climatic inference based on flora, fauna, and sedimentology, and some also include paleopedological and radiometric data. Despite rich deposits at all four sites, existing environmental interpretations lack congruency between floral and faunal interpretations and furthermore suggest less ecological diversity between sites than is indicated in a detailed comparison of the data. Early interpretations of the flora generated a reconstruction of a warm and wet densely forested region, dominated by broad leaf deciduous trees, and other forest-dwelling taxa still represent a greater portion than previously recognized, with a picture of not only a wetter and warmer Northwest in the Early Barstovian, than some previous reconstructions have suggested, but also a high level of ecological heterogeneity between sites, influenced by paleogeography and the climatic influence of the early Cascades.
Technical Session XVI (Saturday, October 20, 9:00 am)

**MORPHOLOGICAL VARIATION IN THE MANDIBLES OF *SMILODON FATALIS* FROM RANCHO LA BREA IN RESPONSE TO CLIMATE AND ENVIRONMENTAL CHANGES**

MEACHEN, Julie, National Evolutionary Synthesis Center, Durham, NC, United States; O’KEEFE, Frank R., Marshall University, Huntington, WV, United States

Climate change drives changes in abiotic and floral elements of ecosystems, changes that can and do impact dependent vertebrate species higher in the food web. Rancho La Brea is an excellent natural laboratory in which to examine these changes through time, as each individual pit serves as a relative time sample among which comparisons can be made. Different pits at Rancho La Brea also coincide with different major climate events; pit 13 coincides with the Last Glacial Maximum (LGM) approximately 16-17 Ky, and pit 61/67 coincides with the Bellings-Allerød warming event and concomitant megafaunal extinction approximately 11.5 Kya. We examined mandibles of the sabertooth cat, *Smilodon fatalis*, to assess changes occurring through time, and to compare these changes to previous studies on the dire wolf, *Canis dirus*, as well as correlation with major climate shifts through the late Pleistocene. We used two-dimensional geometric morphometrics to examine mandibles from pits 91 (29 Ka), 2051 (21 Ka), 13 (16 Ka), and 61/67 (11.5 Kya). We found that *S. fatalis* from pits 2051, 13, and 61/67 had statistically distinct morphotypes, and pit 91 had an intermediate morphotype. Individuals from 2051 were small, but robust with large canines, coronoid processes, and deep mandibles. During the LGM (Pit 13) *S. fatalis* had elongated p4, pronounced mandibular flanges, short condyloid processes, and smaller, posterior-facing coronoid processes, in adaptation for increased bite force. Individuals from Pit 61/67 were largest despite the warming climate, but relatively gracile, with narrower canines, more pronounced mandibular flanges, shorter coronoid processes, and larger angular processes. *S. fatalis* and *C. dirus* show discordant character change through time, although prior studies suggest both species show resource stress in pit 91, and *C. dirus* shows high resource stress in pit 13. In pit 61/67 both species converge on a gracile morphology, but neither are under resource stress, suggesting that both carnivore species were doing well until the end. These results demonstrate laboratory in which to examine both hypercarnivores, respond differently to climate and ecosystem shifts. These differences may reflect disparate prey-killing techniques or carcass consumption strategies.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

**A NEW PLIO-PLEISTOCENE VERTEBRATE SITE IN PHILLIPS COUNTY, COLORADO: PRELIMINARY OBSERVATIONS AND CONCLUSIONS ON STEGOMASTODON**


The Weis Gravel Pit in Phillips County, Colorado, preserves exceptional fossil material of Plio-Pleistocene vertebrates. To date more than 12 tusks, two skulls, a lower jaw, and a partially articulated skeleton and skull of Plio-Pleistocene vertebrates have been excavated. Additional vertebrate individuals were largest despite the warming climate, but relatively gracile, with narrower canines, more pronounced mandibular flanges, shorter coronoid processes, and larger angular processes. *S. fatalis* and *C. dirus* show discordant character change through time, although prior studies suggest both species show resource stress in pit 91, and *C. dirus* shows high resource stress in pit 13. In pit 61/67 both species converge on a gracile morphology, but neither are under resource stress, suggesting that both carnivore species were doing well until the end. These results demonstrate laboratory in which to examine both hypercarnivores, respond differently to climate and ecosystem shifts. These differences may reflect disparate prey-killing techniques or carcass consumption strategies.

Technical Session XVII (Saturday, October 20, 4:00 pm)

**COMPARING LATE PLEISTOCENE WITH PRESENT-DAY AVIAN COMMUNITY STRUCTURE ON FLORES ISLAND, INDONESIA**

MEIJER, Hanneke I., Division of Birds, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; JAMES, Helen F., Division of Birds, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; SUTIKNA, Thomas, The National Research and Development Centre for Archaeology, Jakarta, Indonesia; DUE, Rokkan A., The National Research and Development Centre for Archaeology, Jakarta, Indonesia; TOCHERI, Matthew W., Human Origins Program, Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

We examined mandibles of the sabertooth cat, *Smilodon fatalis*, to assess changes occurring through time, and to compare these changes to previous studies on the dire wolf, *Canis dirus*, as well as correlation with major climate shifts through the late Pleistocene. We used two-dimensional geometric morphometrics to examine mandibles from pits 91 (29 Ka), 2051 (21 Ka), 13 (16 Ka), and 61/67 (11.5 Kya). We found that *S. fatalis* from pits 2051, 13, and 61/67 had statistically distinct morphotypes, and pit 91 had an intermediate morphotype. Individuals from 2051 were small, but robust with large canines, coronoid processes, and deep mandibles. During the LGM (Pit 13) *S. fatalis* had elongated p4, pronounced mandibular flanges, short condyloid processes, and smaller, posterior-facing coronoid processes, in adaptation for increased bite force. Individuals from Pit 61/67 were largest despite the warming climate, but relatively gracile, with narrower canines, more pronounced mandibular flanges, shorter coronoid processes, and larger angular processes. *S. fatalis* and *C. dirus* show discordant character change through time, although prior studies suggest both species show resource stress in pit 91, and *C. dirus* shows high resource stress in pit 13. In pit 61/67 both species converge on a gracile morphology, but neither are under resource stress, suggesting that both carnivore species were doing well until the end. These results demonstrate laboratory in which to examine both hypercarnivores, respond differently to climate and ecosystem shifts. These differences may reflect disparate prey-killing techniques or carcass consumption strategies.

**POSTER SESSION III (Friday, October 19, 4:15 - 6:15 pm)**

**THE RISE OF *ISCHYRHIZA:* A ROSTRUM FROM ALABAMA**

MELSTROM, Keegan, University of Michigan, Ann Arbor, MI, United States

The sawfish *Ischyryzha mira* is a very common element of Late Cretaceous marine faunas from all over North America. Both its rostral denticles and oral teeth are frequently encountered, especially in lag deposits. Even though the rostral denticles are very brittle, and are often found broken, they are very distinct in many of their features and can usually be readily recognized even in a very fragmentary condition. The oral teeth are very abundant in some deposits but are often overlooked because of their small size.

The systematic placement of *Ischyryzha* is uncertain but has traditionally been placed in the Sclerorhynchidae, a lineage long considered convergent with modern sawfishes (Pristidae). Complete Sclerorhynchus specimens are known from Lebanon, sclerorhynch idol rostra with teeth have been noted for the Moroccan taxa Onchopristis and Schizorhiza, and fragments identified as *Ischyryzha mira* rostral cartilage and vertebrae have been reported. However, *Ischyryzha mira* has only ever been confidently identified from isolated rostral denticles and oral teeth making comparisons with pristids and even other sclerorhynchids difficult.

Recently, a partial *Ischyryzha mira* rostrum with associated rostral denticles was recovered from the Maastrichtian Ripley Formation (Selma Group) of Lowndes County, Alabama. Found in situ in the formation, the preserved portion is Stern long, somewhat deformed, and has six rostral denticles still attached. Four more rostral denticles were recovered from matrix near the anterior end. This unique anatomical specimen promises to shed light on this enigmatic group of fishes.

**DESCRIPTION OF A JUVENILE *DIPLODOCUS* FROM DINOSAUR NATIONAL MONUMENT, UTAH AND ITS ONTOGENETIC IMPLICATIONS**

MEILSTROM, Keegan, University of Michigan, Ann Arbor, MI, United States

Articulated sauropod sauropod material is exceptionally rare and can give unique insights into morphological changes experienced during ontogeny. I describe the partial skeleton of a juvenile *Diplodocus* individual from the Morrison Formation of Dinosaur National Monument, Utah and examine both serial and ontogenetic variation. Vertebral remains are articulated and include three posterior cervical vertebrae, ten dorsal vertebrae, five sacral vertebrae, and at least three caudal vertebrae. Appendicular remains include fragmentary pelvis teeth, a partial right humerus, a pair of femur, and a femoral head. Small a lack of fusion of neurocentral sutures in presacral vertebrae, and the absence of lines of arrested growth in the femur indicate the individual is a juvenile. The excellent preservation of the vertebral column allows documentation of both serial and ontogenetic morphological changes in
**Diplodocus.** Pneumatic fossae are found in the centrum and neural arch in the posterior cervical series of this juvenile specimen. The pleurocentra are shallow and divided by fewer internal laminae than in more mature specimens. The cervical prezygapophyses extend far anteriorly, terminating above the pneumatic cavity of the preceding vertebra. This condition differs from that in which prezygapophyses extend above the level of the preceding vertebra. The postzygapophyses of the juvenile are nearly level with the neural spines, whereas the postzygapophyses of adults are more ventrally positioned. Pneumatised in the dorsal vertebrae varies serially. Large pneumatic fossae punctuate the anterior 4 dorsal centra, but these spaces are occupied by extremely reduced, shallow depressions in dorsal vertebrae 5 and 6. Posterior dorsal vertebra 7-10 have well-developed pneumatic fossae that resemble those in the anterior dorsal centra. This variation in the middle of the dorsal series may represent a pneumatic hiatus. The nearly complete sacrum illustrates patterns of fusion among the interneural, costovertebral, and intercostal junctions. Interneural junctions s1/2 and s2/3 are already closed in this individual, but more posterior interneural junctions remain unfused. Costovertebral junctions are nearly completely fused in this specimen, save the final costovertebral junction. Intercostal junctions were likely the last osteological unit of the sacrum to completely fuse, with no sutures having fused in this specimen. Additionally, well-preserved individuals from stages representing other ontogenetic stages will shed light on the ontogenetic and serial variation in Diplodocus.

Technical Session II (Wednesday, October 17, 8:45 am)

**IDENTIFICATION OF THE BONES OF THE SNOUT IN LOWER ACTINOPTERYGIANS — A NEW NOMENCLATURE SCHEME BASED ON CHARACTERS**

MICKLE, Kathryn E., University of Kansas, Lawrence, KS, United States

Currently, there is no standardised nomenclature scheme for identifying and naming the bones of the snout in lower actinopterygian fishes. This creates a situation where the same bone names are used to identify very different bones. This is problematic because it makes comparing previously described taxa difficult, presents potential pitfalls when building character matrices for phylogenetic analyses, and impedes our understanding of the diversity of lower actinopterygians. Because of the problems the absence of a standardised nomenclature scheme presents, a new set of rules for the identification of the bones of the snout of lower actinopterygians is proposed. Definitions for what presently has been termed nasofrontal, prenasal, maxillary, premaxillary, and postnasal bones constitute are presented. The new definitions are based on the presence of characters that are commonly preserved such as the presence or absence of sensory canal lines, location of bones in relation to other bones, and whether or not the bones contribute to the formation of the nasal openings. When numerous characters are present in a single bone, this bone is considered to be a complex bone and the name reflects this. The snout bones of the various Devonian and Carboniferous actinopterygians are re-identified using this nomenclature scheme. When this is done, patterns regarding the morphology of the snout in Devonian and Carboniferous fishes emerge. The snouts of Carboniferous fishes show much more diversity than those of Devonian fishes. Devonian fishes are characterized by a more generalized snout. In depth investigations into characters such as the bones of the snout are important for forming a stronger understanding of the morphological diversity of lower actinopterygian fishes and have implications for phylogenetic studies. When the snout characters in a character matrix are recoded using this terminology and phylogenetic analysis is performed, the resultant tree has clades of lower actinopterygian fishes supported by the characters in a character matrix are recoded using this terminology and phylogenetic analysis is performed. The resultant tree has clades of lower actinopterygian fishes supported by the characters in a character matrix are recoded using this terminology and phylogenetic analysis is performed.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

**DISTRIBUTIONAL PATTERNS OF †MAWSONIIDAE (SARCOPTERYGII: ACTINOPTERYGII): A TRACK ANALYSIS**

MIGUEL, Raphael D., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; MORRONE, Juan J., Universidad Nacional Autónoma de México, Distrito Federal, Mexico; GALLO, Valéria D., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; MIGUEL, Raphael D., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; MEGALOCOELACANTHUS, Rhipis, Diplurus, Mawsonia, and Parnabaia) and 11 genera with some taxonomic controversy (Itapecuru-Alcântara-Santana occurs in the Itapecuru-Alcântara-Santana formations (Lower Cretaceous)). Individual tracks were also obtained for genera by geological periods, showing congruence with the individual species tracks. The taxonomic affinities of this specimen suggest that the specimen is a juvenile specimen of Diplodocus. This specimen is the first Diplodocus specimen to be identified from the Late Triassic of Pangaea. The tectonic events related to the breakup of Pangaea and Gondwana and the evolution of the oceans are suggested as the vicariant events affecting the distribution of this taxon throughout the Mesozoic. The results highlight the potential of the palaeobiogeographical approach for analyzing distributional patterns of fossil taxa.

**EXTRACTION AND ANALYSIS OF INGESTA IMPACTED IN THE DENTITIONS OF MODERN UNGULATES: NEW EVIDENCE FOR LINKING DENTAL WEAR AND FEEDING ECOLOGY**

MIHLBACHER, Matthew C., New York College of Osteopathic Medicine at the New York Institute of Technology, Old Westbury, NY, United States; BEATTY, Brian L., New York College of Osteopathic Medicine at the New York Institute of Technology, Old Westbury, NY, United States; AYOB, Michael, New York College of Osteopathic Medicine at the New York Institute of Technology, Old Westbury, NY, United States

Dental microwear and mesowear analyses rely on observations of feeding ecology and dental wear in living species. Aspects of dental wear that separate grazers from browsers, such as blunted cusps and excessive numbers of scratches, are thought to be a consequence of high concentrations of phytoliths found in grasses and/or ingestion of abrasive food contaminants (e.g. sand) associated with feeding near the ground. Data pertinent to dental wear, such as ingested sand, are rarely available. However, ungulate skulls often contain ingesta impacted in the infundibula of the teeth. Samples of impacted ingesta are unique because they accumulate over the life of the animal and mostly likely represent a life-long record of ingested meals rather than the last few meals represented by fecal or gastric samples. We extracted samples (N=40) of dentaly impacted ingesta from two African browsers, black rhino and giraffe, and two grazers, white rhino and zebra, and compared the relative frequencies of grass, wood, and inorganic particles in these samples with microwear and mesowear. To assess the potential of these samples as proxies for feeding habits, we categorized and measured ingesta particles in low-mag photomicrographs. The composition of the ingesta was highly reflective of the known feeding ecologies of the species examined. The ingesta of the browsers contained primarily wood fragments and low concentrations of sand particles. The ingesta of the grazers contained mostly grass fragments with high concentrations of sand particles. The observed abrasive particles were overwhelmingly sand grains (primarily quartz), which were generally several times wider than the microwear features observed on the specimens from which the samples were extracted. This size relationship is consistent with the sand contributing to the microwear. Isolated phytoliths were rare including samples from grazers and, on average, were smaller than the sand grains. Ingesta composition was related to microwear and mesowear. The bluntest and lowest relief cusp apices were associated with the highest concentrations of sand grains. Likewise, higher concentrations of sand were associated with higher concentrations of scratches quantified on molar paracones. A relationship with pits was less apparent. We conclude that dentaly impacted ingesta are a valuable resource for investigating the relationship of feeding ecology and dental wear in ungulates, although some complications exist. For example it is unclear if there are sampling biases during ingesta impaction. It will be worthwhile sampling more species in this manner and developing more sophisticated methods for measuring and understanding such samples and how they related to feeding ecology and dental wear.

**TAPHONOMIC DIFFERENCES BETWEEN FOX AND WOLF DENS**

MILDE, Lauren, Penn State University Department of Geosciences, University Park, PA, United States; GRAHAM, Russell, Penn State University Department of Geosciences, University Park, PA, United States

Interpretation of palaeontological sites is dependent upon understanding the ways in which bone accumulations form. Workers wishing to extract palaeoecological information from fossil bone assemblages must first determine the temporal and spatial scales that they represent. For example, the degree of time-averaging may indicate the temporal precision of palaeoecological information contained in an assemblage. Many taphonomic processes, including transport of partial or complete carcasses, bone weathering, or density-mediated bone destruction, all may remove elements from the original bone assemblage, yielding fossil materials that may reflect their ecosystem only in part. Site formation processes are therefore an essential component of a rigorous understanding of vertebrate assemblages and subsequent palaeoecological study. Modern den and lair sites (Iyena, fox, puma) have been studied as possible proxies for fossil bone accumulation localities. Here, we present a comparison of fox (Vulpes vulpes) and wolf (Canis lupus) den assemblages from Nunavut, Canada. We statistically compare bone damage (particularly processes reflecting carnivore consumption), bone weathering, and the identities and quantities of elements and taxa present. Additionally, we employ GIS software to examine differences in spatial statistical patterns. This study, part of a larger ongoing actualistic taphonomic project, has identified several patterns in the taphonomy of the fox and wolf den types. These include divergence in taxa types and sizes present, as well as spatial differences between the bone distributions at each den. Such data will aid interpretations of fossil localities, yielding a means of understanding the processes in effect, and accounting for the taphonomic alterations that these processes create.
LUMBAR MORPHOLOGY OF SUSPENSORY, GLIDING AND FLYING MAMMALS: IMPLICATIONS FOR THE LOCOMOTOR BEHAVIOR OF SELECT FOSSIL PRIMATES

MILLER, Charlotte E., Duke University, Durham, NC, United States; GRANATOSKY, Michael C., Duke University, Durham, NC, United States; CHESTER, Stephen G., Yale University, New Haven, CT, United States; BOYER, Doug M., Brooklyn College, New York, NY, United States; SCHMITT, Daniel, Duke University, Durham, NC, United States

Lumbar vertebral morphology has been used as an indicator of locomotor behavior in living and fossil mammals. Rigidity within the lumbar region is thought to have importance for increasing overall axial rigidity during various forms of locomotion, including bridging between supports, inverted quadrupedalism, gliding, and flying. But distinguishing between those behaviors using bony features has been challenging. This study used osteological characters of the lumbar spine that appear to limit lumbar mobility in a broad phylogenetic sample of extant taxa, including members of Dermoptera, Chiroptera, Scandentia, Primates, Pilosa, Rodentia, and Marsupialia, representing a wide range of locomotor behaviors. These same lumbar characters were measured in three extinct species for which locomotor behaviors have been debated, the sloth lemurs (Paleopropithecus and Babakotia radofilai) and paromomyid plesiadapiforms (Ignacius graybullianus), in order to further investigate their possible locomotor and positional behaviors.

Results from a principal components analysis of six geometric mean standardized measurements demonstrate that suspensory taxa are characterized by short and cranio-caudally expanded spinous processes and relatively short transverse processes compared to scanorial and gliding mammals. Both dermopterans and chiropterans exhibit these traits and cluster most closely with committed inverted quadrupeds in this sample. The sloth lemurs Babakotia radofilai groups closely with primate taxa like the lorises and Pongo, while Paleopropithecus groups with extant sloths. In accordance with previously conducted studies, these findings suggest that Paleopropithecus was engaged in inverted quadrupedalism at a high frequency, while Babakotia radofilai may have engaged in a more diverse array of locomotor and positional behaviors. Corroborating previous studies of the locomotion of Lepilemur, Ignacius, and Necrolemur, these results are most similar to those of taxa: it shares no similarities in these characteristics with extant mitten-gliders. If the lumbar of suspensory forms is less mobile than that of non-suspensory taxa, then the osteological characters we have measured appear to reflect those differences well and suggest that axial rigidity is advantageous for suspensory locomotion and possibly flight in bats. Furthermore, lumbar rigidity, as reflected by our measurements, would appear to have arisen independently among multiple mammalian lineages.

TEMPORAL MEGABIAS: LATITUDINAL CONTROLS ON TIME-AVERAGING OF TERRESTRIAL DEATH ASSEMBLAGES AND THEIR ECOLOGICAL DATA

MILLER, Joshua H., Florida Museum of Natural History, Gainesville, FL, United States

Maximum survival durations of bones on landscape surfaces are primary controls on the ecological data captured by death assemblages. Particularly if time-averaging is significantly different among climatic settings or across latitudes (even among constant sedimentation rates), death assemblages from similar, or even identical communities could capture different ecological data. Paleoecological comparisons among fossil assemblages from strongly different communities, latitudinal settings, and across geologic time must be cognizant of inherent differences in time-averaging. Here, I test for differences in time-averaging of modern large-mammal death assemblages in tropical, temperate and arctic settings. I also test for climatic and ecological controls on the weathering stage frequency distribution of landscape bone accumulations across this latitudinal gradient. To test the survival durations of bones on arctic landscapes, I radiocarbon-dated 50 antlers, bones, and teeth of adult and neonatal caribou (Rangifer tarandus) recovered from bone surveys of Alaska’s North Slope (Arctic National Wildlife Refuge). To test for differences in time-averaging durations across latitude, these new data are paired with existing data on survival durations of ungulate bones from high arctic, temperate, and tropical landscapes (including radiocarbon dating and observations of carcases with known postmortem duration). Clear latitudinal controls on bone survival durations are observed, with time-averaging increasing by successive orders of magnitude between latitudinal bins: maximum bone survival reaches decadal time-scales in the tropics, centennial time-scales in temperate regions, and millennial time-scales in the arctic. While over-all time-averaging duration is driven by climate, the frequency distribution of bone weathering stages is strongly influenced by ecological history, particularly species’ population stability (or lack thereof). Ecosystems with significantly different time-averaging durations can produce highly-similar weathering stage frequency distributions, illustrating that such comparisons are not necessarily straightforward. Environmental and ecological settings with faster bone recycling rates (the tropics) may be particularly adept at capturing ecological changes across decadal timescales, without significant blurring by generations from prior centuries or beyond. Colder, more northern ecosystems, including those in temperate and arctic settings, offer extended observational windows, which are particularly insensitive to high-frequency ecological variability. Establishing and understanding differences in temporal resolution among death assemblages is an important component of any paleoecological comparison.
In 1880, the early Eocene fluvial deposits of the Erquelinnes sand quarry in the southern part of the Mons basin in Belgium yielded their first mammal fossil, a well preserved jaw of a primitive plesiadaptid. By 1927, about 40 mammal specimens had been recovered from Erquelinnes and were attributed to Adapis, Protomys, Paramys, Plesiadapis, Archocyonidae, Hyracotheriidae, Coryphodon and Oxyaena or Miacid. By that time however, the Erquelinnes fauna had already been eclipsed by the contemporaneous Dormaal fauna from northeastern Belgium, which yielded thousands of specimens rather than only a few dozen. Since then, attention for the Erquelinnes fauna has therefore been limited to the passing mentions of referred specimens in the formal descriptions of the new plesiadapiform Phlaenotherops georgii and of the miacid Graciliconysole.

Here we present an updated faunal list of the complete Erquelinnes mammal fauna. We part of the Mons basin in Belgium yielded their first mammal fossil, a well preserved jaw and of the miacid Coryphodon, Hyracotherium, Oxyaena or Miacid. By that time however, the Erquelinnes fauna had already been eclipsed by the contemporaneous Dormaal fauna from northeastern Belgium, which yielded thousands of specimens rather than only a few dozen. Since then, attention for the Erquelinnes fauna has therefore been limited to the passing mentions of referred specimens in the formal descriptions of the new plesiadapiform Phlaenotherops georgii and of the miacid Graciliconysole.

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stiffness experiment demonstrate that the vertebral column of *C. niloticus* has a greater propensiy (i.e. increased flexibility) for mediolateral rather than dorsoventral mobility and an increase in mediolateral stiffness in the lumbar region, both of which directly correspond to vertebral measurements. Thus, morphometric parameters appear to have the power to predict vertebral mechanics in modern crocodiles and (with caution) in their extinct relatives. Comparison of the functional profiles between *C. niloticus* and *P. richardsonii* shows that the lumbar region of *P. richardsonii* has several characteristics that are associated with increased dorsoventral flexibility, including more vertically oriented pre-zygapophyses, an increase in centrum width, and more laterally extending transverse processes. These results support the notion that the vertebral column of early crocodylomorphs favoured dorsoventral lumbar motion (necessary for bounding/galloping gaits) to a degree exceeding that in extant Crocodylia. This work provides an objective basis for reconstructing the locomotor evolution of crocodile-line archosaurs, and also provides clues about the anatomical basis for the increased dorsoventral flexibility, including more vertically oriented pre-zygapophyses, and more laterally extending transverse processes. These results provide information to understand the paleoecology of these systems, from woodlands to grasslands, with δ13C of enamel ranging from -15.8 to -3.5‰. Grasslands thus had spread across eastern Australia by this time, providing rich fodder for the diverse large bodied marsupial community. The tooth enamel and diverse vertebrate fauna that includes remains of mammals, reptiles, amphibians and birds. Tayassuid fossil record represents the first of these lineages in northern South America, and provides information to understand the distribution and diversity of the group in South America during the Oligocene-Quaternary.

Romer Prize Session (Thursday, October 18, 11:15 am)

**STABLE ISOTOPE ECOLOGY OF VERTEBRATES IN ARID ENVIRONMENTS: ARCHIVES OF ENVIRONMENT AND CLIMATE IN THE FOSSIL RECORD**

MONTANARI, Shaena, American Museum of Natural History, New York, NY, United States

**THE EARLIEST OLIGOCENE CLIMATE TRANSITION**

Until now, three forms of tayassuids had been recovered from different regions of the continent: *Tajacu*, *Platygonus*, and *Pecari*. These species have a broad distribution in South America, but differ in the mode of resource exploitation. The Venezuelan tayassuid fossil record represents the first of these lineages in northern South America, and provides information to understand the distribution and diversity of the group in South America during the Oligocene-Quaternary.

**INTRA-INDIVIDUAL VARIATION OF CARBON AND OXYGEN ISOTOPES WITHIN THE MIOCENE HORSE PARAHIPPUS LEONIENSIS AND IMPLICATIONS FOR DIET**

MOORE, Jason R., Dartmouth College, Hanover, NH, United States

The earliest Oligocene records one of the most major climate transitions in the Cenozoic. High latitude marine temperatures indicate a temperature drop of 4-5°C over the course of 300,000 years, associated with the formation of a permanent Antarctic ice sheet. Climate change in the mid-latitudes, particularly in terrestrial environments is more difficult to resolve, although there are indications of both cooling and drying, and associated faunal and floral turnover. In North America, mammalian response to this climate shift, as recorded in the classic outcrops of the White River Group, is enigmatic. Extensive museum collections show apparently little, if any, evolutionary response (extinction or origination) of the fauna during this period.

In order to determine whether, instead of an evolutionary response, the White River Group fauna exhibited an ecological response to this climate transition, new, temporally constrained samples were collected spanning the interval of the climate transition in and around Badlands National Park, SD. Extensive taphonomic data were assembled for each collected specimen, and used to establish isotaphonomy among samples. Changes in the abundances of different taxa among isotaphonomic samples indicate true ecological changes, rather than potential artefactual shifts caused by varying taphonomic bias. Analysis of the faunal structure of isotaphonomic samples across the climate transition shows a directional shift in the abundances of several taxa with time (including *Paraepalectroopus* and *Merycoidodon*). This is interpreted to represent an ecological response to the climate shift, as paleoenvironments become drier and more open. This is the first time such a change in faunal structure has been demonstrated using vertebrate taxa in a quantifiably isotaphonomic framework.

**POSTER SESSION I (Wednesday, October 17, 4:15 - 6:15 pm)**

**RECORD OF TAYASSUIDS IN PLATYGOBUNA QUATERNARY DEPOSITS IN VENEZUELA**

MENTELLANO, Marisol, Instituto de Geologia, UNAM, Mexico, Mexico; RINCÓN, Ascanio D., Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela; SOLZARANO, Andrés, Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela

Today the Tayassuidae is represented by at least four extant species distributed throughout the Americas, from south-western United States to north-central Argentina. It is one of the immigrant groups that entered South America during the Great American Biotic Interchange, the oldest unquestionable record for the region. For the paleontologist this has been a difficult problem, particularly in the middle Pleistocene of the country: *Platygonus* sp. had been already reported from the tar pit known as Orocué (ORS-16, *Platygonus*-middle Pleistocene). *Catagonus* (late Pleistocene-Recent), and *Tayassu* (middle Pleistocene-Recent), most of the South American records come from Argentina, Uruguay and Brazil. In the last decade, discoveries of fossiliferous tar pits in northern Venezuela revealed a rich and diverse vertebrate fauna that includes remains of mammals, reptiles, amphibians and birds. Tayassuid material was discovered in different trenches during the excavation for an oil pipeline. Each trench was numbered and studied separately because its faunal association suggest they are not contemporaneous. Remains of *Platygonus* sp. had been already reported from the tar pit known as Orocué (ORS-16, *Platygonus*-middle Pleistocene). *Platygonus* was very common and diverse in Argentina during late Pleistocene and disappeared during the early-middle Pleistocene. This Venezuelan find represents the northernmost record in South America and is intermediate between the northern and southern populations of the continent. Recently, 10 partial lower jaws with teeth in different stages of wear were recovered, as well as isolated upper molars and fragments of maxilla bearing teeth, from another trench, ORS-20 (*Tata Platygonus*). The material is identified as *Tayassu pecari*, because of the molarization of premolars, development of cingula and additional accessory cusps. In this sample there is a partial lower jaw with pm4 and alveoli for pm3, pm2, which is quite similar to *Pecari tajacu*, the trigonid is larger than the talonid, and is more quadrangular in shape. In the western part of the country there is another tar pit known as “Mene de Inciarte” dated 28,000 years, a fragment of a maxilla with M1-M3 of *Pecari tajacu* was collected. Remains of *Tayassu pecari* had been recovered from several caves of Pleistocene-Holocene age, which are located in the northern part of the country.

**TECHNICAL SESSION VIII (Thursday, October 18, 4:00 pm)**

**WHITE RIVER GROUP MAMMALS EXHIBIT ECOLOGICAL RESPONSE TO THE EARLIEST OLIGOCENE CLIMATE TRANSITION**

MORAN, Sean M., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

The earliest Miocene horse, *Parahippus leonensis*, represents an important species in the evolution of equids from *Equus* to *Equus*. Preliminary hypodometry, dental microwear, and isotope data support the hypothesis of *P. leonensis* as an incipient grazer. However, the relative paucity of these data does not allow for the interpretation of dietary variation within the mineralization of an individual tooth, an individual, or an assemblage. These variations may impact conclusions drawn from any individual sample. Additionally, seasonal or ontogenetic influences on diet may have been an underlying mechanism in the shift from browsing to grazing affinities in ancient horses. Stable carbon and oxygen isotope data can help to elucidate any variations in the relative proportions of C4 and C3 plant intake in diet. This study employs stable carbon and oxygen isotope data from associated, serially sampled cheek teeth of *Parahippus leonensis* to investigate intra-individual variation in diet and test the hypotheses that ontogeny and/or seasonality played a role in these variations.

Using a micromill, enamel of six associated mandibular cheek teeth was serially sampled from a *Parahippus leonensis* mandible collected from the Hemingfordian Thomas Farm site located in Gilchrist County, Florida. Approximately 50 samples were collected and analyzed for carbon and oxygen isotope values using the H3PO4 digestion method. The data were statistically analyzed to investigate whether there was a correlation of oxygen and carbon stable isotope ratio variations within the mineralization of an individual tooth, an individual, or an assemblage. Analysis of the faunal structure of isotaphonomic samples across the climate transition shows a directional shift in the abundances of several taxa with time (including *Paraepalectroopus* and *Merycoidodon*). This is interpreted to represent an ecological response to the climate shift, as paleoenvironments become drier and more open. This is the first time such a change in faunal structure has been demonstrated using vertebrate taxa in a quantifiably isotaphonomic framework.

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ISOTOPIC VARIATION AND NICHE SPACE IN MIDDLE AND LATE MIOCENE DRY CLIMATE WITH XEROPTHETIC VEGETATION, THE INFERRED PALEOENVIRONMENT FOR THE CASTILLETES EARLY PLEISTOCENE FISSURE FORMATION (EASTERN GUAJIRA PENINSULA, COLOMBIA). The Castilletes fissure is composed of deltaic and shallow marine deposits, with an abundant continental fauna in some intervals. These new findings will contribute to a better understanding of the neotropical vertebrate communities and paleoenvironments during a time of high tectonic activity and global climate change. The fauna includes sharks (Carcharhiniformes), rays (Myliobatiformes), carcharodonts (Squaliformes), dogtooth tetras (Cynodontidae), fresh water turtles (Podocnemidae), and one of the oldest records of Crocodylus in the Americas. The mammal assemblage comprises five orders and ten families. Xenarthrans include megatheriid and nothrotheriid sloths and the cingulates Necrolestinae. (Neoepiblemidae) and Megatheriidae. Among the South American ungulates there are horse-like protherotheriids (Litopterna), rhino-like toxodonts (Notoungulata), and astrapotheres (Astrapotheria). Associated fossil wood is found in some localities. Overall, the Castilletes fauna and flora indicates the presence of extensive water bodies, in a delta complex with moderate to high rates of rainfall during the late Miocene-early Pleistocene. Considering that today the Guajira peninsula is characterized by a very dry climate with xerophytic vegetation, the inferred paleoenvironment for the Castilletes Formation indicates that the region has suffered a drastic climatic change over the last 4 million years.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

Isotopic Variation and Niche Space in Middle and Late Miocene South American Megatheriids and Hyaenodontids

MORGAN, Michelle E., Harvard University, Cambridge, MA, United States; BARRY, John C., Harvard University, Cambridge, MA, United States; CERLING, Thure E., University of Utah, Salt Lake City, UT, United States; NELSON, Sherry V., University of New Mexico, Albuquerque, NM, United States; PILEAM, David, Harvard University, Cambridge, MA, United States

The Siwalik Group of northern Pakistan preserves a rich Neogene terrestrial fossil record. Recent studies have focused on detailing mammalian community structure and faunal change in the late Miocene starting around 8.5 Ma, coincident with the appearance and influence of C3-dominated grassland habitats. Here we focus on the period 13.7 and 8.5 Ma to examine variation within stable carbon and oxygen isotopic signatures of mammalian species in predominantly C3 ecosystems. A number of ubiquitous herbivore species present for three or more million years in the Chinji Formation are replaced in the younger Nagri Formation between 11 and 10.3 Ma by larger-bodied, closely related and possibly descendant, species in bovids, suivari, suids, and anaphrodis. We present a stable carbon and oxygen isotope data collected on a suite of species between 13.7 and 8.5 Ma (n ~450 specimens) including primates, proboscideans, artiodactyls and perissodactyls, and focus on comparisons between several closely related artiodactyl species pairs to look for differences in isotopic niche space. Despite body-size increases of more than 50% (based on body mass estimates derived from astragular and other postcranial measurements), little isotopic change is seen within families. Thus substantial body-size increases are not associated with dietary change, at least as reflected isotopically, in the early late Miocene. Isotopic separation between species from different families is observed in carbon and/or oxygen both before and after the observed faunal change. Although most herbivores are almost exclusively consuming C3 vegetation prior to 8.5 Ma, equids, which are first documented in the Siwaliks at 10.8 Ma, incorporate C4 vegetation in their diet by 10.1 Ma. Equid species sampled span the range from pure C3 to pure C4 diets before 8.5 Ma. Between 13.7 and 8.5 Ma, the stable carbon and oxygen isotope signature of many Siwalik artiodactyl lineages remains essentially constant. The ecological conditions that selected for larger body-size within these lineages around 10.5 Ma may have included slightly more open habitats. However, neither artiodactyl nor proboscidian taxa sampled show any evidence of significant C4 vegetation consumption until after 8.0 Ma. This pattern may reflect preferences for C3 forage and more closed habitats, due to factors including diet quality, relatively low-crowned teeth, and social structure. In contrast, the earliest Siwalik equids appear to have been versatile generalists that exploited both C3 and C4 dietary resources.

Technical Session IV (Wednesday, October 17, 3:00 pm)

From Endocast to Brain: Assessing Brain Size and Structure in Extinct Archosaurs Using Gross Anatomical Brain Region Approximation (GABA)

MORHARDT, Ashley C., Ohio University, Athens, OH, United States; RIDGELY, Ryan C., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States

Cranial endocasts have potential for elucidating qualitative and quantitative trends in brain evolution. Although the fossil record is sparse, research on the endocasts studied is substantial. For the purposes of this study, we examine three aspects of the endocasts studied being adequate proxies for the brain, which depends on the extent to which the bony endocast cavities contribute to neural tissue. Through this approach, we are able to test hypotheses relating brain size and structure in extant reptiles. We present Gross Anatomical Brain Region Approximation (GABA), a technique developed to address these concerns that tests 3D digital hypotheses of reconstructed brain shape and size based on a set of validated comparative anatomical criteria. Homologous endocast features and associated osteological correlates observed for hundreds of taxon provided the basis for hypothesized GABA criteria. We validated these criteria using dissection and CT scanning of extant outgroup specimens (e.g., ostrich, turkey, alligator, iguana) with iodine-soaked soft tissues. Criteria were used to delimit brain regions (cerebrum, cerebellum, optical tracts, etc.). These effects were modeled as 3D endocasts within the digital endocast using Maya modeling software. Validation by direct comparison with the exact brain test shows these virtual models to be credible, testable hypotheses of the size and shape of the underlying brain. We applied these validated criteria to generate GABA brains for certain nonavian dinosaurs (Camarasaurus, Diplodocus, Euplocephalus, Pachyrhinosaurus, Majungasaurus, Stegosaurus), providing novel insights into the cranial contents and their inferred functions in these taxa. For example, sauropod dural sinuses are extensive compared to other groups, Stegosaurus brain volume was approximately twice that of previous estimates, and the optic lobes of Majungasaurus were large relative to other fossil taxa studied, suggesting that vision was important to its lifestyle. GABA analysis advances endocast studies of fossil taxa by providing testable information about the brain itself. Thus, GABA permits testing of hypotheses of neurological mosaics evolution of different brain regions and puts quantitative scaling analyses of brain and brain region size on a sounder biological footing, both of which are future directions for the larger project.
HISTOLOGICAL VARIATION SUGGESTS UNUSUAL LEVELS OF DEVELOPMENTAL PLASTICITY IN THE STEM ARCHOSAUR FANCLEAVEA

MORRIS, Zachary, The University of Texas at Austin, Jackson School of Geosciences, Austin, TX, United States; WERNING, Sarah, The University of California at Berkeley, Berkeley, CA, United States

Bone histology has been used to study growth and physiology of extinct archosaurs at individual, ontogenetic, and phylogegetic scales, but few studies have examined how histology varies within a species among specimens of comparable ontogenetic stage. When all individuals of a taxon share a similar growth trajectory, minimal sampling of like-sized individuals that have nearly identical histological profiles reduces destructive sampling of specimens. Conversely, if individuals of a taxon are developmentally plastic, conservative sampling will obscure variation and may miss histological differences that result from evolutionary, environmental, or geographic change. We report a potential case of such developmental plasticity in the stem archosaur (non-archosaur archosauromorph) Fancleavea campi. This taxon, from the Late Triassic of the American Southwest, persisted with little morphological change for over 20 million years. We reanalyzed a previously sampled femur, and sampled an additional five femora and three humeri (seven individuals) from five localities, to assess potential variation in Fancleavea's growth regime. Our sampling covered as much of its stratigraphic range as possible, but we restricted our study to specimens diagnosed using a unique combination of femoral/humeral characters and association with apomorphic osteoderms. Four femora and all humeri are of nearly identical size, but the dominant bone tissue type is highly variable within our sample. One individual displays woven bone with no apparent cessation of growth until its death; another is dominated by lamellar bone with many lines of arrested growth; and other specimens exhibit various permutations of these patterns. These data reveal at least three growth trajectories to achieve common adult size: rapid growth to adult size in 1-2 years; slow, prolonged growth lasting several years; and one highly unusual growth trajectory beginning with 4.5 years of very slow growth, followed by a year of very fast growth in which half the cortex is deposited, and then 10 or more years of slow growth to adult size. We hypothesize that paleoenvironmental variability may have contributed to the observed differences, because all specimens are from localities that experienced highly seasonal semi-arid conditions. Given the long stratigraphic range of this taxon, our sample may represent more than one species, but the morphological similarity among individuals makes this impossible to determine at this time. Whether or not we are dealing with more than one species, we hypothesize that developmental plasticity may have played an important role in the formation of the observed histological differences in this taxon.

Acrotoryctidae are a family of extinct "condylarth" mammals that were abundant and speciose during the Paleocene and declined in diversity and number during the early Eocene in North America, Europe, and Asia. Acrotoryctids have been reconstructed as primitive omnivorous condylarths and may be the sister group to Artiodactyla. This study focuses on acrotoryctids within the Paleocene-Eocene Thermal Maximum (PETM), ~56 Ma, when global temperatures increased by ~5-10° C. Three species were initially identified in the PETM faunal zone Wasmannian-0: (1) Thryptacodon barae, characterized by a centralized paracodon equal in size to the metaconid on M3 and a distinct hypconeulid on the lower molars; (2) Chriacus badgleyi, characterized by the absence of a metaconid on the P3, an anteriorly placed molar paraconid, and a highly reduced hypconeulid; and (3) Plesiodon yalensis, characterized by a lingual molar paraconid and a low, shallow, anteroposteriorly compressed trigonid compared to Chriacus. The latter two species have been difficult to distinguish in part because the holotype of C. barae contains only C1-P3, whereas the holotype of P. yalensis contains only M1-M3. These species were recently synonymized under the name C. badgleyi (based primarily on a poorly-preserved specimen). We report a large collection of acrotoryctid specimens from the PETM, collected in the southern Bighorn Basin, Wyoming. The number of specimens includes ~100 molars, numerous premolars, and deciduous teeth. It also includes the most complete specimen of P. yalensis known: a partial dentary of C. badgleyi with alveoli for C1-P4, crowns of P5-M3, and a preserved ascending ramus and mandibular condyle. The measurements and morphology documented in this sample clearly separate specimens of Thryptacodon, while supporting a second morphological group (Chriacus) in which body size range exceeds that normally observed in extant mammal species. When placed in stratigraphic context, C. badgleyi body size is found to correspond well with inferred temperature during the PETM, similar to recent findings for the earliest equal SfKrippner. These results support the classification of two species: the less abundant T. barae (in contrast with the northern Bighorn Basin), and C. badgleyi. While the morphotype described for P. yalensis is present in the collection, it is rare and observed only in worn specimens. These findings, coupled with a lack of discrete tooth dimensions in the temporal series, suggest that the P. yalensis morphotype results from wear to the molars of C. badgleyi and support the synonymy of these taxa.
sharks or cetaceans but similar to those of ram-feeding sharks; (3) two of the postulated suction feeders, namely Shastasaurus and Shonisaurus, possessed the two most slender hyoid bones among the ichthyosaurs examined. Most importantly, ossified hyoid corpus to which hyoid retractor muscles attach is unknown in any ichthyosaur, whereas a strong integration of the ossified corpus and corma of hyoid has been identified in the literature as an important feature of suction feeders. Therefore, these elements suggest that all ichthyosaurs were ‘ram feeders’. We also found that the highest mandibular bluntness (width/ramus length) value in ichthyosaurs was about 0.45, which is not very blunt in the cetacean standard; published data suggest that most suction-feeding cetaceans have much blunter mandibles, with the ratio ranging between 0.58-0.86. Most of the cetaceans in the range near 0.45 are ‘ram feeders’, except some beaked whales that have extra superficial tissues around the corner of the gape that shortens the gape in effect. There is no evidence that ichthyosaurs had such ‘cheek-like’ soft tissues. In conclusion, it is most likely that there was no suction feeder among Triassic and Early Jurassic ichthyosaurs. Our study illuminates the risk of qualitative functional inferences in paleontology, and reemphasizes the importance of quantitative assessment of mechanism-related morphology.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 8:30 am)

EXAMINING CHARACTER CONGRUENCE AND COMPATIBILITY OF VERTEBRATE CLADISTIC DATA - EMPIRICAL APPROACHES APPLIED COMPARATIVELY ACROSS CLADES

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Previous phylogenetic work using conventional character partition homogeneity tests has often revealed significant incongruence between cranial and postcranial data. We extend this approach by applying pairwise character compatibility tests across a sample of more than 60 pseudo-independent vertebrate data sets. We contrast ‘fuzzy’ compatibility, boldown bootstrap and clique approaches. In particular, we find that the Le Queine probability (LQP) has several desirable properties. The LQP is simply the probability that a randomly permuted character will have incompatibility with other characters in the matrix at low or lower than that of the original character. Within recent analyses of Sauropod taxa, we find that characters related to neural arches often conflict with dental characters in some datasets but it is difficult to generalise; we are still exploring possible causative mechanisms for this. In contrast, other vertebrate groups such as raptors appear to have relatively little character conflict between morphological characters. Pairwise tests of character compatibility work well with binary data and ordered multistate characters, but can only give an indication of ‘potential compatibility’ with unordered multistate characters. Composite ‘higher’ taxa and polymorphic codes are also problematic for existing compatibility software, typically creating artificial incompatibilities. We recommend that composite taxa be decomposed into their constituents in order to remove ambiguity for the purpose of these tests, or else that polymorphic states are treated as missing data.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

MELANOSOMES... OR MICROBES?

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Elongate microbodies associated with feathers were originally attributed to microbial biofilms, but recently, in a series of papers, they have been reinterpreted as intracellular, pigment-containing organelles (melanosomes). Based upon this interpretation, coloration in non-avian and avian dinosaurs has been hypothesised. The only support presented for either hypothesis is morphological. Because melanosomes and microbes overlap in size, distribution and morphology, morphological data is insufficient to robustly support either claim. Here, we re-evaluate both hypotheses using chemical and molecular analyses. Melanin is highly resistant to degradation, with high preservation potential, but the intracellular organelles storing the melanin have not been shown to be equally resistant. Microbes, however, as well as the exopolymeric substance they secrete, are known to persist in the fossil record.

We have applied scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), and elemental transmission electron microscopy (TEM) to fully characterize melanosomes in extant feathers, and we conducted degradation experiments to visualize microbial growth on pigmented feathers from chicken (Gallus gallus). Melanosomes are intracellular and limited to internal regions surrounded by and embedded in the keratinous matrix of the feather. Microbes, on the other hand, grow across the surface of feathers. If analytical data support a melanosome origin for these microstructures, we hypothesize that feather specific β-keratin will also be identified using immunohistochemical methods. If these microbodies are melanosomes, they should reflect characteristics of melanin, including localized levels of S and transition metals such as Cu, Ca, Mn and Zn. Microorganisms in a biofilm should demonstrate elevated C, N, and P because of the high protein and phospholipid content in their membranes and associated exopolysaccharide (EPS) matrix. We will compare these data with published and unpublished results for fossil feathers.

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Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

NEW DREPA NOSAURID (ARCHOSAUROMORPHA: DREPA NOSAURIDAE) MATERIAL FROM THE LATE TRIASSIC DOCKUM GROUP OF WEST TEXAS

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Drepanosauriforms are best known from the Late Triassic of Europe. They are represented by the genera Vallesaurus, Drepsaurus, and Megalanosaurus. North American drepanosauriforms are less represented by a number of specimens of the genus Hypanoroventer from the Newark Group of Eastern North America. In the southwestern United States only a single specimen of Dolobrosaurus and five indeterminate drepanosaurid vertebrae from the Chinle Formation have previously been described. A recent review of drepanosaurids reprised many of the previous drepanosaurid publications. Drepanosaurid material from the Triassic Dockum Group of Texas has not been formally described previously.

The Museum of Texas Tech has over 300 drepanosaurid elements from five localities from the Dockum Group in their collection. The collection represents a variety of skeletal elements and multiple taxa. The collection includes an ontogenetic series of the terminal centra and a series of three-dimensional cervical vertebrae. The collection includes some of the oldest drepanosaurid specimens from the lower portion of the Tocovas Formation (Otsitschalikian) through the Revueltian Cooper Canyon Formation. The majority of the drepanosaurid elements were collected at two localities; however, the distribution of material geographically and stratigraphically illustrates that drepanosaurids were more widely distributed and taxonomically diverse than previously described.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

THE ROLE OF ELEVATION IN UNDERSTANDING THE BIOGEOGRAPHIC DISTRIBUTION OF THE EXTINCT LEMURS OF MADAGASCAR

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The subfossil record of Madagascar demonstrates that several extant species currently restricted to humid forests once had more widespread geographic distributions. Furthermore, an east-west distance effect in extant mammal distributions has been interpreted as evidence that faunal exchange routes once crossed portions of the central highlands. In this paper, we examine the biogeographic distributions of the extinct lemuras of Madagascar, and their effects upon lemur community composition in the late Quaternary, using the statistical techniques and mapping capabilities of a Geographic Information System (GIS).

We developed a database of extinct and extant mammal occurrences across Madagascar. Variables collected for each locality include species occurrence, geographic coordinates, elevation, radiocarbon dates, and paleoenvironment (pollen and stable isotope data). These data were analyzed using ArcGIS software.

Our results indicate that several extinct lemur taxa are shared among southern localities and Christmas River, the only known site from the south-central highlands, including inferred southern forest-dwelling animals such as Archaeolemur majori, Pachylemur insignis, and Megaladapis edwardsi. This lemur assemblage is fundamentally different from those recovered from a string of subfossil sites forming a corridor crossing the central highlands well to the north of Christmas River, through the Antananarivo Province (especially the Vakinankaratra and Hasy regions). The only characteristically southern giant lemur that is unequivocally found within this mid-central highland corridor is Hadropithecus stenogathus, which is rare. Other primate taxa from the mid-central highlands include the extinct lemuras Archaeolemur edwardsi, Megaladapis grandíleri, and Pachylemur insignis, as well as the extant lemuras Prolemur simus, Indri indri, Propithecus diadema, Eulemur fulvus, and Cheirogaleus major, among others. Sites in the more northern corridor are higher in altitude than those in the south. Our results indicate that the higher elevational distribution of subfossil sites in the mid-central versus the south-central highlands may have acted as a filter to limit the species that may have dispersed across the island in the past. It has been suggested that watersheds with sources at high elevation may have maintained mesic conditions during Quaternary climate shifts, due to orographic precipitation. For forest-dependent mammals, such mesic conditions may have also dispersed across the mid-central passage, but limited dispersal of moisture-restricted animals in the south.

Technical Session XIV (Saturday, October 20, 9:30 am)

THE ENIGMATIC REPTILE KADALI Saurus FROM THE LOWER PERMIAN OF GERMANY AND THE MONOPHYLY OF ARAEOSELIDIAN DIAPSIDS

MÜLLER, Johannes, Museum für Naturkunde Berlin, Berlin, Germany; DANTO, Marylène, Museum für Naturkunde Berlin, Berlin, Germany

The Aaraeoselidians are considered the oldest clade of diapsid reptiles and the sister group to all other members of Diapsida, comprising several taxa from the Late Carboniferous and Early Permian of North America and Europe. The European forms in particular have never been studied in detail, and the monophyly of Aaraeoselidians has not been tested within a modern phylogenetic framework. In the present study we reinvestigated Kadaliusaurus priscus from the Lower Permian of Saxony, Germany, a poorly known taxon which had
remained unstudied since its first description in the late 19th Century. The taxon is based on a single specimen that only preserves the trunk vertebral column and parts of the the fore- and hindlimbs, as well as some caudal vertebrae. The specimen is notably deteriorated in comparison to the original description, but new preparation nevertheless revealed additional details, such as the morphology of the zygopodia of both fore- and hindlimbs and the shape of the caudal vertebrae. Kadadilaurus superficially shares the elongate morphology of the limbs with the araeoscleridians Araeoscelis and Petrolacosaurus, but the proportions of the individual limb elements are different in these taxa. Also, there is currently no evidence for swollen neural arches in Kadadilaurus, in contrast to Araeoscelis and Petrolacosaurus. In order to assess the phylogenetic position of Kadadilaurus and to test if Araeoscelida is monophyletic, we scored all supposed members of the clad into a phylogenetic data matrix for early amniotes and analyzed the data using parsimony and Bayesian methodology. The results reveal that there is no support for a monophyly of araeosclerids and that only Araeoscelis and Petrolacosaurus are unequivocally part of Diapsida, whereas the remaining taxa variably group along the stem of diapsid reptiles together with the “protorothyridids” Protorothyris, Anthracodonemus and Caphalerpeton. Our results suggest that the elongation of fore- and hindlimbs is not an unambiguous apomorphy of Diapsida but either evolved several times or several times with the origin of early Euparkeria. Also, based on the current evidence it remains questionable if the presence of only a single temporal fenestra in Araeoscelis is secondary and it cannot be ruled out that the evolution of temporal fenestrations might have evolved in a stepwise manner. In conjunction with recent findings that also the “Younginiformes” are not monophyletic but merely a grade of early diapsids, the falsification of araeoscleridian monophyly indicates that the early history of Diapsida is far more complicated than previously thought.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

FIRST RECORD OF A PONTOPORIID CETACEAN (ODONTOCETI: INIOIDEA) FROM LATE MIocene OF CHIBA, JAPAN

MURAKAMI, Mizuki, Waseda University, Tokyo, Japan; HIRAYAMA, Ren, Waseda University, Tokyo, Japan

Pontoporiidae is represented today only by one relict species Pontoporia blainvillei restricted to the eastern coastline of South America. The fossil record of the family, however, is more diverse and is known from eastern and western South America, eastern North America, and the North Sea back to the late Middle Miocene. Here we report the first pontoporiid fossil from the uppermost Miocene Senhata Formation (6.3-5.7 Ma) of Chiba, central Japan. The specimen WU SILS (Waseda University, School of International Liberal Studies) 408 was discovered in a quarry owned by Towa Stone Limited in a medium sandstone layer in the lower part of the formation and includes a right neurocranium, an isolated bone crust, and the specimen is similar to Pontoporia blainvillei. The specimen is similar to Pontoporia blainvillei in having a low or absent maxillary crest. The premaxilla contacts the nasal in the specimen, similar to Pontoporia, Protophocaena, and Brachydolphins. Presence of a clearly asymmetrical vertebral on WU SILS 408 is shared with that of Stenodophelis, Protophocaena, and Brachydolphins. The specimen is similar to Brachydolphins in having the posterior edge of the bony nares located at the level of the postorbital process. The specimen is similar to Pontoporia in having obvious medial and lateral lobes of the premaxilla and a tooth without the bulbous part of the root. At the same time, WU SILS 408 has several aponomorphies: right premaxillary eminence with pronounced overhang on the right maxilla (6.5 mm); right premaxilla that extends posterior to the right nasal; very short or absent postero-lateral sulcus; relatively short nasal; relatively conical tooth (the crown diameter 2.9 mm) with several perpendicular striations; and a short zygomatic process of the squamosal. This mosaic, unique combination of characters, and large skull size of WU SILS 408 (the neurocranium length over 180 mm) indicates that the taxon is a new genus and new species of pontoporiid. The occurrence of a pontoporiid in our report is not only the first fossil record of its kind from Japan but also the North Pacific. This new discovery greatly extends the paleogeographical distribution of the family.

Posterm Session III (Friday, October 19, 4:15 - 6:15 pm)

THREE NEW BASAL ACANTHOMORPH FISHES FROM THE LATE CRETAceous OF MOROCCO

MURRAY, Alison M., University of Alberta, Edmonton, AB, Canada; WILSON, Mark V., University of Alberta, Edmonton, AB, Canada

Acanthomorph fishes first appear in the fossil record in the earliest part of the Late Cretaceous, in deposits from both the Western Interior Seaway of North America and the Tethys Sea between Europe and northern Africa. The earliest acanthomorphs are from the early Cenomanian of Canada and Mexico, and from various Tethyan localities of Cenomanian age in Lebanon. Although more than 20 acanthomorph species are known from Cenomanian deposits, fewer Turonian acanthomorphs have been described, with only four genera known from Turonian deposits and two or three from Western Interior Seaway deposits. Recently, three new acanthomorphs of Turonian age were recovered from the Agoult Formation, which samples marine carbonates of the Akkrub Formation on the Cretaceous North Saharan Platform, deposited during an incursion of the Tethys Sea into this area of Africa. Isotopic data confirm a normal marine paleoenvironment, with no evidence of brackish or freshwater influence, and a paleotemperature of approximately 24.8º C. The associated flora and fauna from the deposits indicate that the platform waters were likely very shallow and near shore. Two of the new acanthomorphs represent different species allied with the Aipichthyoidae based on the high supraoccipital crest, the caudal skeleton with a reduced neural spine on the second preural centrum and 19 principal caudal fin rays, and the predorsal formula, but they cannot be included in either of the named aipichthyoid families (Aipichthyidae or Protophocaenidae). The third new species is allied with the Polymixiiformes based on having a caudal skeleton with a full spine on the second preural centrum and 18 principal rays. The three new species contribute to the unique nature of the Agoult fauna at the generic and specific level, while reinforcing similarity at higher taxonomic levels to other early Late Cretaceous Tethyan faunas.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

JAW MECHANICS OVER PROBOSCIDIAN EVOLUTION

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Throughout proboscidean evolutionary history, cranial anatomy and mandibular anatomy have been highly integrated. Their feeding mechanisms presumably have modified the shape of the skull to maximize the forces exerted during mastication and minimize loads to vulnerable parts of the head. It has previously been stated that the temporalis muscle in modern elephants, with the main function of elevating the jaw while chewing as well as retraction of the jaw, originates just above the center of gravity of the proboscidean skull, directing force more or less vertically. Because of this, the coronoid process is angled rostrally directing the insertion for the temporalis rostrally, allowing for a vertical line of action. This forms a sling for the jaw to be able rock rostrocaudally relative to the cranium. In more archeaic proboscideans, such as the long-jawed gomphotheres, the temporalis was directed more horizontally with a rostrocaudally longer basioccipital. The coronoid process in these more archeaic forms was more vertically oriented compared to modern short-jawed elephants. This helped in major retraction of the jaw, however it likely impeded the powerful forward thrust seen in modern elephant chewing. The masseter musculature and medial and lateral pterygoid muscles in modern elephants are involved in elevation, mediolateral translation, and protraction of the jaw. These muscles are very robust, originating from the anterior portion of the zygomatic arch and from either side of the lateral pterygoid plate, respectively, and extending to insert around the entire rounded angle of the mandible. These muscles produce the powerful thrust needed for the rostral protraction of the jaw in modern elephants. Although assertions have been made about when the transition of jaw mechanisms occurred in the history of proboscideans, it has not been quantified. Lever arm mechanics analyses are performed, using lateral views of the skulls, to compare different proboscidean jaw mechanisms to observe transitions of coronoid process angle as well as temporalis, masseter, and medial pterygoid muscle angle. Results agree with previous hypotheses of mechanical advantage transitioning from a caudal thrust to a proal thrust of the mandible in the transition to modern proboscideans with a vertical temporalis and large masseters and pterygoids. The differences in mastication between proboscidean taxa, in addition to giving insight into changes in their dietary ecology, also provide suggestions as to evolution of morphological changes of the proboscis. As the mandibular symphysis elongated, so did the narial region, with later retraction of the symphysis in some lineages. Thus jaw mechanics were likely a significant driving factor in proboscidean evolution.

Education and Outreach Poster Session (Posters displayed October 17 – 20)

THE FIELD BOOK PROJECT: CONNECTING FIELD BOOKS WITH THE WORLD

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Field books and notes are primary sources that document scientific research during fieldwork. In vertebrate paleontology, field books and associated documentation can be rich in details about localities, stratigraphy, specimens, collecting methods, and personal correspondence that may not be recorded in the scientific literature nor in electronic databases. Thus, they constitute a kind of “hidden collection,” with poorly understood, yet large potential value that requires care and stewardship. The mission of the Field Book Project, based at the Smithsonian Institution’s National Museum of Natural History, is to centralize, organize and digitize these “hidden collections” online for scholars and others to accurately search for research materials and to gain greater access to institutional collections within the Smithsonian, and it interfaces with the Smithsonian Institution Archives, the Smithsonian Institution Libraries, and the Office of the Chief Information Officer. Among its goals, the Field Book Project aims to create a national Field Book Registry. Its unique online location would serve scientists worldwide. The registry would also be a tool for professionals in other academic disciplines, helping to inspire emerging new generations of scientists, as well as citizen-scientists and life-long learners. This poster will provide an informative overview of the Field Book Project by depicting paleontological field notes as use cases and explaining how the Field Book Registry’s levels of description will allow researchers to more easily assess relevant field book content. The poster will also briefly discuss future goals including transcriptions from oral archives. The authors will also display the Field Book Project Blog, Flickr sets, website, and a demo of the Field Book Registry.
DERIVATION OF THE AETOSAUR OSTEODERM CARAPACE: EVIDENCE FROM A NEW, EXCEPTIONALLY PRESERVED “STEM AETOSAUR” FROM THE MIDDLE TRIASSIC ANISIAN MANDA Beds OF SOUTHWESTERN TANZANIA

NESBITT, Sterling J., University of Washington, Seattle, WA, United States; Sidor, Christian A., University of Washington, Seattle, WA, United States; ANGIELCZYK, Kenneth D., Field Museum of Natural History, Chicago, IL, United States; SMITH, Roger M., South African Museum, Cape Town, South Africa; PARKER, William, Petrified Forest National Park, Petrified Forest National Park, AZ, United States

Phylogenetic estimates of the relationships and diversification of Triassic archosaurs predict that subclades known exclusively from the Late Triassic (e.g., aetosaurs, ornithischians, phytosaurs) originated in the Early or Middle Triassic. Because these subclades are morphologically divergent and differ in their body plans, the early members have not been identified with confidence thus far. Here we report on a nearly complete skull and partial skeleton of a new MIDDLE Triassic pseudosuchian from the diverse Manda beds archosaurian assemblage of Tanzania. The new form bears an elongated skull with a rugose skull table; small antorbital fenestra surrounded by a large antorbital fossa; laterally compressed, recurved teeth; and osteoderms down the back, on the belly, and on the limbs. Thissuite of character states includes osteoderms that were first produced to allocate fossils of uncertain origin to specific stratigraphic beds and thus age and provenance.

Technical Session IX (Friday, October 19, 9:30 am)

MAMMALIAFORM TAXONOMIC DIVERSITY AND TURNOVER THROUGH THE MESOZOIC

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Recent morphological, ecological and phylogenetic analyses of Mesozoic mammaliaformes have shed light on their unappreciated biodiversity. However, the taxonomic diversity of Mesozoic mammals has not been analysed with the same quantitative rigor of modern methodological tools. Here, we present a comprehensive statistical analysis of global mammaliaform taxonomic diversity and generic turnover from the Carnian (Late Triassic) to the Maastrichtian (end Cretaceous). Collections data for 282 Mesozoic mammaliaform genera were updated in the Paleobiology Database and then taxonomic diversity was assessed using species counts, residual diversity estimates based on mammaliaform-bearing collections, and shareholder quorum subsampling. Mammaliaform subclades were also analysed separately through the Mesozoic to assess changes in clade dominance, both globally and in individual geographic regions. Origination and extinction rates were estimated using the three-timer method, and the results of all these approaches were combined to provide a robust picture of Mesozoic mammaliaform diversity. Mammaliaform taxonomic diversity is punctuated by multiple significant peaks and troughs through the Mesozoic. Statistically robust falls occur through the Callian-Borealian-Oxfordian, Valanginian-Hauterivian and Aptian, while significant increases in diversity are observed over the Triassic-Jurassic boundary, Jurassic-Cretaceous boundary and in the Cenozoic. Results for the Triassic and Jurassic periods are necessarily more tentative that those for the Cretaceous, as they are dominated by a few well-studied faunas. Turnover analyses identified peaks in extinction rates through each decline in diversity, although the relationship between increases in diversity and origination or extinction rates is more complex. Analysis of mammaliaform subclades shows that the Cretaceous diversity signal is dominated by a few mammalian subclades, with multituberculates and eutrochodonts driving Early Cretaceous diversity. Indeed eutrochodonts are most consistently successful through the Middle Jurassic to Early Cretaceous, repeatedly radiating following declines in overall mammalian diversity before giving way to eutherians and metatherians in the Late Cretaceous. Spatial signals are markedly affected by preservation bias, but some general patterns are clear, such as Asian endemism during the Jurassic. Lastly, comparison with stable isolate provinces of paleoclimate suggests that Mesozoic mammaliaform diversity and turnover may have been affected by abiotic factors, such as Late Callavian-Oxfordian cooling and mid-Oxfordian warming pulses.
used to assemble biogeographic reconstructions for vertebrate clades. Despite some of the inherent weaknesses of this method in failing to account for certain events that could be responsible for a given species distribution pattern (such as geodispersal, or removal of barriers to permit gene flow), PAE remains a highly useful method for formulating testable hypotheses about the processes responsible for observed biogeographic patterns.

Distributional data were obtained from more than 100 published articles and other references in order to construct a georeferenced records database. Geographic distribution maps for each taxon were assembled within the distributional data using ArcGIS 10 software. Next, a presence-absence matrix was generated to detail lungfish generic distribution across all continental units. Binary cluster analysis was applied to the data using the R statistical package (version 2.14.0), and the biogeographic relationships of lungfish genera were examined in PAUP (version 4.0) using the Jaccard coefficient of similarity. Twenty six most parsimonious cladograms were recovered, and summarized in a single consensus tree. Six areas (representing six continents) of endemism were identified: Africa, Asia, Australia, Europe, North America, and South America. Results in part suggest a patterned distribution variance between African and South American landmasses, recovering a close relationship between lungfish clades from those regions to the exclusion of those inhabiting other areas, consistent with findings obtained in other studies. The present analysis expands upon previous phylogenetic and biogeographic studies of lungfish that have either included subsets of this taxonomic sample, or fewer of the possible zoogeographic regions.

Technical Session III (Wednesday, October 17, 2:00 pm)

STABLE ISOTOPE DATA FROM THE CHILGA BASIN, ETHIOPIA, AND THEIR IMPLICATIONS FOR RESOURCE PARTITIONING AMONG LATE PALEOGENE AFRICAN ENDEMIC MAMMALS

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Herbivorous mammals in modern tropical ecosystems are characterized by a high degree of specialization, resulting in the systematic distribution of food resources among them. In order to test whether this also occurred within ancient tropical ecosystems, and to understand better the ecology of endemic Afrotropical mammals, δ13C and δ18O data were collected from carbonate in fossil herbivore tooth enamel apatite among orders Proboscidea, Hyracoidea, and Embrithopoda from the Chilga Basin, Ethiopia. Weight percent carbonate of each sample was calculated as a test for diagenesis and the samples yielding values outside the expected range were not included for interpretation. The entire δ13C dataset ranges between -16% and -6‰ (V=Dee Belemont), or V=VPDB). Excluding the possibility of diagenesis, this large range most likely indicates that the landscape was heterogeneous, and likely included areas similar to modern closed-canopy forests. There are taxon-specific peculiarities among the enamel δ13C values which indicate that systematic distribution of food resources may have existed: the Proboscidea, on average, yielded the lowest values (-13.39%, V=VPDB) and the Hyracoidea yielded the highest (-9.73‰, V=VPDB). It is not clear whether these data indicate that herbivore diets were different with regard to food types (e.g., legumes vs. palms), food source locations (e.g., canopy vs. ground, more closed vs. more open canopy areas), or whether these differences reflect seasonal variability. Nevertheless, the Embrithopoda δ13C values varied the least (15 = 1.35‰), indicating that their diet was the most restricted of the taxa studied. This is consistent with the current understanding of the genus Arsinotherium as a specialized feeder. Variation in δ18O values within each taxonomic group was high (15 > 2%). Excluding the possibility of diagenesis, and assuming that local surface waters did not vary greatly, this indicates none of these groups was semi-aquatic, in contrast to the wide sampled view of the habitat of Arsinotherium (Embrithopoda).

Technical Session XI (Friday, October 19, 2:15 pm)

WHAT BIG CLAWS YOU HAVE: IMPLICATIONS OF MORPHOLOGICAL VARIATION IN THEROPOD MANUAL UNGUALS

NOTO, Christopher R., University of Wisconsin-Parkside, Kenosha, WI, United States; SACKS, Robert, University of California, Berkeley, CA, United States; MORRIS, Robert, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

In order to understand the functional morphology of theropod forelimbs and interpret their use in behavior it is necessary to study the role played by the manual unguals. Among living vertebrates claws have a diversity of uses, including locomotion and food acquisition, and it has been shown that claw shape varies systematically with function. Among living birds, research suggests that correlations between claw morphology and such factors as diet and function, used for locomotion or predatory preferences and behavior. A similar approach to theropod unguals may yield insights into their behavior, predatory or otherwise. Theropod manual unguals vary greatly in overall morphology (size, length, curvature). While most had a likely predatory role, the claws of some taxa are thought to have had other functions, such as locomotion. Applying what we know about the correlation between shape and function in living vertebrates we may expect that differences in claw shape will follow ecological and/or evolutionary patterns in theropods. A series of 14 cephalopar landmarks were applied to photographs and published figures representing taxa from all major theropod clades, including birds. Over 200 individual claws are in the sample, representing over 80 taxa. Procrustes superimposition and thin-plate splines were used to quantify shape differences while principal components analysis (PCA) was used to explore patterns of shape variation. PCA results show that most of the shape variation is explained by changes in two areas: the degree of nail curvature and nail size relative to the ungual body. In many taxa, the first digit is strongly differentiated from the remaining digits. Certain features of shape variation have an evolutionary significance. Coelurosaurs differ significantly from non-coelurosaurian theropod clades, filling a much larger proportion of shape space suggesting greater ecological diversification. The claws of non-coelurosaurian theropods were almost exclusively predatory in function, and more likely being used as piercing gaffes to hold prey. Within different theropod clades, the evolution of ecological specializations is recorded in the changing claw shape as one move towards more derived members of the group. This includes the evolution of gaffe-like claws in giant predatory tyrannosaurids and elongated, straight claws in herbivorous ornithomimids. Some small carnivores, including birds, are notable for having a claw shape that falls far outside all other groups, which may be a specialization for climbing. This novel approach allows one to explore ecological differences between theropod species and higher taxa, including food preference and predatory behavior. Furthermore, these results may aid in understanding the evolution of the theropod manus, its functional changes, and yield important character data useful for cladistic analyses.
and complementary role of fossil data in the light of recent advances phylogenetic comparative methods.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

AIR SPACE PROPORTION IN A DORSAL VERTEbra OF A NEW TITANOSAUr (dinoSAURia: SAU ropodA) FROM JORDAN

O'CONNELL, Taryn L., University of Michigan, Ann Arbor, MI, United States; WILSON, Jeffrey A., University of Michigan, Ann Arbor, MI, United States; ZALMOUT, Iyad S., University of Michigan, Ann Arbor, MI, United States

Postcranial skeletal pneumaticity is present in birds and many fossil archosaurs, and it is especially well developed in the vertebral column of sauropod dinosaurs. The degree of vertebral pneumatization varies along the vertebral column and among sauropod genera. The air space proportion (ASP) is a convenient measure of the percentage of the vertebra that is occupied by air. Two-dimensional measurements of ASP are typically made by importing Computed Tomography (CT) images of vertebrae into a photo-editing program, and counting the pixels representing both airspace and bone. We used a slightly different technique to measure ASP in a new titanosaur from Jordan. We selected a sample of CT slices in the horizontal, sagittal, and transverse planes, enhanced the images, and then outlined internal and external pneumatic spaces using the image-processing program ImageJ. Internal pneumatic spaces are those enclosed within the vertebra and typically only visible in damaged regions or in CT images. External pneumatic spaces are fossae that are visible on the outside of the vertebra. Both internal ASP (iASP) and total ASP (tASP, sum of internal and internal ASP) varied among different CT slice orientations and within sections in a single orientation. Horizontal CT sections had the most variation of both iASP and tASP, in addition to having the highest iASP value. These sections had an average iASP of 67.3% and ranged from 66.5% to 74.2%. Average iASP for these sections was 78.6% and ranged from 67.7% to 85.9%. Sagittal cross-sections displayed the least variation of iASP and tASP, as well as the lowest iASP values. The iASP values range between 62.7% and 69.3%, with an average of 66.2%. The iASP values were between 70.4% and 78.9%, with an average of 73.4%. Transverse sections presented little variation in iASP (63.5–67.8%), but great variation in tASP (65.5–81.4%; average 74.0%). The average iASP for the Jordanian dorsal vertebra is 67.1%, and iASP is 75.3%. From this study, it is clear that ASP values can vary considerably within a single vertebra. Patterns of variation within and between vertebrae along the column may provide insights into vertebral mechanics and function.

Technical Session XII (Friday, October 19, 2:00 pm)

THE ONTOGENY OF THE SHOULDER IN POLICYTUS LATIPINUS (PLESIOSAURIA: POLICYTUSIDAE) AND ITS BEARING ON PLESIOSAUR VIVIPARITY

O'KEEFE, Frank R., Marshall University, Huntington, WV, United States; BYRD, Christina J., Marshall, University, WV, United States

Understanding ontogenetic change in shoulder morphology in plesiosaurs is critical to proper taxonomic identification of embryonic plesiosaur material. The first known gravid plesiosaur was described in 2011, a large, Late Cretaceous polycotylid (Polycotylus latippinus), that provided evidence for viviparity in plesiosaurs. One main supporting argument for viviparity in this fossil was the taxonomic identity of the adult and embryo, an attribution based primarily on humeral morphology. Comparison of the embryonic material with another juvenile polycotylid skeleton described here demonstrates that the embryonic scapulae were misidentified as humeri, and the embryonic clavicles were misidentified as scapulae, in the original paper on plesiosaur viviparity. In this study, the scapulae and clavicles of the new material are compared with the juvenile polycotylid mentioned above as well as with those of an adult Dolichorhynchops eosiorn and with the Polycotylus adult. The scapulae of the embryo and juvenile possess ossifications that resemble the scapulae of basal nothosaurs and pistosaurs much more than they resemble those of adult plesiosaurs. As polycotylids grow, however, progressive ossification produces scapular ossification similar to adult basal plesiosaurs, such as Plesiosaurus. At full adulthood the scapula is maximally derived, with a large and well-ossified ventral ramus. Therefore, the ontology of the polycotylid scapula recapitulates its saurian phylogenetic history. The morphology of the scapula is too ontogenetically variable for reliable classification of the embryo; however, the triradiate morphology and concavities of the embryonic clavicles are maintained throughout ontogeny, and are diagnostic to Polycotylidae. While the embryo cannot be directly attributed to the genus Polycotylus, it is attributable to a large polycotylid. Therefore, the taxonomic identity of the embryo continues to support the in utero relationship with the adult Polycotylus, and the general conclusions concerning plesiosaurian viviparity are unchanged.

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platykurtosis. Conversely, no significant kurtosis was found in the distribution of data for those species with indeterminate growth (C. mydas: g = -0.57, t = -0.90, p = 0.4; lepidosaur: g = -0.11, t = -0.23, p = 0.5). The distribution of dentary data for M. watsoni was found to be platykurtic (g = -0.54, t = -2.55, p = 0.02), supporting the hypothesis of determinate growth in this animal. Additionally, coefficients of variation (CV) of dentary depth were found to be less in the extant mammals than in those species with indeterminate growth patterns. The CV for M. watsoni was found to lie within the range of the extant mammals, further supporting the conclusion that growth was determinate in Morganucodon. This conclusion is consistent with evidence for diphydonty in both M. oehleri and M. watsoni, and the hypothesis that the evolution of determinate growth and diphydonty in basal mammalianiforms were interlinked and possibly related to the origin of lactation.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 10:30 am)

**EVOLUTION OF SEX CHROMOSOMES IN DINOSAURS**

ORGAN, Chris, University of Utah, Park City, UT, United States; JANES, Dan, NIH, Washington DC, DC, United States

Sex determination by chromosomal inheritance (genotypic sex determination) is common in amniotes and plays an important role in life history. Although sex chromosomes are often homomorphic, structural differences between homologous chromosomes is widespread. Inheritance of the heterogametic sex chromosome produces females (by inheriting the W; theZW system) or males (by inheriting the Y; XY system). TheZW system is found in birds, snakes, and some other reptiles, while theXY system is found in mammals and some non-avian reptiles, like skinks. Generally, the heterogametic sex chromosome (W or Y) is smaller, heterochromatic, and gene poor in comparison to its partner. Although different information is genetically encoded in W versus Y chromosomes, their degradation suggests a consistent general trend in the evolution of sex chromosomes. Theory suggests that heterogametic sex chromosomes decay rapidly, perhaps completely vanishing within 10-20 million years, and the reorganization of deleterious mutations in the non-recombining region. However, a comprehensive large scale, phylogenetically-grounded analysis of chromosomal degradation within amniotes has never been performed. Moreover, it is unknown how the phylogenetic decay rates differ between theXY andZW systems. Here we present a large-scale phylogenetic analysis ofXY andZW sex chromosome evolution using a large catalogue of karyotypic measurements. We discuss the rates and first appearance of sex chromosomes in the dinosaur lineage and present a novel Bayesian comparative method to make phylogenetically-informed univariate predictions.

**FLUVIAL SEDIMENT AND EGGSHELL INTERACTIONS: A METHOD FOR ASSESSING TRANSPORT IN FOSSIL EGG SHELL ACCUMULATIONS**

OSER, Sara E., Montana State University, Bozeman, MT, United States

Assessment of transport history of fossil eggshell remains problematic given the complex taphonomic processes acting on fragments (e.g., breakage by trampling, dissolution, soil bioturbation). Previous studies focus on eggshell shape and orientation (conceal-up/down) to assess whether a fossil assemblage represents an in situ or allochthonous deposit. However, these studies are not applicable to all eggshell accumulations. At the Egg Mountain locality (Museum of the Rockies locality 006) near Choteau, Montana, hadrosaur eggshell occurs on multiple, poorly defined horizons, limiting the applicability of fragment orientation ratios.

Thus, taphonomic studies require a different means for assessing possible transport. In a previous study I used a rock tumbler as a partial analogue of fluvial transport, and noted that sediment-eggshell interactions quickly induced distinctive wear on the edges of chicken Gallus gallus domesticus eggshell fragments. My current study investigates whether the presence or absence of edge wear provides a reliable means to distinguish allochthonous from in situ fossil eggshell accumulations. Eggshell from three localities that represent an in situ nesting site (Wayan Formation, Idaho) and high energy environments (i.e., crevasse splay and channel sandstone) provide a baseline for comparing the Egg Mountain material. The fossil eggshells from all localities are of similar thickness (1 mm) and size (10 mm). Scanning Electron Microscopy (SEM) imaging reveals that eggshell deposited in high energy paleoenvironments display edge wear similar to that observed in the rock tumbler experiments (i.e., substantial rounding and loss of surface detail). In contrast, in situ eggshell from the Wayan Formation collected both as surface float and during excavation shows no evidence of edge wear. Further, this also demonstrates that short term subaerial exposure of untransported material will not produce wear. Eggshell from the Egg Mountain locality does not display edge wear, consistent with an in situ assemblage.

This study provides a more broadly applicable method to identify transported eggshell than previous techniques. However, this method is limited because it is an assessment of sediment interaction, which may not a direct indicator of transport. Flume studies reveal that some abrasion of modern eggshell occurs in place. Nevertheless, the absence of edge wear in fossil eggshell assemblages supports the interpretation of an in situ deposit.

**GIANT FELID POSTCRANIA & THE EARLY EVOLUTION OF NORTH AMERICAN CATS**

ORCUTT, John D., University of Oregon, Eugene, OR, United States; DA VIS, Edward B., Oregon, Eugene, OR, United States; COOPER, Lisa N., Ohio University, Athens, OH, United States; OBI, Gordon C., Department of Geology, Uli, Oregon

The Paleocene-Eocene strata of northeastern Nigeria collectively represent a rich and relatively unexplored source of fossil vertebrates. Recent expeditions have focused on expanding the Paleocene ichthyofauna of this vast geological sequence. Deposits are represented by the upper part of the Nsukka Formation (Danian), the Imo Formation (Paleocene) and the Ameke Formation (Eocene). A transgressive erosional surface separates the Nsukka faunia from the overlying Imo Formation that begins with estuarine clay, shale and limestone, and grades upward into fossiliferous calcareous shoreface facies. The Imo Formation-Ameke Formation contact is marked by the transition from fossiliferous/calcareous shoreface facies at the upper levels of the Imo Formation, into the overlying coarse grained tidally-influenced fluvial sandstones that form the basal units of the Ameke Formation. Fossiliferous facies of the Ameke Formation consists of phosphaté-bearing estuarine mudstone and coquoid limestone that pass upward into shoreface and coastal plain sandstones and clays. Recovery of vertebrate fossils has long been limited to the estuarine facies of the Eocene Ameke Formation. More recently, an actinopterygian, five chondrichthyans and the enigmatic taxon Cylindricanthus were recovered from newly discovered Paleocene Imo Formation localities in the Bende district. Additional field exploration to the region has revealed two additional fossil localities, Umunze (in the Imo Formation) and Ameke (in the Ameke Formation). Study of the fauna collected from these new localities revealed three chondrichthians at Umunze, and one chondrichthian together with two actinopterygians and one amale. Sustained work in the region documents a diverse ichthyofauna containing at least six taxa. Five chondrichthian taxa are represented by two ray species and four shark species, the latter including Galeocerdo sp, a taxon hitherto undocumented in the Imo formation of northeastern Nigeria.

**PHYLLOGENY, HISTOLOGY AND INFERRED BODY-SIZE EVOLUTION IN A NEW Rhabdodontid Dinosaur from the Late Cretaceous of Hungary**

OSL, Attila, MTA-ELTE Lendulet Dinosaur Research Group, Budapest, Hungary; PRONDVAI, Edina, MTA-ELTE Lendulet Dinosaur Research Group, Budapest, Hungary; BUTLER, Richard J., GeoBio-Center, Ludwig-Maximilians-Universität, Munich, Germany; WEISHAMPEL, David B., Center for Functional Anatomy and Evolution, Johns Hopkins University, Baltimore, MD, United States

Following 12 years of extensive excavations and screen-washing, the Iharkút locality, the first appearance of sex chromosomes in the dinosaur lineage and encompassing the immigration of the saber-toothed carnivores into the New World, was discovered in the late Miocene near Choteau, Montana, has yielded an as-yet unrecognized species of Machairodus. This conclusion is consistent with evidence for diphydonty in both M. oehleri and M. watsoni, and the hypothesis that the evolution of determinate growth and diphydonty in basal mammalianiforms were interlinked and possibly related to the origin of lactation.

The Late Miocene is a critical interval in felid evolution in North America, falling at the end of the "Cat Gap" and encompassing the immigration of the enigmatic, endemic M. coloradensis from Eurasia, the evolution of the enigmatic, endemic Nimravus, and the appearance of the continent's first true conical-toothed cats. Much of the research on felids from the Late Miocene has focused on cranial and dental remains, using those skeletal systems to infer evolutionary trends and behavior. However, this cranial focus ignores the extensive record of felid postcrania in this interval, and the larger sample of postcranial elements can be a comparative method to make phylogenetically-informed univariate predictions.

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paravian theropods, nodosaurid ankylosaurs, coronosaurian ceratopsians, and a new species belonging to the endemic European ornithopod clade Rhabdodontidae, which is represented by both cranial and postcranial remains. A global phylogenetic analysis of ornithischian dinosaurs including all known rhabdodontid genera supports the rhabdodontid affinities of Zalmoxes. In addition to this new European taxon, Rhabdodon loricatus, a poorly-known rhabdodontid from the lower Campanian of Austria, and Zalmoxes spp. from the Maastrichtian of Romania. Based on characters of the dentary, an element that is known in all rhabdodontid species, the Hungarian species is most similar to the Austrian rhabdodontid. This close affinity is further supported by their close temporal as well as spatial proximity. The Hungarian rhabdodontid also shows similarities to Zalmoxes, a genus that is approximately 15 million years younger in age, but the morphologies of the quadratojugal, dentary, and some limb bones clearly indicate important differences between the two forms. Historological study of limb bones has allowed estimation of adult body size for all genera of Rhabdodontidae. Samples from the Hungarian and Austrian species indicate a similar adult body length of 1.6–1.8 m that is in accordance with the morphological similarities between these two rhabdodontids. In contrast, the French specimens of Rhabdodon had a much larger, 5–6 m, adult body length, indicating a substantial difference in body size between the western and eastern European taxa. However, phylogenetic mapping of body size onto the results of the phylogenetic analysis calls into question the hypothesis that insular dwarfism found in the western and eastern European taxa. These results imply a deep divergence (prior to the Santonian) between a western rhabdodontid lineage represented by Rhabdodon loricatus and the Austrian and Hungarian rhabdodontids. Zalmoxes spp. is the sister group of the clade comprising the western rhabdodontids. In contrast, the French specimens of Rhabdodon are the sister group of the clade comprising the western and eastern European taxa. Here we test the effect of ontogenetic changes on inferences of phylogenetic position of Massospondylus carinatus, scoring specimens from different ontogenetic stages as separate operational taxonomic units: only adult specimens (lacking cranial characters), only non-adult specimens (including cranial characters), and a mixture of non-adult (cranial) and adult (postcranial) characters in the same data matrix in order to test the impact of ontogenetic variations in the retrieved tree topology. The results depicted of Massospondylus as the sister group of massospondylians when only juvenile specimens, when only juvenile cranial characters, and when only juvenile postcranial characters, are scored. On the other hand, when we scored characters solely from adult individuals, all MPTs depict Massospondylus as a basal member of Anchisauria, being the sister group of the clade comprising Aardonyx + more derived sauropodomorphs. Massospondylus is therefore placed in a more derived position forming part of the basal sauropodomorph-saurischian transition. The same results are retrieved when we scored a mixture of juvenile cranial and adult postcranial characters. Certain characters related to limb proportions in the juvenile specimens, such as the skull/ femur length and humerus/femur length ratios show derived states, like those present in the quadrupedal clade (i.e., Esauropoda) suggesting a primitive quadrupedal locomotion. Those characters, however, present plesiomorphic states in the adult specimens, suggesting, at least, facultative bipedal locomotion. In contrast, most character states related to the manus in the juvenile specimens show no changes when compared to adult specimens, depicting this structure as a conservative module through ontogeny. The results show the character states that vary through ontogeny and such variation does not always represent plesiomorphic states in early ontogenetic stages, but instead a mixture of apomorphic and plesiomorphic states reflected in different tree topologies. These changes are shown to be relevant for determining the phylogenetic position of Massospondylus, as its affinities change if adult morphology is ignored, suggesting that a careful evaluation of ontogenetic stages is needed for testing the phylogenetic relationships of basal sauropodomorphs. Increasingly scientists are required to include an outreach or communication component in their research projects, especially those funded by government agencies. The Panama Canal Project (PCP) Partnerships in International Research and Education (PIRE) is an international partnership among several institutions from United States and Panama. PCP PIRE students created a bi-lingual (English/Spanish) e-newsletter to keep participants and partners informed about the different project activities and to engage new potential stakeholders.

E-newsletters have numerous advantages over other media, including printed newsletters, list-serves, and even web sites. These include ease of targeted distribution via email, reduced costs, active engagement, and rapid transmission. Our PCP PIRE e-newsletter, published monthly (10 times per year), has grown over the past 15 months to a readership of more than 200 including students, faculty, educators, funding agencies, and partner institutions. Our monthly readership continues to grow as new stakeholders are added to our mailing list. During the initial development, formative feedback indicated that, given the barrage of communications, some readers wanted the e-newsletter to be short with “snippets” organized in a way similar to the screen that appears in hand-held devices like iPhones. If readers want to delve more deeply into a particular subject they can link to the longer article. PCP-PIRE students write the e-newsletter stories. Articles are typically 250 to 450 words. Stories are organized in four sections: People, International, Research and Education. All of the e-newsletters are archived on our PCP PIRE web site. The PCP-PIRE e-newsletter open rate (42-58%) is higher compared to other newsletters with a similar scope. Also, 25% of recipients click on the links to learn more about the stories (click rate). People, International and Research sections are preferred by the recipients (23- 33%); 15% of recipients read complete stories in the Education section. The variety of sections in the e-newsletter and the Spanish version of every story meet the needs of the different stakeholder demographics. Other similar projects may benefit from lessons learned such as how to write for a diverse audience, understanding readership reports, and avoiding being reported as a spammer.

**Poster Session**

**PHYLLOGENETIC RELATIONSHIPS OF MUSSAURUS PATAGONICUS: TESTING THE EFFECT OF ONTOGENETICALLY VARIABLE CHARACTERS ON TREE TOPOLOGY**

**MOTE, Alejandro**, Museo de La Plata, La Plata, Argentina; POL, Diego, Museo Egídio Furtulugio, Trelew, Argentina; POWELL, Jaime, Instituto Miguel Lillo, Tucumán, Argentina

**Massosaurus patagonicus** is a basal sauropodomorph dinosaur from the Upper Triassic Laguna Colorada Formation, Patagonia, Argentina. This taxon is known from multiple specimens of different ontogenetic stages, including hatchlings, juveniles, and adult specimens, providing a case study of ontogenetic changes in a basal sauropodomorph. Skull morphology is known from hatchlings and juveniles whereas postcranial remains are known from all ontogenetic stages. Here we test the effect of ontogenetic changes on inferences of phylogenetic position of *M. patagonicus*, scoring specimens from different ontogenetic stages as separate operational taxonomic units: only adult specimens (lacking cranial characters), only non-adult specimens (including cranial characters), and a mixture of non-adult (cranial) and adult (postcranial) characters in the same data matrix in order to test the impact of ontogenetic variations in the retrieved tree topology. The results depicted *M. patagonicus* as the sister group of massospondylians when only juvenile specimens, when only juvenile cranial characters, and when only juvenile postcranial characters, are scored. On the other hand, when we scored characters solely from adult individuals, all MPTs depict *M. patagonicus* as a basal member of Anchisauria, being the sister group of the clade comprising *Aardonyx* + more derived sauropodomorphs. *M. patagonicus* is therefore placed in a more derived position forming part of the basal sauropodomorph-saurischian transition. The same results are retrieved when we scored a mixture of juvenile cranial and adult postcranial characters. Certain characters related to limb proportions in the juvenile specimens, such as the skull/ femur length and humerus/femur length ratios show derived states, like those present in the quadrupedal clade (i.e., *Eusauroptera*) suggesting a primitive quadrupedal locomotion. Those characters, however, present plesiomorphic states in the adult specimens, suggesting, at least, facultative bipedal locomotion. In contrast, most character states related to the manus in the juvenile specimens show no changes when compared to adult specimens, depicting this structure as a conservative module through ontogeny. The results show the character states that vary through ontogeny and such variation does not always represent plesiomorphic states in early ontogenetic stages, but instead a mixture of apomorphic and plesiomorphic states reflected in different tree topologies. These changes are shown to be relevant for determining the phylogenetic position of *M. patagonicus*, as its affinities change if adult morphology is ignored, suggesting that a careful evaluation of ontogenetic stages is needed for testing the phylogenetic relationships of basal sauropodomorphs.

**Technical Session IV**

**META-ANALYSIS OF REPORTED PTEROSAUR TRACKWAYS: TESTING THE CORRESPONDENCE BETWEEN SKELETAL AND FOOTPRINT RECORDS**

**PABON, Kevin**, University of California, Berkeley, CA, United States; FALLON, Brenna, University of California, Berkeley, CA, United States

It is sometimes remarked that there is a “landslide of evidence” for ubiquitous trackways of pterosaurs in the Jurassic and Cretaceous Periods. We performed a meta-analysis of nearly 100 reports and reviews of alleged pterosaur trackways. We first focused on the redundancy of works that attributed trackmakers based on referrals of previous authors, but that provided no first-hand justification for the attribution. More than a third were redundant reports; fewer than 10% examined the evidence for attribution. There was a significant correlation among (1) attribution of trackways to pterosaurs, (2) no consideration of alternative hypotheses of trackmakers, (3) lack of anatomical or kinematic evidence for the attribution, and (4) referral of justification for the attribution to two (or a very few) recurrent publications. We then focused on the justification for the attribution of trackways to pterosaurs. We found many cases where apomorphies of pterosaurs reflected in any diagnosis of trackways, including reformulations of the original diagnosis of Pterachnus saltwashensis. In almost all cases of trackways referred to pterosaurian trackmakers (with the notable exception of the tracks from Crayssac, France) there is no evidence of pterosaurian apomorphies. Some of these assigned trackways, such as *Parbeckospus*, show clear crocodilian apomorphies reflected in their diagnoses. Others, such as *Haenamichnus*, show no discernible anatomical features. Over 90% of the ichnological literature contains no analysis of skeletal or functional features. Most reports and reviews of alleged pterosaur tracks contain no analysis of skeletal or functional features that an assignment to a pterosaurian trackmaker requires. Because no trackways assigned to pterosaurs are well enough preserved to determine either a manual or pedal phalangeal formula, it is impossible to reconstruct the skeletal manus and pedes of the trackmakers assigned to *Pterachnus* (traditionally presumed to be tracks of pterosaurs). Nearly all trackways attributed to pterosaurs show (1) a gleno-acetabular ratio lower than commensurate with known pterosaurs, (2) a length-width ratio of the pes (metatarsals + phalanges) incommensurate with known pterosaurs, and (3) a preservation so poor as to make attribution of a trackmaker impossible. The Crayssac trackways differ in derived respects from all other attributed trackways, despite deficient preservation, because they show true pterosaurian apomorphies; they should be systematically separated as *Pteracnidae*. Some other authors have advocated. It is difficult to assign most trackways referred to *Pterachnus* to pterosaurs or any taxon. We propose morphological and preservational criteria by which to evaluate alleged pterosaur trackways. Our analysis has important implications for palaeoecological and taxonomic assessments of ancient communities.
structural similarity, for a reinterpretation of the homology of the dorsal and posterior orbital ossifications of snakes. First of all, we note that the postorbital of lizards is typically an ossification that takes part in the formation of the upper temporal bar, and has little or no contribution to the posterior margin of the orbit. As a consequence of this, squamates that lost the upper temporal bar also lost the postorbital. The possible exception could be represented by the Gekkota, where the postorbital may be retained if fused with the postfrontal, but this is still debated. Therefore, considering that snakes primitively lack an upper temporal bar, there is no reason to consider the postorbital as present in snakes. Moreover, considering that the posteroventral margin of the orbit is typically formed by the jugal, we conclude that the postorbital ossification of snakes is topologically more consistent as a homologue of the jugal of lizards. On the other hand, based on the ophidian topology with the jugal and the frontoparietal suture, the dorsal orbital ossification that appears in some snakes (e.g., pythons, Loocemus and Calabaria) should be considered as the homologue of the lacertian postorbital. These primary homology statements are consistent with the observed anatomy of the fossil snake Dinilysia patagonica, and with a new interpretation of the jugal and postfrontal morphology and articulations for the fossils Pachyrhachis problematicus and Eupodophis descouensi. As a consequence of our observations, we propose that the terms postorbital and supraorbital be abandoned when talking about the circumorbital bones of snakes, and that they should be replaced with the terms jugal and postfrontal respectively. This re-interpretation of the circumorbital bones of snakes may have important repercussions on future phylogenetic analyses and consequently on our understanding of the origin and evolution of snakes.

Technical Session II (Wednesday, October 17, 10:45 am)

A MICRO-CT INVESTIGATION OF MODES OF TOOTH IMPLANTATION AND REPLACEMENT IN EARLY TETRAPODS

PARDÖ, Jason D., University of Calgary, Calgary, AB, Canada; ANDERSON, Jason S., University of Calgary, Calgary, AB, Canada

Although tooth development and evolution is a potentially rich source of information on the origin of modern tetrapod groups, little is actually known about the morphology, histology, and development of teeth in early tetrapods. This is especially important because tooth morphology and succession are used to inform phylogenetic hypotheses, especially hypotheses concerning heterochrony processes, but not a solid baseline for comparison. Thus, comprehensive study of tooth morphology, histology, and succession in early tetrapods plays a critical role in contextualizing novel tooth morphologies and successional patterns in lissamphibians and amniotes, as well as informing debates on the relationships of modern groups to Paleozoic forms.

In order to investigate the evolution of the dentition in early tetrapods, we used a micro-CT approach to investigate morphology, implantation, and tooth succession on marginal tooth-bearing elements in a survey of early tetrapod taxa. We focussed sampling on temnospondyls and lepospondyls, focussing primarily on dissorophids and dicynodonts, while also sampling representative reptilomorphs. Along with gross morphology, we were able to reconstruct the alveolus, pulp cavity, canals within the bone housing the mandibular branch of the trigeminal and alveolar nerves, and tooth resorption zones associated with development of replacement teeth. Histological sectioning was performed on voucher specimens in order to confirm morphology imaged with micro-CT.

Teeth in small temnospondyls typically attach to the medial surface of the dentary with a dentine stalk and are replaced lingual to the tooth row. Teeth of dicynodont lepospondyls attach to either the lingual or occlusal surface of the dentary and lack a dentine stalk entirely, and the enamel cap directly attaches to the underlying dentary, and are replaced from a lingual and successional lamina. Teeth in the temnospondyl Archiceratops are also deep sockets, but are replaced from a successional lamina lingual to the tooth row, with implantation into the alveolus occurring after replacement of the crown, in contrast to true thiodonty, where the successional lamina is housed within the alveolus. Replacement, when it occurs, is constrained to pairs, triplets, or series of teeth, and may occur in either an anterior or posterior direction, depending on the taxon and position within the jaw. Replacement modes are inconsistent with a global zahnreihe model of tooth replacement.

Incentivising community contribution is key to keeping the database active and up to date and so the Fossil Calibration Database is paired with a rapid publication outlet for fossil calibration data through partnership with an open access online journal (Palaeontologia Electronica).

Education and Outreach Poster Session (Posters displayed October 17 – 20)

JURASSIC JOURNEY: INTRODUCING THE PUBLIC TO “SCIENCE-IN-PROGRESS” AT AN ACTIVE DINOSAUR QUARRY

PARKS, Hillary L., Burpee Museum of Natural History, Rockford, IL, United States; WILLIAMS, Scott A., Burpee Museum of Natural History, Rockford, IL, United States; RAWLINGS, Sheila, Burpee Museum of Natural History, Rockford, IL, United States; CARLSON, Elizabeth C., Burpee Museum of Natural History, Rockford, IL, United States; FIVECOAT, Sue, Utah Bureau of Land Management, Hanksville, UT, United States

Jurassic Journey is an innovative program that introduces the general public to science-in-progress at an active dinosaur quarry through guided tours and engages students in hands-on paleontological field work. Since 2009 Burpee Museum has collaborated with the Utah Bureau of Land Management and the town of Hanksville, Utah to introduce the general public to the science behind the Hanksville-Burpee Dinosaur Quarry and promote the importance of fossil resources on public lands. The Hanksville-Burpee Dinosaur Quarry, located outside the town of Hanksville, Utah, was first excavated by Burpee crews in the summer of 2008, though the area had long been known to be rich in dinosaur fossils and petrified wood by local residents. The quarry is a saurorap dominated, Morrison Formation (Brushy Basin Member) locality. This locality has a high-density, bone bearing layer and has yielded fossils from Diplodocidae, Camarasauridae, Apatosauridae, Allosauridae and potentially Barosaurus.

The first goal of the Jurassic Journey tours is to introduce the general public to the basics of field paleontology, but also to what one aspect of science “looks” like. Since 2009, the active quarry has been open for educational tours led by Burpee Museum education staff. The tours are the core of the Jurassic Journey project. For many visitors, these are their first visit to an active paleontological quarry. The tours cover a wide range of disciplines, including the geology, paleoecology and paleobiology of the quarry, as well as paleontological field work techniques. During the tour the Burpee lab staff, volunteers and students are encouraged to share with the group what they are working on and the techniques they are using.

The second goal of the Jurassic Journey project is to engage, in particular, undergraduate students in outreach education as they share their experience and knowledge with the tour groups that come through. Each dig season the quarry is worked by Burpee Museum lab staff, volunteers, and undergraduate students from as many as three universities. In the past three years the Hanksville-Burpee Quarry hosted over 1200 people including: school groups, visitors from nine countries and 20 other states. An additional 600 people are expected to visit the quarry during the 2012 dig season.

Very few institutions currently bring the general public in contact with science-in-progress at an active dinosaur quarry in North America. Fewer still, are the groups that pair exposure to science-in-progress with an educational experience. The Jurassic Journey project has the strong potential to serve as a framework for other projects to bring the general public in contact with science-in-progress at other active paleontological quarries and promote fossil resources on public lands.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 9:15 am)

A FIELD GUIDE TO THE BIRDS (VOLANT VERTEBRATES) OF THE CRETAEOUS OF APPALACHIA

PARRIS, David C., New Jersey State Museum, Trenton, NJ, United States; CLEMENTS, Donald, New Jersey State Museum, Rocky Point, NC, United States; LAUGINIGER, Edward, New Jersey State Museum, Boothwyn, PA, United States; HOPE, Sylvia, California Academy of Sciences, San Francisco, CA, United States

Although considered uncommon, bird and pterosaur specimens of Appalachia have accumulated in sufficient numbers as to permit more general analyses of the volant vertebrates. Avian specimens come primarily from the New Jersey greensands, closely associated with the Cretaceous/Paleogene boundary, and typically are analyzed as a group regardless of precise age. The taxa represented generally have a modern aspect, and most can be identified with extant bird orders (Neornithes). This contrasts with Laramidian birds, which also include specimens of Enantiornithes and Hesperornithiformes, taxa not closely related to extant forms. Bird specimens from both subcontinents have been found primarily in sediments from aquatic palooenvironments, and the Laramidian birds come primarily from freshwater deposition and estuarine channel fills of clastic material, while the greensands of Appalachian are marine shelf deposits of authigenic minerals. Consequently, although the avifaunas of both subcontinents appear to be dominated by birds of powerful
flight associated with aquatic environments (including Anseriformes and Charadriiformes), the birds of Appalachia appear to be somewhat more so. As might be expected, the bird groups with strong flight capabilities populated both subcontinents, so that greater faunal similarity would be expected for birds than for non-volant vertebrates. However, the same cannot be said for the pterosaurs of the later Cretaceous, which have a rather meager record of primarily localized taxa. Even the apparently widespread Pteranodontidae have no certain record of a genus occurring on both subcontinents. The flight capabilities that enabled birds to populate large areas across continental borders seem to have been lacking in pterosaurs, even those of great size and strength. A corollary to this observation is the likelihood that pterosaurs were less capable of surviving the Cretaceous/Paleogene boundary catastrophe, which indeed they did not.

Technical Session I (Wednesday, October 17, 11:45 am)

THE FIRST INTACT SCAPULAR GLENOID REGION OF DEINONYCHUS ANTIHRIPUS AND THE CONSEQUENT RE-INTERPRETATION OF DROMAEOSAURID FEATURES THAT ENHANCED THE EVOLUTION OF AVIAN FLIGHT

PARSONS, William L., Buffalo Museum of Science, Buffalo, NY, United States; PARSONS, Kristen M., Buffalo Museum of Science, Buffalo, NY, United States

Within Dromaeosauridae, the morphology of the glenoid region of the scapula is the key to understanding the overall mobility of the shoulder and thus the extent to which this joint functioned to enhance the evolution of avian flight. The discovery of the proximal ends of two scapulae of Deinonychus, each possessing a shallow, posterolaterally facing glenoid, helps to elucidate this understanding. The dorsal edge of the glenoid possesses a considerably curved embayment that would have presented no obstacle to the raising of the forelimb above the horizontal plane of the shoulder girdle, but could, regardless of position, allow for the upward movement of the acrocoracohumeral ligament and the scapulohumeral ligament. The positioning of the scapulohumeral ligament fossa is deeper than that on Velociraptor, Deinonychus, and Amargasaurus, which is simple, conical, and relatively short compared to that of other saurapods. The morphological similarity would be expected for birds than for non-volant vertebrates. However, the same cannot be said for the pterosaurs of the later Cretaceous, which have a rather meager record of primarily localized taxa. Even the apparently widespread Pteranodontidae have no certain record of a genus occurring on both subcontinents. The flight capabilities that enabled birds to populate large areas across continental borders seem to have been lacking in pterosaurs, even those of great size and strength. A corollary to this observation is the likelihood that pterosaurs were less capable of surviving the Cretaceous/Paleogene boundary catastrophe, which indeed they did not.

Technical Session II (Thursday, October 18, 4:15 - 6:15 pm)

TAPHONOMIC COMPARISON OF MODERN EAST AFRICAN OWL PELLETS AND THE TANZANIAN FOSSIL MICROMAMMAL ASSEMBLAGE

PATTERSON, David B., The George Washington University, Washington, DC, United States; DU, Andrew, The George Washington University, Washington, DC, United States; BOBE, René, The George Washington University, Washington, DC, United States; BEHRENSMEYER, Anna K., National Museum of Natural History, Washington, DC, United States; REED, Dennis, University of Texas, Austin, TX, United States

Micromammals have long been recognized for their value in the reconstruction of hominin paleoenvironments, but they are relatively understudied in East Africa in comparison to large mammals. Within an avian predator joint can be interpreted as possessing all the necessary elements for the evolution of the triscopal canal. This is the cranial reinterpretation of the motor potential of the shoulder joint of Deinonychus along with the unfused mobile suture between the coracoid and scapula and the relationship between the arcocoracohumeral ligament, M. deltoideus clavicularis, and M. supracoracoideus present a combined morphological morphology that would allow for an alternative form of “wing-flapping” without humeral rotation. Additionally, it raises questions as to the functional aspects of other features that enhanced the evolution of flight, such as the flexibility of the cervical vertebrae articulations and the caudal muscular contribution to mobility possessed by this and other taxa within Dromaeosauridae.

Assemblage Zone, subzone C (CAZ-C) of the Karoo Basin in South Africa and the Manda Beds of the Ruhuhu Basin in Tanzania, the latter of which yielded the silesaurid Amargasaurus. The phylogenetic analysis including new pelvic characters, places the Zambian silesaurid with Late Triassic silesaurids such as Asilisaurus, Saccisaurus, and Eucoelephysis rather than sister to coeval Asilisaurus. With the later forms the Zambian silesaurid shares a laterally oriented brevis fossa on the ilia and transversely thin ischia in cross section, though both the Zambian silesaurid and Asilisaurus have high ilial blades relative to the acetabulum. The discovery of a silesaurid bonebed in 2011 likely contains referable material. Bird-line archosaurs, and silesaurids in particular, were more diverse than previously supposed in the Anisian. The new Zambian silesaurid Amargasaurus can be regarded as the two oldest known members of the bird-line archosaurs.

The discovery of a silesaurid, as well as a number of other distinct archosaur taxa, increases the taxonomic diversity between the upper Ntware and archosaur-rich Manda Beds, to the exclusion of CAZ-C. Despite the increased time and effort put into sampling the Karoo Basin relative to the Luangwa and Ruhuhu basins, the CAZ-C contains no diagnostic members of crown-Archosauria. These results suggest enhanced Triassic terrestrial provinciality, implying that the Karoo Basin may not be a representative model system for Triassic terrestrial fauna. To test this we applied theoretic methods to track assemblage heterogeneity across southern Pangaea during the first 15 million years of the Triassic.
GEOMETRIC MORPHOMETRIC STUDY OF THE EVOLUTION OF THE HIND LIMB IN NON-AVIAN DINOSAURS

Technical Session XV (Saturday, October 20, 8:00 am)

Non-avian dinosaurs were the dominant terrestrial vertebrate group during the middle and late Mesozoic, and they developed a large diversity of body plans and skeletal morphologies indicative of varied ecologies. We use geometric morphometrics to study evolutionary and ecological patterns in the foot morphology of non-avian dinosaurs, and compare the distribution of taxa in hind limb morphospace on the basis of phylogeny and function. A preliminary analysis including over 120 samples from all major non-avian dinosaurian groups was conducted to test disparity among the hind feet. Results show that the feet of dinosaurs differ primarily from each other in relative robustness and patterns of asymmetry. Sauropodians exhibit a higher level of disparity in the metatarsals than ornithischians, which is probably related to the wider range of ecological niches occupied by sauropodians. On a PC1 vs PC2 figure, most theropod dinosaurs are tightly clustered, while sauropodomorphs and ornithischians partially share this morphospace. Non-carnivorous sauropodian taxa, such as therizinosaurids and sauropterygians, are predominantly found in regions of morphospace close to, or even overlapping with, the herbivorous ornithischians. Quadrupedal and bipedal taxa generally cluster in different regions. Other information can be inferred from these results. For instance, different lineages of archosaurian theropods occupy dissimilar morphospaces, and functional differences may occur along with the morphological variation. Additionally, only two of six shows a correlation between body size and robustness of the feet of non-avian dinosaurs. Ancestral state reconstruction shows that ancestors of different lineages are distributed in a more restricted morphospace than their descendants. The distribution of non-avian dinosaurs in morphospace is correlated with both phylogeny and behaviors such as diet and stance. These results imply that behavior and phylogeny both played important roles in the evolution of the metatarsals of non-avian dinosaurs.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

A 1:1 POSTCRANIAL RECONSTRUCTION OF THE BASAL EUPELYCOSAUR AEROSAURUS WELLESI

Several methods have been used for estimating chewing parameters in extinct mammals. Using muscle data from dissections, chewing force can be inferred from these results. For instance, different lineages of archosaurian theropods occupy dissimilar morphospaces, and functional differences may occur along with the morphological variation. Additionally, only two of six shows a correlation between body size and robustness of the feet of non-avian dinosaurs. Ancestral state reconstruction shows that ancestors of different lineages are distributed in a more restricted morphospace than their descendants. The distribution of non-avian dinosaurs in morphospace is correlated with both phylogeny and behaviors such as diet and stance. These results imply that behavior and phylogeny both played important roles in the evolution of the metatarsals of non-avian dinosaurs.

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Pellietier, Valerie, California State University, San Bernardino, San Bernardino, CA, United States

The basal eupelycosaurian family Varanopidae has the longest fossil record of the Paleozoic amniotes, extending from the Late Carboniferous to the Late Permian and ranging from the United States to South America. It appears to have been a highly conservative lineage, surviving Permian climatic changes and coexisting with therapsids in both Laurasia and Gondwana where they were the top predators. Only two of these sites are known at this time, resulting in a limited sample available, we conclude that an attribution of the La Grive material to Pierolapithecus can be discounted, its traditional assignment to D. t. being more likely. However, given the lack of upper central incisors for both Dryopithecus and Anostraciceps, and the high variability displayed by extant great apes in lingual incisor features and M3/ development, we prefer to provisionally leave the La Grive material unsassigned at the genus level as Dryopithecinae indet.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

METHODS FOR ESTIMATING CHEWING MUSCLE SIZE, BITE FORCE AND GAPE IN FOSSIL PRIMATES

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IMPLICATIONS FOR MUSCLE RECONSTRUCTION IN FOSSILS FROM HISTOLOGICAL EVIDENCE FOR MUSCLE INSERTION IN EXTANT ANNIOTE FEMORA

PETERMANN, Holger, University of Bonn, Freital, Germany

Identification of muscle attachment sites has been important for muscle reconstructions in fossil tetrapods ever since the 19th century. Therefore, numerous biological and paleontological studies focused on the subject. In histological thin sections, Sharpey’s fibers have been the sole reliable feature for identification of tendon-bone or muscle-tendon-bone interactions at the microscopic level. However, muscles are not restricted to indirect attachment with tendons, but attach also directly with muscle fibers. The question of the identifiability of direct muscle attachment has not been addressed by previous studies.

However, histological identification of direct muscle attachments is important as these attachments do not leave visible marks on the bone surface (e.g. scars and rugosities). Other than Sharpey’s fibers no indicators for muscle attachment have been provided. I dissected the right hind limb and mapped the muscle attachment sites on the femur of one rabbit (Oryctolagus cuniculus), one Alligator mississippiensis, and one turkey (Meleagris gallopavo). I then extracted the right femur and prepared 4 histological thin sections for the rabbit and the turkey and 5 histological thin sections for the alligator. I found that, additionally to Sharpey’s fibers, vascular canal orientation and a frayed periosteal margin can be indicative of indirect and direct muscle attachments. Orientation of Sharpey’s fibers to the cutting plane of the thin section can occur at high angles. Furthermore, two Sharpey’s fibers orientations can occur in one area, possibly indicating a second force axis, e.g. from the action of a tendon or ligament. However, of the mapped attachment sites only about 60% could be detected in thin sections, and histological features suggestive of muscle attachment frequently occurred outside of mapped areas. While these insights are expected to improve our ability to successfully identify and reconstruct muscles in extinct species, the limitations of this approach are also apparent.

Technical Session I (Wednesday, October 17, 4:15 - 6:15 pm)

POSTEROPANORAL LANMARKS

PETERSON, Joseph E., Department of Geology, University of Wisconsin Oshkosh, Oshkosh, WI, United States; DISCHLER, Collin, Department of Geology, University of Wisconsin Oshkosh, Oshkosh, WI, United States

The frontoparietal domes of pachycephausalosaurs have long been hypothesized as weapons for agonistic bouts similar to the behavior of extant ungulates. This hypothesis has been supported by structural models and the recent identification of pathologies on the calvaria of frontoparietal domes. However, a standardized analysis of the spatial distribution of lesions on frontoparietal domes remains absent. Presented here are the results of an evaluation of frontoparietal domes that possess indented lesions along the calvarium. Lesions were differentially diagnosed based on CT data and the presence of gross pathological characteristics consistent with cortical damage, such as irregular-shaped lesion surfaces, remodeling, and rounded lesion margins. In order to map the distribution of lesions on frontoparietal domes and assess the impact of their spatial relationships, domes from the genera Pachycephalosaurus, Sphaerotherium, Stoegecerus, Hanssuesia, and Gravitoholus were studied. In total, 144 lesions were identified on nine frontoparietal domes. Homologous landmarks were utilized to partition frontoparietal domes into five regions to standardize lesion distributions, and include the sutural surfaces of the nasal, anterior supraorbital, posterior supraorbital, postorbital, squamosal, and frontoparietal suture. Lesions were classified based on their morphology and location in relation to homologous landmarks. The distributions of lesions on frontoparietal regions were compared for percent abundance and Kolmogorov-Smirnov Goodness-of-Fit tests (p<0.01). Based on these analyses, all specimens except Gravitoholus illustrate a strong related distribution of lesions on the dorsal surface of the frontal region, regardless of dome mass, height, or taxon. Over 60% of all identified lesions occur on the dorsal surface of the frontal region, while nearly 30% occur along the frontoparietal suture on the dorsal surface. The strong clustering of lesions along the frontals and around the frontoparietal suture is in agreement with the expected location of injuries resulting from agonistic head-butting or shoving, suggesting that pachycephausalosaurs sustained injury from such behaviors.

Technical Session IV (Wednesday, October 17, 3:15 pm)

DINOSAUR CEPHALIC VASCULAR ANATOMY AND ITS PHYSIOLOGICAL IMPLICATIONS: EVIDENCE FROM THE FOSSILS

PORTER, William R., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States

Evidence of cephalic blood vessels is written into bone as osteological correlates (OCs). When these OCs are analyzed in the context of extant outgroups, we gain insight into vascular patterns in extinct taxa, which illuminate physiological processes. OCs found on dinosaur fossils were recorded, focusing on three sites (orbital, nasal, and oral cavities) that in extant outgroups are critical in thermoregulation. Most dinosaurs experienced high heat...
loads due to their high surface-to-volume ratios, and we tested the hypothesis that dinosaurs exploited these same three sites of heat exchange. Vascular OCs in extant taxa (birds, crocodylians, iguanas) were used to formulate hypotheses of dinosaur vascular anatomy. To test these hypotheses, we characterized OCs on dinosaur fossils using direct observation, CT scanning, and the Extant Phylogenetic Bracket approach. Dinosaur vascular anatomy was reconstructed in Avizuo and Maya. OCs relating to the orbital region were observed in theropods (e.g., *Rugops, Majungasaurus, Aliosaurus, Carcharodontosaurus, Albertosaurus, Daspletosaurus, Tyrannosaurus*) as grooves traversing the postorbital bone. In the extant sample, an orbital plexus traverses the postorbital region. Grooves also traverse the ventral surface of the frontal, and then curve onto its dorsal surface in theropods, sauropods (Camarasaurus, Diplodocus) and Stegosaurus. In the extant sample, these grooves are formed by branches of supraorbital vessels supplying dorsal regions of skin on the head, which, in birds, correspond to brightly colored display surfaces. OCs relating to the nasal region were observed in theropods as grooves traversing the ventral surface of the nasals. In the extant sample, similar grooves correspond to vessels supplying the nasal region. Unique grooves found in the ventral aspect of the antorbital fossa in theropods indicate that the antorbital air sinus was well vascularized. OCs relating to the oral region were observed in theropods and saurophags as grooves on both the medial and lateral aspects of the maxilla. In extant taxa, these grooves correspond to branches of the dorsal alveolar vessels and palatal plexus. The large submucosal foramen between the maxilla and premaxilla in saurophags indicates that large volumes of blood passed between the oral and nasal regions. In the extant sample, these vessels connect these same two sites of thermal exchange, suggesting an emphasis on the vasculature of these regions in at least saurophagous dinosaurs. In general, the OCs found within the intratemporal are different from those in the postorbital region. Also, when properly connected, they offer a glimpse of regions of the head that may have been well vascularized and likely held important roles in key physiological processes.

MEGAFAUNA EXTINCTION AND CLIMATIC CHANGE IN THE PAMPEAN REGION, ARGENTINA

PRADO, Jorge I., Universidad Nacional del Centro, Olavarria, Argentina; ALBERDI, Maria T., Museo Ciencias Naturales, CSIC, Madrid, Spain; DOMINGO, Laura, Earth and Planetary Sciences Department. University of California, Santa Cruz, CA, United States

The extinction of megafauna in South America was particularly pronounced. This region witnessed one of the major extinction events that occurred at the end of the Pleistocene. The continent lost more genera of megafauna than any other, with most of the last appearances occurring at the end of the Pleistocene. The extinction event in South America seemed to have taken considerably longer than did it did in North America. The last appearance of megafauna was estimated to occur over the range between ca. 20,000 and 5,000 BP.

The late Pleistocene to Holocene transition in South America is characterized first by a rapid, pronounced cooling (similar to the Younger Dryas), then by a rapid warming as the Holocene interglacial began. In the present study, we evaluated published radiocarbon dates and 30 new AMS dates for late Pleistocene-Holocene paleontological sites. Most of the dates are robust enough to assess correspondence between last-appearance records of megafauna and the Holocene climatic change. We compared the data to stratigraphic levels. The extinctions in the region seem more common after the arrival of humans and during intensified climatic change between 11.2 and 13.5 ka. Nevertheless, even in these regions, some large mammals persisted for thousands of years during the Holocene and after the climate warming. These results highlight the need for future intensive dating efforts on megafauna remains in order to construct a more complete portrait of the sequence of events that gave rise to this extinction episode.

SYMPOSIUM: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 11:00 am)

UNDERSTANDING MAMMALIAN DIETARY EVOLUTION USING A PHYLOGENETIC AND COMPARATIVE APPROACH

PRICE, Samantha A., UC Davis, Davis, CA, United States; HOPKINS, Samantha A., University of Oregon, Eugene, OR, United States; BOTERO, Carlos A., North Carolina State University, Raleigh, NC, United States

Diet has played a critical role in the evolutionary history of mammals as evidenced by their extraordinary dental diversity. Previous studies of dietary evolution have focused solely on specific dietary categories or individual clades of mammals, which deprives us of the ability to generalize about the common processes affecting mammalian macroevolution. A large-scale, phylogenetic comparative approach can help elucidate these macroevolutionary dynamics. We have collected the largest existing dataset of primary observations on mammalian diets, covering over 1500 species have analyzed it using a phylogenetic comparative method that simultaneously estimates the rate of transition between dietary categories and speciation/extinction rates. Contradictory hypotheses have been proposed concerning the role of diet in large-scale diversification patterns, we show net diversification rate (the cumulative effect of speciation and extinction), differs significantly among living mammals, depending upon trophic strategy. Herbivores diversify faster, about three times faster than omnivores which are the slowest and carnivores diversify at intermediate rates. Countering the slow diversification of omnivorous lineages, we find that the tempo of transitions between the trophic strategies is highly biased: the highest rates occur into omnivory from herbivory and carnivory. Thus, omnivore diversity evolves primarily through transitions into that strategy and rarely by diversification within omnivorous lineages, whereas herbivore and carnivore diversity is chiefly produced through diversification. These results suggest that, globally there are fewer niches available for omnivores and/or that speciation occurs more slowly or extinction more rapidly in omnivorous lineages. Ecologically, omnivory may be a strategy for surviving variation in the environment or for ensuring viability, if lineages shift to omnivory during times of environmental perturbation, this may explain why diversification is low and transition rates are highest into not out of omnivory. Indeed, we find that worldwide omnivory is currently more prevalent in unpredictable climates using historical climate data and phylogenetic Markov Chain Monte Carlo Generalized Linear Mixed Models. It is however crucial to incorporate palaeontological data to fully understand the processes generating these macroevolutionary patterns, as well as how these patterns have changed over time. For example the fossil record is the only way to test the only way to investigate the association between diet and speciation and extinction rates independently.

LATE CRETAUCEOUS TECTONIC EVENTS TRIGGERED NORTH AMERICAN MEGAHerbivore Dinosaur Cladogenesis

PRIETO-MARQUEZ, Albert, Bayerische Staatsanstalt für Paläontologie und Geologie, Munich, Germany; GATES, Terry A., Ohio University, Athens, OH, United States; ZANNO, Lindsay E., Nature Research Center, North Carolina Museum of Natural Sciences, Raleigh, NC, United States

Prior studies of Mesozoic biodiversity document a diversity peak for dinosaur species in the Campanian stage of the Late Cretaceous, but have yet to provide explicit causal mechanisms. We present evidence that geographic and ecological barriers created from incipient Laramide uplift, in combination with the presence of the Sevier Orogenic Belt and the Cretaceous Western Interior Seaway (KWIS), caused initial isolation of northern and southern megaherbivore dinosaurs (e.g., saurolophine hadrosaurids and chasmosaurine ceratopsids). Increasing topological complexity ultimately led to the establishment of geographically restricted evolutionary centers, with relatively rapid cladogenesis and increased taxonomic diversity. Detailed fossil occurrences document correspondence between the shift from Sevier-style, laterally aligned basins to smaller Laramide-style, longitudinally aligned basins, through decreased geographic range, and increased taxonomic diversity of hadrosaurian and ceratophsan species. Our hypothesis meets three predictive tests of speciation via tectonic processes. The first test requires that increased levels of endemism should be present in regions affected by tectonic speciation. In this regard, dispersion-vicariance analysis shows that the similar biogeographic histories of the hadrosaurian and ceratopsian clades are attributable to rapid diversification events within restricted basins, and the last test requires that speciation rates should be greater in topographically complex regions. SymmTree analysis establishes that hadrosaurids and ceratopsids experienced variations in diversification rates during the Campanian and Maastrichtian. Our data show that in a small window of the Campanian, when several topographic features (Sevier Orogenic Belt, KWIS, and Laramide structures) coincided, new megaherbivorous dinosaur species appeared at average rates of more than one species per million years, as opposed to the Maastrichtian rates of one species per several million years. The last test requires correspondence between tectonic activity and cladogenesis. We present evidence that clade divergence of megaherbivorous dinosaurs occurs contemporaneously with incipient Laramide uplift between southern Alberta and southern Utah at approximately 75 Ma. Furthermore, phylogenetic divergence estimates of fossil clades offer a new lower boundary on Laramide surficial deformation that precedes estimates based on sedimentological data alone.
digit is extensively modified, with a dorsoventrally flattened and elongate distal phalanx. The second manual ungual is enormous and flattened in the pre-axial-post-axial plane. There are extensive flanges on the second manual ungual for the flexor musculature. This radical departure from the standard tetrapod forelimb condition is only shared with Drepanosaurus ungucanadus.

A phylogenetic analysis of 250 characters and 40 basal diapsids and saurians, including a complete sampling of drepanosaurid taxa, strongly supports a clade including the Ghost Ranch Drepanosaurus and the previously-recognized, early Eocretaceous taxon Simojovelhus poctosense as the sister group of all other drepanosaurids. This relationship is supported by characters relating to the forelimb and vertebral column. Another drepanosaurid taxon from the Petrified Forest Member of the Chinle Formation, Dolobrosaurus aqualitis, is resolved as basal to this clade. This topology suggests a complex biogeographic history for drepanosaurids, with multiple vicariance or dispersal events throughout their evolutionary history.

Posterior Session I (Wednesday, October 17, 4:15 - 6:15 pm)
SIMOJOVELIUS, THE OLDEST MOSAIC FOSSIL FROM CENTRAL AMERICA, IS A PECCARY, NOT A HELOHYID
PROTHERO, Donald R., Natural History Museum of Los Angeles County, Los Angeles, CA, United States; BEATTY, Brian L., NYCOM, Old Westbury, NY, United States; MAMANI QUISPE, Bernardino, MNHN-Bol, La Paz, Bolivia; ANTOINE, Pierre-Olivier, ISE-M, UM2, Montpellier, France; MAMANI QUISPE, Bernardino, MNHN-Bol, La Paz, Bolivia; ANTOINE, Pierre-Olivier, ISE-M, UM2, Montpellier, France; RUBILAR-ROGERS, David, Museo Nacional de Historia Natural, Santiago, Chile; SUÁREZ, Mario E., Museo Paleontologico de Caldera, Caldera, Chile

Since the late Miocene, tectonic events in the Southern Cordillera have created broad expansions of marine sediments in basins associated with the Humboldt Current System. In the Atacama Region of Chile, the Bahia Inglesa Formation preserves several sequences of marine rocks of late Miocene to Pliocene age, including fossiliferous units with marine vertebrates. Some of these taxa include extant lineages of marine mammals (phocid seals,rorqual whales) and seabirds (Spheniscus sp.), as well as completely extinct lineages, such as aquatic sloths (Thalassocnus sp.), giant bony-toothed seabirds (Pelagornis chilensis), and walrus-convergent dolphins (Odobenus rosmarus). In the upper Bahia Inglesa Formation, road construction expanding the Pan-American Highway in 2010 and 2011 uncovered a mass death assemblage of fossil marine mammals in a quarry with an area of 250 meters by 20 meters. This site, called Cerro Ballena, is dominated taxonomically and numerically by incomplete, although mostly intact skeletons of 44 rorqual whales (Balaenopteridae). These mysticete remains are also associated with one skeleton of a stem pinnotheroid, an incomplete pinniped postcranium, and a partial skull and skeleton of Odobenus rosmarus. Notably, there are no less than four marine mammal-bonebed localities at the site with hundreds of thousands of individuals per section, indicating that a recurring phenomenon created unique conditions for the preservation of large marine vertebrates. A range of death mechanisms can explain the sequence of assemblages at Cerro Ballena, although only a few are consistent with the sedimentologic evidence from the sandstone sequence, which suggests a quiescent embayment setting or a restricted lagoonal environment. Based on long bone orientation and the degree of skeletal articulation, the assemblage of multispecies marine mammal remains at Cerro Ballena most strongly favor taphonomic pathways where death was relatively rapid (hours to weeks in duration), and likely caused by an allochthonous mechanism. Modern analogs of marine mammal deaths caused by red tides and domoic acid, both associated with harmful algal blooms, outline a possible mechanism that occurred repeatedly at Cerro Ballena during the Pliocene.
ADAPTIVE RADIATIONS AND ECOLOGICAL DIVERSITY OF EUROPEAN ADAPIFORMS IN WESTERN EUROPE
RAMDARSHAN, Anusha, Carnegie Museum of Natural History, Pittsburgh, PA, United States; BARRÓN-ORTIZ, Christian R., University of Calgary, Calgary, AB, Canada; SIZE CHANG IN MAMMALS ACROSS THE PALEOCENE-EOCENE THERMAL MAXIMUM. Indeed, adapines do show specialization towards leaf-eating, and fruit-eaters also decline in the fossil record during the middle Eocene, as adapines first occur in the European primate communities. These mostly large-bodied primates seem to have filled the ecological niche left vacant by the disappearance of cercamonines during the middle Eocene. Indeed, adapines do show specialization towards leaf-eating, and fruit-eating was also common among this group. These results demonstrate this radiation followed some typical trends, similar to those seen in extant examples, such as an increasingly fine partitioning of available resources with the rise in the number of competing species and a generalized trend towards specialization throughout the Eocene.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)
USING THE EXTENDED PRICE EQUATION TO ANALYZE PATTERNS OF BODY SIZE CHANGE IN MAMMALS ACROSS THE PALEOCENE-EOCENE THERMAL MAXIMUM IN NORTH AMERICA
RANKIN, Brian D., University of Calgary, Calgary, AB, Canada; LUDTKE, Joshua A., University of Calgary, Calgary, AB, Canada; BARRÓN-ORTIZ, Christian R., University of Calgary, Calgary, AB, Canada; YANG, Xingkai, University of Calgary, Calgary, AB, Canada; FOX, Jeremy W., University of Calgary, Calgary, AB, Canada
The patterns of mammalian evolution across the Paleocene-Eocene Thermal Maximum (PETM) (approximately 56 million years ago) have become an important focus of research as interest in the response of mammals to climatic shifts during this interval has heightened. Among the most intriguing and often-cited of these patterns is the apparent dwarfing of many different taxa near the onset of the PETM, a phenomenon commonly attributed to elevated temperatures and/or higher carbon dioxide levels. Prior considerations of this pattern, however, have not been able to differentiate variations in body size into components attributable to separate evolutionary forces (e.g., natural selection). In this study, we use an innovative, extended adaptation of the Price equation to analyze patterns of body size change in mammalian communities from the middle Clarkforkian through middle Wasatchian North American Land Mammal Ages of the Bighorn and Clarks Fork Basins of Montana and Wyoming. The extended Price equation, a comprehensive description of evolutionary change under all conditions, provides valuable insight into body size change by partitioning variation into three meaningful components: changes resulting from non-random speciation and extinction of resident taxa (i.e., mammals whose ancestors preceded them in the specified area), changes owing to non-random immigration of taxa (i.e., those whose ancestors did not precede them in the area), and anagenetic changes (i.e., biased ancestor/descendant transmission). In agreement with other studies, our results document a remarkable decrease in mean mammalian body size during the earliest Wasatchian, a pattern that is principally driven by the considerable number of small-bodied taxa that make up the clade. These results highlight the importance of considering this time interval, including priates, perissodactyls, artiodactyls, and hyaenodontid creodonts. Our results further reveal that non-random selection acting on resident taxa during the middle Clarkforkian to the middle Wasatchian generally favored smaller body sizes, while, in contrast, anagenetic changes favored larger body sizes over the same interval. Following the earliest Wasatchian, body size changes resulting from the non-random immigration of taxa was minimal. The application of the extended Price equation in this study represents a novel approach to discriminate the influences of distinct evolutionary forces on select traits, and further underscores the knowledge that can be garnered from temporally well-constrained, geographically confined settings.

Technical Session XIV (Saturday, October 20, 9:15 am)
NEW SMALL PARAREPTILES FROM THE LOWER PERMIAN OF RICHARDS SPUR, OKLAHOMA, AND THE EARLY DIVERSIFICATION OF PARAREPTILES IN LAURASIA
REISZ, Robert R., University of Toronto Mississauga, Mississauga, ON, Canada; MACDOUGALL, Mark J., University of Toronto Mississauga, Mississauga, ON, Canada; MODEST, Sean, Cape Breton University, Sydney, NS, Canada
Early Permian parareptiles are restricted to a handful of taxa, and include Massosaurus from Gondwana, the bolosaurids Bolosaurus and Bolosaurus from Europe and North America, Aelurognathus and the Microleter from North America. Microleter was discovered in the Dolese Bros Limestone Quarry, Oklahoma, and appears to represent the most basal known parareptile from Laurasia. Numerous new specimens from this locality have augmented recently the overall fauna of parareptiles. These include a new, very small parareptile with large, well developed caniniform teeth, several pelvic new specimens of the enigmatic Colobomycter that includes a new species of this genus, a new, undescribed species of Delorphynchus, and another new taxon that closely resembles the Middle Permian Russian parareptile Nyctiphruretus. Thus, the parareptilian fauna of Oklahoma now includes nine taxa of small parareptiles. Phylogenetic analysis of their interrelationships indicates a rather unusual distribution of taxa, with Bolosaurus, Microleter and one of the undescribed new species among various position on the parareptile stem, while Aelurognathus, the two species of Delorphynchus, the two species of Colobomycter, and another new taxon, form the clade of Aelurognathinae. Thus, we are able to propose that the initial evolutionary history of parareptiles includes taxa that had a widespread Laurasian distribution, as characterized by bolosaurids, as well as taxa that formed a regionally restricted evolutionary radiation of small predators. The latter shows a surprising diversity of dental anatomy, ranging from the homodont dentition of Delorphynchus to the greatly exaggerated, large first incisoriform and relatively large caniniform teeth of Colobomycter. This indicates that the initial stages of parareptile evolutionary history is much more complex than previously envisaged.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)
AN ONTOGENETIC STUDY AND POPULATION HISTOLOGY OF THE CERATOPSID DINOSAUR EINOSAUROS PROCURVICORNIUS
REIZNER, Julie A., Museum of the Rockies, Montana State University, Bozeman, MT, United States
Histologic studies have been utilized in paleontology to determine rates of growth for several dinosaur taxa, but members of the otherwise relatively well-known family Ceratopsidae have largely been excluded from this analysis. This species includes the centroceratopsine Einosaurus procurvicorinus, ranging from juveniles to putative adults, has been found in the Upper Cretaceous Two Medicine Formation of northwestern Montana. This specimen represents a drought-induced assemblage, and is hypothesized to represent a single population. The full available range of sizes of tibiae (N = 16) were sectioned and bone...
histology examined. Tissue types and degrees of remodeling are discussed, and growth lines are used to determine ages at time of death of the individuals. The rate of growth for *Einosaurus* peaks at about 3-5 years of age, at which time growth slows, suggesting that this may be the age that reproductive maturity is reached. The nature of the bone tissue suggests that growth in *Einosaurus* is still relatively rapid in even the largest specimens, indicating that a fully adult tibia has not been recovered from the studied bonebed, and this bonebed is biased toward juveniles and subadults. Since the bonebed is a snapshot of the standing herds, information dynamics of the herbivores, such as social organization and behavior, are assessed. This information on growth dynamics and life histories of a species has implications for future taxonomic resolution and morphometric studies of ceratopsid dinosaurs, and marks the first study on population histology of a large-bodied herbivorous dinosaur.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

**USING SCANNING ELECTRON MICROSCOPY TO RECONSTRUCT FEEDING ECOLOGY IN GROUND SLOTHS**

RESAR, Nicholas A., Kent State University, Kent, OH, United States; GREEN, Jeremy L., Kent State University at Tuscarawas, New Philadelphia, OH, United States

Understanding the paleoecology of extinct extant rhinos, such as ground sloths, is complicated because they lack modern ecological analogues. Previous studies have applied functional morphology and biomechanical analyses to reconstruct the diet and lifestyle of ground sloths, yet the application of dental microwear as a proxy for feeding ecology in extinct rhinos remains understudied. Here, we hypothesize that only oral microwear patterns can be used to reconstruct dietary niche partitioning among extinct ground sloths, thereby providing new evidence of feeding ecology in these animals. In this study, 17 second molar molariforms from 5 taxa (*Megalonyx*, *Acratocnus*, *Thrinobadistes*, *Oxtodontotherium*, *Hapalops*) were molded and cast for dental microwear analysis. Using scanning electron microscopy, two non-overlapping digital images of microwear on the occlusal surface of each tooth were captured at 500x magnification. In a blind study, each image was independently analyzed using the semi-automated software package, microwear 4.0.2, which allows microwear features to be digitally counted and measured. To examine the reproducibility of results, both intra- and interobserver error in microwear feature recognition was statistically assessed for two independent observers. As a baseline for reconstructing paleodiet, ground sloth microwear patterns were directly compared to microwear from living tree sloths and armadillos, which were analyzed in a separate study using the same experimental design. Results suggest that ground sloths can be statistically differentiated based on a combination of the number of scratches and width of features. Number of scratches and feature width suggest that *Megalonyx* and *Thrinobadistes* form the ends of the browser-grazer spectrum, respectively. Additionally, *Acratocnus* and *Oxtodontotherium* are here predicted to be mixed feeders, while *Hapalops* appears to be a grazer. These results support scanning electron microscopic analysis of dental microwear as a tool for reconstructing paleodiet in ground sloths. Further investigation should focus on South American ground sloths to allow direct comparison with other methods of dietary reconstruction.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

**CHRONOLOGY OF THE LATE JURASSIC DINOSAUR FAUNAS, AND OTHER REPTILIAN FAUNAS, FROM PORTUGAL**


The chronostratigraphy of Late Jurassic vertebrates from Portugal, including those from the Lourinhã Formation, which is known for its rich vertebrate fauna, is poorly understood due to the continental nature of the sediments and the diachrony of the lithostratigraphic units. The chronostratigraphy of Late Jurassic vertebrates from Portugal, including those from the Lourinhã Formation, which is known for its rich vertebrate fauna, is poorly understood due to the continental nature of the sediments and the diachrony of the lithostratigraphic units. Recent results using Sm²⁴⁰ isotopes confirmed the position of the Kimmeridgian-Tithonian boundary (150.8 Ma) in the Lusitanian Basin central sector. This boundary, within a marly layer representative of the more southernly limestone Farta Pão Formation, lies within the siliciclastic Lourinhã Formation and is assumed to be the transgressive upper Kimmeridgian -lower Tithonian event. The most productive vertebrate-bearing Upper Jurassic formations in Portugal are: the Alcobaça Formation, Lourinhã Formation (divided into the Amoreira-Porto Novo, Sobral, Bombarral, and Freixial (pars) members), and the Porto da Calada Formation. The chronological range (given by biostratigraphy, eustatic curves, general regional context, and calibrated by strontium isotope curves) is important for Portuguese specimens of chelonians, pterosaurs, dinosaurs, crocodylomorphs, and other reptiles is as follows: Early (to late?) Kimmeridgian (Alcobaça Beds Formation): *Thertosuchus guimarotae*, *Machimosaurus hugi*, *Goniopholis barygraphy, Lusianietsus microstostus, Phyllodon henkeli, Parvivipar estes, Marmoretta sp.*, *Aviatyrannus serrarius*. Late Kimmeridgian (Lourinhã Formation, Amoreira-Porto Novo Member): *Seleneys lunaticina, Plesioschelys sp.*, *Cteniogenys reedi*, *Einiosaurus sp.*, *Lusitaniana rhynchophorus*, *Ctenocephalos longicollum, Plesioschelys sp.*, *Ceratosaurus nasicornis, Torvosaurus alf. tanneri.* Around the Kimmeridgian/Tithonian boundary (Sobral Member): *Seleneys lunaticina, Plesioschelys sp.*, *Machimosaurus hugi, Rhamporhynchos sp.*, *Lourinhonasauros antunesi, Luositian estalaiensis, Lourinhonasauros alenguerensis, Dryosaurus sp.*, *Cryptochlid plesiosaur.*

Early Tithonian (Bombarral Member): *Plesioschelys sp.*, *Allosaurus europaeus, Dracnossuros lucqueiroi, Stegosaurus sp.*

Late Tithonian (Freixial Member): *Plesioschelys sp.*, *Theriosuchus sp.*, *Ornithopoda sp.* B. Around the Tithonian/Berriasian boundary (Porto da Calada Formation): *Stegosaurus sp.*

Despite the fragmentary occurrences of certain taxa, the chronology of some vertebrates seem to be age-restricted, and can thus be used for biostratigraphy. There is a peak of vertebrate fossil diversity and abundance near the Kimmeridgian/Tithonian boundary and a decline towards the end of the Tithonian. Is not yet understood if such trend represents true diversity/abundance in the Jurassic or if it is caused by any geologic and taphonomic bias.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

**CHONDRICHTHYANS IN THE CARBONIFEROUS OF THE BRITISH DERBYSHIRE PEAK DISTRICT**

RICHARDS, Kelly R., University of Cambridge, Cambridge, United Kingdom; CLACK, Jennifer A., University of Cambridge, Cambridge, United Kingdom

Productive Carboniferous marine deposits are found worldwide, including sites in North America, Poland, Russia, Belgium, Iran and Britain. Recent work in the Derbyshire Peak District of Britain has established a diverse chondrichthyan fauna, comparable with the rich dichotomous microfossil assemblages. Derbyshire has a diverse bony fish fauna in the Late Devonian (known for a typical and varied invertebrate fauna. Additionally, the vertebrate and scales of palaeoniscid actinopterygians have been recorded and previous records of the Derbyshire chondrichthyan documented twenty five species, with recent publications adding a further seven species. In this study, limestone material representing four localities was collected. Two of these have been documented to contain chondrichthyan remains and two are unreported localities, all localities are within ten km of each other. The material was acid digested and mechanically prepared and the macro and micro fossils were recorded. The microfossils typically consist of teeth, scales and dental denticles, the macrofossils include teeth, a large fin spine and also, in the two new localities, a variety of skeletal material ranging from partially articulated to fragmented. The skeletal material includes several jaws, endocranial material, a scapula coracoid and a probable pelvic fin arrangement including a clasper attributed to *Akmizonia zangerli*. The microfossils recovered and identified increase the known diversity of the Derbyshire palaeoenvironment by at least 9 taxa, including several taxa unknown from Derbyshire, such as *Akmizonia zangerli, Harpakuco des dentatus, Heslerudos diversus* and *Mesodus, or Europe, such as Belantsea montana, Bransonnella nebraskan and 'Denea weang'. Our data show that chondrichthyan microremains dominated three of the four near-shore sites- chondrichthyan represent two thirds of all micromammals in the combined localities- and that the Derbyshire localities share many taxa with the localities in North America, such as *Bransonnella nebraskan, Heslerudos, Fissudos, Leidus* and *Squatinactis; and with localities across Europe, such as *Akmizonia zangerli, Denea, Thrinacodus, Petroudas and Orodus*. The data collected from a short sequence of clycal beds at one of the localities expose faunal changes on a shorter timescale. The persistent occurrence of particular taxa such as *Denea, Squatinactis, Harpakuco des, Petroudas* and *Bransonnella nebraskan*, through the different localities reflects a close palaeoecological relationship between the study sites. We use data from existing boreholes in order to assess the relative importance of the temporal and spatial relationship between the localities.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

**LATE PLEISTOCENE GIANT BEAVERS: THE PARALLEL EVOLUTION OF GIANT SIZE AND RIDGED ENAMEL IN TWO SPECIES**

RINALDI, Caroline E., University of Missouri-Kansas City School of Medicine, Kansas City, MO, United States; MARTIN, Larry D., University of Kansas Natural History Museum and Department of Ecology and Evolutionary Biology, Lawrence, KS, United States; TIMM, Robert M., University of Kansas Natural History Museum and Department of Ecology and Evolutionary Biology, Lawrence, KS, United States; COLE, III, Theodore M., University of Missouri-Kansas City School of Medicine, Kansas City, MO, United States; KUMAR, Vandana, University of Missouri-Kansas City School of Dentistry, Kansas City, MO, United States

Skulls of two similar, but morphologically distinct, giant beavers from the late Pleistocene were studied using high resolution cone-beam computed tomography (CT). One specimen is from eastern Kansas and is assigned to *Castoroides ohiensis*. The other specimen is from the Cooper River of South Carolina and is currently assigned to *Castoroides leiseyorum*. The basicranial region is characterized by a unique ladle-shaped depression in the basisphenoid bone called the mesopterygoid fossa. This unusual morphology is similar to that of the Pliocene beaver, *Procastoroides sweeti*, from the Broadwater Formation of Nebraska; however, the skull of *P. sweeti* is much smaller and the enamel of its incisor teeth do not have the ridges characteristic of late Pleistocene species. The late Pleistocene specimen referred to *C. leiseyorum* lacks a mesopterygoid fossa as does the early Pleistocene material from the type locality (*Leisey Shell Bed*), although the holotype is much smaller. Despite their differences, both late Pleistocene beavers are characterized by a choana that is divided into dorsal and ventral passages, a feature unique among mammals. In both
giant beavers, evolutionary expansion of the internal pterygoid muscles resulted in the
primitive, single choana being divided into a dorsal and ventral choana by the expanded
internal pterygoid plates, which form the origin for the enlarged muscles. However, CT
studies and 3D reconstructions indicate that the two giant beavers differ substantially in the
internal structure of the dorsal and ventral choanae. In C. olivaceus, the ventral
choana is too small to be effective as the primary path for respiration, and it is the ventral
choana that functions as the primary pathway. The presence of divergent basioccipital
respiratory morphologies, dating at least as far back as the Pliocene, suggests that both giant
size and ridged incisor enamel evolved in parallel in the two late Pleistocene species.

The Vaqueros Formation in Laguna Canyon of the San Joaquin Hills of Orange County,
California, has yielded a diverse and unique assemblage of early Miocene marine mammals.
Arikareean/Hemigondingian transitional terrestrial mammals and paleomagnetic dates bracket
the fauna as Burdigalian in age. Thus, the Vaqueros Formation has currently produced some
of the earliest sirenians from the early Miocene in the eastern North Pacific and the first
specimen that can be identified to the specific level.

Technical Session XVI (Saturday, October 20, 9:30 am)

PALEOBIOLOGY OF PREVIOUSLY UNEXAMINED DIRE WOLVES (CANIS DIRUS) FROM THE EARLIEST EXCAVATIONS OF THE LA BREA TAR PITS

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The earliest excavations of the Late Pleistocene fossil deposits at the La Brea tar pits in southern California were led by J. C. Merriam of the University of California, Berkeley.

From 1906 to 1915, nearly two million specimens of large animals were collected from the
tar pits and divided between the Hancock Collection of the Los Angeles County Museum of
Natural History (LACM) and the collections of the University of California Museum of
Paleontolgy (UCMP). The extinct dire wolf, Canis dirus, is one of the best represented
animals from La Brea. However, the paleobiology of the dire wolf at La Brea has been
studied only on specimens from the LACM’s Hancock Collection and more recently
excavated Rancho La Brea Project Collection, while the material held in the UCMP has
remained largely unexamined for the last century. Here, we present the first quantitative
study of morphological variation in dire wolves from this neglected collection of material
from La Brea. Linear measurements of size were taken from fifty-eight left femora and the
postcranial elements of fifty unassociated left dentaries. Shape variation was also quantified
for thirty-eight adult crania using a three-dimensional geometric morphometric approach.

Principal component (PC) analysis of cranial shape variation indicates that the greatest
dimension of variation contrasts wide crania with dorsally angled rostra and narrow crania
with ventrally angled rostra (PC1 = 16%). Cranial shape also varies in the posterior extension
of the premaxilla and anterior extension of the frontals along the nasals with decreasing
zygomatic width (PC2 = 13%), as well as in the relationship between facial width and height
(PC3 = 10%). Interestingly, the shape variation represented by the first three PCs (and the
amount of variation accounted for by each PC) is nearly identical to that found in a
sample of 120 recent gray wolf crania (Canis lupus).

Despite body size differences between the two species, the similarities in cranial shape variation suggest that the gray wolf could potentially be used as a proxy for the dire wolf. Distributions of cranial centroid size, femoral size
dimensions, and individual tooth size dimensions do not indicate sexual dimorphism in
this sample, with the possible exception of the width of the greater trochanter. Average
body mass, estimated from femoral shaft circumferences, was found to be 61.24 kg with
a range of 43.05-85.31 kg — a slightly higher average value and wider range than that
previously reported for western dire wolf populations. These data show that more extreme
forms existed than were previously described. These differences could be due to greater
geographic or temporal variation within the sample, but are not due to greater sampling
effort.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

FIRST DESCRIPTION OF THE TALAR MORPHOLOGY OF PSEUDOLORIS PYRENAICUS (OMOMYIDAE, PRIMATES) AND IMPLICATIONS FOR ITS
LOCOMOTOR BEHAVIOUR

ROIG, Imma, Institut Català de Paleontologia, Cerdanyola del vallès, Spain; MOYÀ-SOLÀ, Salvador, Institut Català de Paleontologia, Cerdanyola del vallès, Spain

The omomyid Pseudoloris pyreanicus from the Robiánic (middle Eocene) locality of Sant
Jaume de Frontanyà 3C (MP14-15; Eastern Pyrenees, NE Spain) has been recently described
on the basis of the most abundant dental sample of this genus found until now in the
Iberian Peninsula. Additionally, this level has also yielded some postcranial elements of P.
pyreanicus. Here, we describe for the first time the morphology of the talus of this genus and
group it with other fossil and living primates. We emphasize those talar features that have
proven useful in reconstructing higher-level primate phylogeny and discuss the osteological
features that reflect functional attributes related to locomotor behaviour. We estimated
the body mass of P. pyreanicus in 80 g using the multivariate regression equation (“the
prosimian model”) based on the crown areas of the cheek teeth. The talus of P. pyreanicus
exhibits a suite of features that are primarily found in extinct and extant haplorhines (e.
g., a vertically oriented articular lateral facet for the fibula, a plantar groove on the posterior
trochlear shelf for the hallucis longus muscle and a shallow medial talo-tibial facet) and
in omomyids (e.g., a moderate talar neck angle, a moderately high talar body, a small posterior
trochlear shelf and a relatively narrow talar body). These characteristics are consistent with
the haplorhine-like dentition characterization Pseudoloris. From a functional point of view,
the combination of a high talar body with some degree of development of the posterior
trochlear shelf, the elongation of the talo-trochlear and the trochlear rims with a similar degree
of height, are features supporting the hypothesis that leaping was an important component
of the locomotor behaviour of P. pyreanicus. According to this, the locomotion of P. pyreanicus
may be similar to that inferred for other omomyids.
ONTOGENY OF THE BRAIN ENDOCASTS OF OSTRICHE (AVES: STRUTHIO CAMELUS), WITH IMPLICATIONS FOR INTERPRETING EXTINCT DINOSAUR ENDOCASTS
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The study of brain evolution in the fossil record typically uses the cranial endocast (the internal surface of the braincase) as a proxy for the brain itself. Computed tomographic (CT) analysis has revolutionized the field, and digital endocasts are now available for many extinct and extant species. A component missing from these recent studies, however, relates to ontogenetic changes in the endocast, compromising the interpretation of endocasts from presumably juvenile dinosaurs. Our lab has previously studied endocast ontogeny in alligators, and this project presents a comparable ontogenetic study in ostriches (Struthio camelus), which are basal members of the avian limb of the extant phylogenetic bracket of nonavian dinosaurs. This study provides the densest ontogenetic sampling for any palaeognath bird to date: nine ostriches, including two embryos, neonatal chicks, juveniles 2–4 months old, as well as young and fully mature adults. All specimens were subjected to microCT scanning (45 and/or 90 micron voxels). Digital endocasts of the brain cavity, inner ear, and neurovasculature were generated for all specimens using the 3D visualization software Avizo 7. Additionally, some of the specimens were soaked in an iodine/potassium-iodide solution to stain the neural and other cephalic soft tissues. These heads were subsequently rescanned and the iodine-stained brain tissues were segmented to compare the osteologically-based endocasts with the actual brain tissue. One two-month-old specimen also was subjected to radio-opaque vascular injection to assess how blood vessels impact the endocast. The results of the comparison of the iodinated brains with bone endocasts confirmed that the endocast is a fair approximation of the surface structure of the brain at all ages, which differs from the finding in alligators in which the endocast becomes progressively less like during ontogeny. Ontogenetic changes in brain growth include relative expansion of the cerebral hemispheres, greater prominence of the Wulst (hyperstriatum, associated with visual processing), and relative contraction of the cerebellum, among others. Some structures, such as the optic tectum, change relatively little in general proportions. In general, the cranial endocast becomes much more detailed during ontogeny, such that neural and vascular structures become increasingly apparent and discrete. The ontogenetic findings broadly correlate with phylogenetic trends in the cranial endocasts of Theropoda as a whole, and shed light on the interpretation of the endocasts of presumed juveniles in certain dinosaur clades (e.g., tyrannosaurids), some of which appear to follow ontogenetic trends more characteristic of alligators than ostrich.

WHOLEY SMOKE: BRACKETING AND EMPIRICAL RECOGNITION OF THE INNER EAR ANATOMY OF LEPTICTIDUM AUDERIENSE (LEPTICTIDA, MAMMALIA) REVEALS HIGHLY AGILE LOCOMOTION
RUF, Irina, Steinmann Institut für Geologie, Mineralogie und Paläontologie, Universität Bonn, Bonn, Germany; VOPATRO, Virginie, Abteilung Paläoanthropologie und Messelforschung, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany; BILLET, Guillaume, Steinmann Institut für Geologie, Mineralogie und Paläontologie, Universität Bonn, Bonn, Germany; DE MUZON, Christian, Département Historie de la Terre, Muséum National d’Histoire Naturelle, Paris, France; LEHLMANN, Thomas, Abteilung Paläoanthropologie und Messelforschung, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany

Leptictidium is basal insectivorous placental species comprising with highly specialized postcranial features. Among these Leptictidium from the middle Eocene of Messel (Germany) is considered to be very agile with a bipedal saltatory locomotion as indicated by its very short forelimbs and extremely elongated hind limbs and tail. Agility and locomotor behavior can also be investigated from the shape of the semicircular canals of the inner ear bony labyrinth, which are involved in detecting angular acceleration of the head. As clearly demonstrated by former studies the size of the semicircular canals in mammals correlates with body mass and agility. Here we provide the first insight into the inner ear anatomy and morphology of Leptictidium represented by Leptictidium auderiense, the smallest of the three species known from Messel. High resolution computed tomography scans were used for preparing reconstructions of virtual 3D models of the bony labyrinth. The morphology and morphology of the bony labyrinth in Leptictidium auderiense were compared with those of the extant Leptictidium from the Oligocene of North Dakota referred to Leptictidium lakotensis. Though Leptictidium resembles Leptictis in much of the skeleton except limb proportion, the locomotion of the latter is supposed to be mainly quadrupedal. The general morphology of the bony labyrinth reveals that both species have a prominent secondary crus commune which is a primitive mammalian character. The cochlea of Leptictidium shows almost 2 turns and a secondary bony lamina is not present. Leptictis has 2.25 cochlear turns and a short but distinct secondary bony lamina. Both species have thin and prominently arcuated semicircular canals, but those of Leptictidium are relative larger than in Leptictis. The mean size of the radii of the semicircular canals was plotted against the geometric mean of the body mass in a regression analysis taken from literature and comprising 210 therian species. Leptictidium clusters with other highly agile mammals and has much larger semicircular canals than most similar sized species. In contrast Leptictis plots below the regression line closer to slow moving species. Complementarily, we also estimated the agility scores of the semicircular canals. The agility scores of Leptictidium range from 4.5 to 5.5, which indicate a medium to medium-fast moving animal. Its highest scores fall into the range of extant salamander species supporting the hypothesized very agile and saltatory locomotion. Conversely, Leptictis has much lower agility scores (3.5-3.7), which refer to a medium-slow to medium speed of locomotion and correspond to the scores of most extant mammals comprising more general types of locomotion (terrestrial, cursorial, scansorial, arboreal, semi-aquatic).

THE VERTEBRAL COLUMN OF THE PACHYSTEOMORPH ARCHITRORD DUNKLEOSTEUS TERRIELLI
RYAN, Michael J., Cleveland Museum of Natural History, Cleveland, OH, United States; CUMBA, Stephen L., Canadian Museum of Nature, Ottawa, ON, Canada

The Late Devonian (Famennian) Cleveland Shale of north central Ohio has historically produced an abundance of placodont and shark specimens. The placoderms are known primarily from head and thoracic shields, with only rare evidence of vertebrae due to their composition and presumed preservational properties. Recently, the most complete segment of vertebral column known for the pachyosteomorph architrode Dunkleosteus terrielii was recovered, along with a partially articulated skull which preserves at least 12 plates and both lower jaws. The specimen, CMNH 50322, is a subadult Dunkleosteus less than 3 m in length. At least 20 articulated vertebrae, each measuring approximately 2.5 cm high and 6.7cm long, are preserved in lateral view in a 14.6 cm section. The vertebrae are on a block of shale which includes the left anterior dorsal plate, apparently in anatomical position. The vertebrae nearest the skull are not fused, either to each other or completely around the notochord, leaving a small open space on each side. Each vertebra is composed primarily of a fused neural arch and spine, and a fused haemal arch and spine. The curved edges of the bases of the neural and haemal arches of the anterior 13 vertebrae are ornamented with a line of small, rounded tubercles; some show a double line, with the inner line composed of much smaller tubercles. The five complete posterior vertebrae of the remaining seven exhibit marked structural differences from the anterior portion; the notochordal area appears to be covered with a thin layer of bone, which is considerably fractured. These vertebrae are laterally somewhat expanded, with cup-like structures forming the lateral portion of the bases of the neural and haemal arches; they show no ornamentation. The interpretation of these latter few vertebrae is perplexing. Chirichynshtys and some placoderms have a cervicothoracic synarcual posterior to the occipital region which fuse vertebrae to each other and enclose the notochord. However, a synarcual is unknown in Dunkleosteus, although it may have been present on a 10 cm portion of the block directly behind the skull that was lost during collection. The preserved vertebrae are located posterior to normal healing bites. Perspective that bone pathology is phylogeny-independent in character has been tested and found valid for both recent and fossil reptiles.
to the position that a synarcual would have occupied, and they would have to have been flipped 180° and moved 10 cm forward to allow for this interpretation. Alternatively, if the vertebrae are approximately in anatomical position, it is possible that these vertebrae either represent a thoracolumbar synarcual (a second, more posterior fused unit common in myliobatoid chondrichthyes), or that this structural change indicates the beginning of the abdominal region above the pelvic girdle and fin, with the increased bony structure providing protection for the gut.

Preparators’ Session (Thursday, October 18, 10:30 am)

COMPARING IMPRESSION MATERIALS FOR DENTAL MICROWEAR ANALYSIS IN A SMALL FOSSIL MAMMAL

SADOWSKA, KA, Victoria University of Toronto, Toronto, ON, Canada; MORRISON, Ian, Royal Ontario Museum, Toronto, ON, Canada; SILCOX, Mary T., University of Toronto, Scarborough, ON, Canada

Casting is a common procedure for making high-quality replicas in order to conduct microwear analysis. The goal of this project was to determine the best impression material to create high resolution casts that preserve the pits and scratches present on the original specimen. A range of molding materials was chosen that differed in viscosity and age to determine the effect of these variables in producing a faithful mold. The molding materials used in this study include Colten Regular, President-jet MicroSystem Light Body, and President-jet MicroSystem Regular Body (a batch from 1999 and another from 2011) polyvinylsiloxanes; Rhodia’s RTV 4410 Platinum and RTV 4420 QC food grade silicones; Bluets V-SIL 1062 silicone; and Reflection Patterson Super Hydrophilic Vinyl Polysiloxane Putty. All eight molding materials were used to mold a partial dentary with p4-m3 (USGS 7788) of the primitive microtine Microtus latidens from the early Eocene of the Bighorn Basin, a small (but not tiny) mammal (m2 length ~ 3.8 mm). A shaving facet on the m2 was impressed in the original specimen, and in epoxy casts made using the various molds. Images were taken using JEOL-5000 scanning electron microscope (SEM) and microscopic features were manually counted in Microware 4.0 software. The quality of dental surface replication was assessed by comparing the percent visible features in the cast relative to the original enamel surface. The values range from 73.17% for V-SIL1062 to 34.15% for Colten Regular body from 1999. Age of the material was found to have an effect, with Colten Regular Body from 2011 producing a better quality replica (46.34% visibility of microwear features). Viscosity also had a significant effect. The least viscous molding compound used (V-SIL1062) provided the best resolution, and the Light Body President-jet material more faithfully represented microscopic features than the more viscous Regular Body, although the molds made from the Light Body material were quite fragile, so that they were unsuitable for repeated casting. The most commonly used molding material for microwear studies, Colten Regular Body, performed comparatively poorly, although major pits and scratches were preserved, suggesting that it may nonetheless be possible to use casts produced with this impression compound to make general statements about diet.

Preparers’ Session (Thursday, October 18, 8:45 am)

IMPROVING CURATION AND CONSERVATION STANDARDS AT THE VERTEBRATE PALEONTOLOGY LABORATORY THROUGH INTERDISCIPLINARY COLLABORATIONS

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The history of the collections at the Vertebrate Paleontology Laboratory (VPL) of the Texas Memorial Museum spans more than one hundred years. This history is tied to both famous names in vertebrate paleontology and the histories of many other institutions. Preventing and mitigating the loss of archival data, historic documents and photographs, as well as the specimens themselves are the focus of recent conservation efforts by the VPL collections staff. Although interest in preserving documents, photographs, and digital data related to the fossil collections is high, the small permanent staff of VPL faces a number of constraints familiar to most natural history curators and conservators – limited time, staff and training. Our approach over the past year has been to exploit the resources from our larger campus and museum community. We have targeted resources on our own university campus by first defining our collections care priorities. The photographs and documents held by VPL are a rich archival resource. However, this archive has only recently been organized. Documentation within the VPL collection itself is another source of hidden archival riches. However, these documentary materials (as well as the specimens) have suffered from gross variations at all levels in storage conditions and treatments. Field notes and photos are critical to interpretation of fossil materials; likewise, documentation of the provenance of specimens is crucial to collections management. By stressing to our students, faculty, and staff that the documentation of specimen treatments are essential part of the specimen, we are improving this situation. VPL curatorial staff found willing partners in our conservation efforts through the University of Texas at Austin’s Harry Ransom Center and School of Information. Working with these campus units, we have found not only a wealth of opportunity for expanding our own expertise, but also potential funding and qualified personnel. Our retrospective effort to conserve archives is informing our present curatorial practices and procedures. Documentation of the collections is expanded to include conservation methods and materials. Materials and practices for storage are more transparently.” These efforts are also receiving greater emphasis among the students who are the most frequent users of the VPL.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

QUATERNARY BATS FROM SERRA DA MESA (BRAZIL): HUMERAL REMAINS AND TAXONOMIC ASSESSMENTS

SALLES, Leandro O., Museu Nacional, Rio de Janeiro, Brazil; CARLOS, Moraes Neto R., Museu Nacional, Rio de Janeiro, Brazil; LANEZELOTTI, Wagner, Museu Nacional, Rio de Janeiro, Brazil; PERINI, Fernando A., American Museum of Natural History, New York, NY, United States; SIMMONS, Nancy B., American Museum of Natural History, New York, NY, United States

The fossil record of bats from the Quaternary of Serra da Mesa (Brazil) is here documented with 231 humeral fragments collected in three limestone caves, displaying stratigraphic profiles covering a timeframe of approximately 25,000 BP (unpublished C14 data). Serra da Mesa is a karstic region in the middle of Brazilian savannas (Cerrado Domain), located in the State of Goias. This material is being studied as part of a research project focused on the patterns of variation in the morphology of the humerus in the order Chiroptera. The identification of the material so far reveals an especially rich paleofauna of bats. It includes 22 genera, with potentially another 4, which are identified up to this point as incertae sedis; and 37 species (22 determinate, 15 under investigation), belonging to 5 families (the parentheses denote number of fragments followed by an indication of the status of the taxon as fossil (F) or recent (R) record for the bat fauna of Serra da Mesa): Phyllostomidae, Desmodontinae – Desmodus rotundus (5), Glossophaginae, Glossophagini – Anoura cf. geoffriri (2), Glossophaga soricina (3) (F), Glossophaga sp. (10), cf. Glossophaginae (1), Lonchophyllina – Lonchophylla sp. (5); Phyllostominae – Lonchorhina sp. (22), cf. Lophostoma (1), Macrophlyrum macrourum (1) (F), Micronycteris sp. (1), cf. Micronycteris (1), Minom bennetti (6), Minom cf. crenulatum (1), Phyllostomus discolor (2), Phyllostomus hastatus (16), Phyllostomus sp. (1), Trachops cirrhatus (1), Phyllostomina inc. sedis 1 (5), Phyllostomina inc. sedis 2 (2); Carollinae - Carollia castanea (1) (F&R), Carollia perspicillata (2); F; Stenodermatinae, Stenurina – Stenura sp. (5); Vespertilioninae – Artibeus cf. fambrictus (1) (F&R), Artibeus jamaicensis (2) (F), Artibeus sp. (1), cf. Artibeus (1), Platyrrhinus cf. Helleri (1) (F), Vampyrum coracioides (1) (F&R), cf. Stenodermatinae (1); Mormoopidae – Pteronotus gymnotus (28) (F&R), Pteronotus parnelli (75); F; Furipteridae – Furipterus horrens (1) (F); Natalidina – Natalus stramineus (20); Molossidae, Molossinae – Nyctinomops cf. laticaudatus (1) (F&R); Vespertilionidae, Vespertilioini – Histiotus sp. (1) (F&R); Myotisinae – Myotis albescens (1) (F), Myotis riparius (1) (F). Six taxa were not recorded previously for the extant fauna of the region. Some material, such as a Macrotrus-like humerus, may represent new taxa, while others represent the first fossil records for the Brazilian territory and the South American continent. We conclude highlighting the potential of bat humeri as a source of character information for taxonomic and phylogenetic studies.

Technical Session III (Wednesday, October 17, 4:00 pm)

SKULL SHAPE REFLECTS LOCOMOTOR ECOLOGY IN RODENTS AND CARNIVORANS

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The postcranial morphology of mammals has been shown to reflect cursorial, aquatic, arboreal, and fossorial locomotor habits. In the fossil record relatively complete postcrania are uncommon, while well-preserved skulls exist for many taxa. Features of the cranium, particularly the orientation of the orbits, have also been demonstrated to be linked to locomotor ecology. This study examines how skull shape, particularly the size and orientation of sensory structures, reflects locomotor habits in two ecologically diverse orders of mammals. Digital photographs of over 800 skulls, from 153 rodent and 54 musteloid and carnivoran species, were analyzed using geometric morphometric methods. Results of relative warps analyses reveal some convergence in skull shape associated with locomotor ecology, as well as some distinct differences in herbivorous and faunivorous taxa. Semi-aquatic carnivores and rodents both display a broad and deep rostrum with elevated nasals and enlarged external nares. This position would allow the animal to breathe while most of the body is submerged and accommodates enlarged maxilloturbinate associated with thermoregulation. Semi-aquatic herbivores display elevated orbits and external acoustic meatuses, which allow them to see and hear predators out of the water while submerged. Arboreal species display enlarged and more convergent orbits, allowing larger binocular visual fields. This is more pronounced in arboreal faunivores than herbivores, possibly due to pressure for a wider field of view in prey species. Salitary rodents show enlarged orbits and auditory bullae; this reflects their nocturnal habits, their dependence on binocular vision for locomotion, and enhanced hearing for detection of predators. Fossorial species show reduced orbit size and enlarged auditory bullae, likely reflecting increased reliance on hearing to detect predators and prey. Canonical analysis classification of species ecology by skull shape was very accurate, greater than 90% correct for both carnivores and rodents. Mapping the morphospace onto phylogeny reveals convergence in skull shape within multiple lineages. Application to 51 extinct rodents and 22 extinct carnivores helps confirm previous researcher’s hypotheses and reveal aspects of paleoecology that were previously unknown.
Placental mammals occupy a larger morphospace and are taxonomically more diverse than marsupials, as shown by quantitative and phylogenetic studies of several character complexes and clades. This pattern holds when considering the rich ecomorphological diversity of fossils. The contrasting evolutionary path of therian clades has been coupled with a bias introduced by marsupials’ developmental features, including lack of feto-maternal intimacy, general altriciality and functional requirements around birth. But the relevance of life history features in imposing constraints on the evolution of morphological features, such as those in the appendicular skeleton, is at best speculative. There are numerous cases of circumvention of developmental biases in morphological evolution, such as the autopodial specializations of mice. This and other examples as well as the common decoupling of morphogenetic events from adult anatomy in several groups of organisms and character complexes suggest that other factors produced the pattern of restricted morphospace in marsupials. A review in the literature on phylogenetic and geographic data for fossil and living species and the physiology in living forms offer new insights on this issue.

At many time and places in geological history, metatherians have been more diverse than eutherians or at least as diverse as the latter, as documented in Creataceous and Paleogene faunas. Furthermore, there are no positive tests of competitive displacement of metatherians by eutherians. The diversification of Marsupialia and that of the major clades within it occurred about 20 myr. more recently than that of Placentalia and its ‘orders’. The geographic pattern of taxonomic and morphological diversity within Placentalia mirrors that of placentalia as a whole versus marsupials: northern clades are more diverse (ca. 4,800 spp.) than southern ones (200 spp.) and include those that are outliers in taxonomic (rodents; bats) and ecomorphological (whales; bats) richness. This pattern suggests that the largely restricted distribution of marsupials in southern continents after the Cretaceous must have played a decisive role in their diversification.

Physiological features are a likely source of biases in the evolution of marsupials, as shown by past macroevolutionary patterns that followed conditions imposed by global temperatures at the Eocene-Oligocene boundary. The apparent lack of brown adipose tissue and the close tie of metabolism with food consumption make marsupials more vulnerable to climate change. In general, the differential diversity and disparity among therians is more a reflection of ‘opportunity’ than one of biases in the production of morphological variants during the development in marsupials.

CERVICAL RIB HISTOLOGY OF SAUROPOD DINOSAURS SUGGESTS FUNCTION IN THE MUSCULAR CONTROL OF THE NECK

SANDER, P. Martin, University of Bonn, Bonn, Germany; KLEIN, Nicole, University of Bonn, Bonn, Germany

Cervical ribs were an integral part of the anatomy of the neck of sauropodomorph dinosaurs. Prosauropods such as Plateosaurus show extremely elongated, posteriorly directed ribs that span more than one intervertebral joint, depending on position in the vertebral column. This condition is retained in most Sauropoda except for Diplodocidae which have been autopomorphically shortened and ribs never overlap more than one intervertebral joint at most. Two competing hypotheses address the function of the elongate cervical ribs of sauropods. One views them as ventral bracing elements taking up compressive force, and the other interpreting them as tensile elements integrated into the muscle-tendon system of the neck. We used bone histology to test these hypotheses, sampling the cervical ribs of Diplodocus and Brachiosaurus in serial sections along their entire length as well as fragmentary cervical ribs of some other sauropods. In addition, we studied the histology of ostrich cervical ribs. Except for the region of the capitulum and tuberculum, the primary bone of the entire ribs is metaphysically ossified tendon, including the anterior process of the Diplodocus rib. This is the situation in the ostrich as well. Only the region of the rib heads shows the normal periosteal bone seen in the dorsal ribs of sauropod dinosaurs. The primary metaphyseal bone is made up of tightly packed fiber bundles that are surrounded by a fibrous sheath. Bundle orientation is strongly longitudinal. This histology indicates that the posterior shafts and anterior processes of sauropod cervical ribs are ossified tendons that may have been part of the ventral m. longicollis system. The lack of radially oriented fibers argues against the long overlapping cervical ribs having been bound into a tightly intergrafted rod but is consistent with these ribs having slid past each other during neck movement. The hypothesis of a ventral bracing function for the cervical ribs of both long-ribbed and short-ribbed sauropod dinosaurs thus can be confidently rejected. Instead, the extremely long ribs may have allowed a caudal shift of the heavy musculature operating the neck, as seen in some birds. This would have decreased the mass of the anterior and middle parts of the neck, contributing to lightening of the neck in addition to its extensive pneumatization.
the preservation of at least 83 fossil footprints in two distinct track-bearing horizons from interdunal deposits in the lower part of the Navajo Sandstone Formation. The Early Jurassic ichnofauna preserved in the block referred to as the “Megatrack Block” includes: 10 large ornithopod-like tracks which were likely produced by a theropod; 47 tracks tentatively identified as Grallator, produced by small crocodyliform theropod dinosaurs; three large theropod tracks showing indiavals in statistical plots of theropod tracks that appear to be Kayentapus-like in morphology; five smaller unidentified quadruped footprints possibly made by a crocodylomorph; and, 10 unidentified tracks. The ichnocoasmatamblage preserved on the “Megatrack Block” sheds new light on the life of the Jurassic Navajo desert.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

INTRASPECIFIC VARIATION IN THE STYLOCLAS CUPS OF DIPEDILPHUS VIRGINIANA
SARTIN, Catherine E., Johns Hopkins School of Medicine, Baltimore, MD, United States; ROSE, Kenneth D., Johns Hopkins School of Medicine, Baltimore, MD, United States
In the fossil record, mammalian taxa are routinely identified on the basis of molar morphology. The presence, absence, size or unique shape of just one cusp or conule can lead to the naming of a new species, even a new genus. The underlying assumption is that these surface features do not vary within species; that these features only vary between species. This study challenges that assumption.

We examined the upper molars of extant Dipedilphus virginianus from the collections of the Smithsonian Institution, National Museum of Natural History, Division of Mammals. Only molars that showed little to no evidence of wear, whose crown details could be seen relatively clearly and unambiguously, were used in order to avoid confusing wear patterns with morphology. Only specimens that possess a right and left M1 and M2 were used, so that variation within an individual, as well as between individuals, could be assessed for each molar. Specimens were photographed under a light microscope using a standardized procedure. At this time, any variation in the morphology of the stylar cusps was noted. The width of the molar and height of each stylar cusp was measured from the photograph using ImageJ.

Intraspecific variation was found with respect to cusp height (especially Cusps B and C) and cusp morphology (especially Cusp C). Using ANOVA analyses, we were able to detect that the variation between individuals is statistically significant. These variations occurred across the collection localities, as well as across the four subspecies. Interestingly, some of the variations found are reminiscent of characters used to discriminate between taxa in the fossil record. This study forces us to re-evaluate the characters we use to distinguish taxa.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

TRANSITIONAL TRICERATOPS: DETAILS OF AN ONTOGENETIC SEQUENCE FROM THE UPPER MIDDLE UNIT OF THE HELL CREEK FORMATION, MONTANA
SCANNELLA, John B., Museum of the Rockies and Department of Earth Sciences, Montana State University, Bozeman, MT, United States; FOWLER, Denver W., University of California Museum of Paleontology, Berkeley, CA, United States; HORNER, John R., Museum of the Rockies and Department of Earth Sciences, Montana State University, Bozeman, MT, United States
Currently, two species of the latest Cretaceous ceratopsid Triceratops, T. horridus and T. prorius, are distinguished, in part, by the following cranial morphological features: postorbital horn core length, morphology of the rostrum, closure of the frontoparietal fontanelle, and the length of the epinasal. Recent work in the approximately 90 meter thick Hell Creek Formation (HCF) of Montana confirms that these species are stratigraphically separated. T. prorius is found in the upper third of the HCF and T. horridus occurs in the lower and middle thirds. A collection of disarticulated skulls represents a range of ontogenetic stages and reveals new cranial characters of the epinasal, nasals, and premaxillae that further distinguish these species. Triceratops recovered from the upper part of the middle third of the HCF (~ 5 meters below the base of the upper third) are morphologically intermediate between T. horridus and T. prorius, and exhibit a combination of cranial features that characterize each taxon. Targeted collecting of the upper middle HCF has produced an ontogenetic sequence of Triceratops from this stratigraphic zone. These skulls exhibit: (1) elongate postorbital horn cores and a pronounced anterior nasal process, features that are characteristic of Triceratops from the lower half of the HCF; and (2) an elongate epinasal, expanded ascending process of the premaxilla, and deep rostrum that are characteristic of Triceratops from the upper third of the HCF. The absence of autapomorphies in these specimens from the upper middle HCF supports the hypothesis that the evolution of Triceratops was characterized by anagenesis, the morphological transformation of a lineage over time. Interestingly, juvenile skulls and cranial elements from the upper third of the HCF exhibit character states found in more mature individuals collected from lower in the formation. This HCF dataset suggests that morphological variation in Triceratops may be largely a result of heterochrony, indicating that stratigraphic and ontogenetic details are necessary for a comprehensive taxonomic evaluation of non-avian dinosaurs.

Technical Session IX (Friday, October 19, 11:30 am)

UNIDIRECTIONAL AIRFLOW AND PULMONARY ARCHITECTURE IN ALLIGATOR MISSISSIPIENSIS AND THE IMPLICATIONS FOR THE EVOLUTION OF THE AVIAN RESPIRATORY SYSTEM
SCHACHERN, Emma R., University of Utah, Salt Lake City, UT, United States; SARRAZIN, John C., University of Utah, Salt Lake City, UT, United States; FARMER, C. G., University of Utah, Salt Lake City, UT, United States
The unidirectional airflow pattern in the lungs of birds has long been considered both novel and unique; however, the evolution of this trait in the lungs of the American alligator (Alligator mississippiensis) suggests that it is not an avian autapomorphy but plesiomorphic for Archosauria. In birds, unidirectional airflow is maintained by a series of inspiratory and expiratory aerodynamic valves. These valves arise from the geometry and branching angles of the primary and secondary bronchi. This anatomy is what maintains unidirectional airflow during both the inspiratory and expiratory phases of ventilation. Experimental and CT data indicate that the alligator also has a functional alligator airflow mechanism from all of the major secondary bronchi in five specimens of A. mississippiensis show that airflow follows an avian-like pattern. Air flows cranially to caudally in the cervicoventrobronchus (CVB or D1), and caudally to cranially in the following four dorsobronchi (D2-D5) and medial bronchi (M1-3). These airflow patterns support previous hypotheses of homology between the CVB and the avian ventrobronchi, and the crocodilian and avian dorsobronchi. Dissections, CT, and experimental data demonstrate that flow patterns are maintained by aerodynamic valves, suggesting that this trait, like the airflow patterns, is plesiomorphic for Archosauria. A computation fluid dynamic model was created using this CT data, which supported the experimental data and confirmed the hypothesis that bronchial geometry and airflow conditions are the key factors that generate unidirectional flow in alligators.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

QUANTITATIVE INTERPRETATION OF DINOSAUR TRACKS REVISITED
SCHANZ, Tom, Ruhr-Universität Bochum, Bochum, Germany; LINS, Yvonne, Ruhr-Universität Bochum, Bochum, Germany; VIEFHAUS, Hanna, Ruhr-Universität Bochum, Bochum, Germany; SANDER, P. Martin, Universität Bonn, Bonn, Germany
All over of the world, dinosaurs left their tracks in sediment, the original subsoil, which are observed as fossil footprints today. In this study, we present two theoretical approaches to the prediction of dinosaur weights based on the geometry (i.e. the 3D deformation field) of fossil footprints. The deformation field is the result of the stress state applied to the subsoil by the weight of the dinosaur via its foot, and we use the deformation field to back-calculate this weight by inverse analysis. Since the mechanical behavior of any soil varies with soil type and bedding conditions, the stiffness parameters of the original subsoil have to be back-calculated from the properties of the rock in which the footprint is preserved. Using Micro-CT as well as experimental soil mechanics, we derive subsoil grading properties and original stiffness.

The first theoretical approach estimates the error introduced by sediment compaction, i.e., the difference between today’s track geometry (the fossil footprint) and original track geometry (the footprint left by the dinosaurs when uplifting the foot). Any subsoil stiffness parameter is sensitive to loading path direction and stress level. Therefore, the stress history contributed by the geological surcharge (i.e., the overburden) is taken into account by introducing an equivalent stiffness parameter. The main outcome of this approach is that the weight calculated using only the fossil footprint geometry and neglecting the deformation of the track by compaction of the sediment underestimates the true weight by less than 7%.

The second theoretical approach addresses the problem of undertracks. Fossil footprints as preserved in the field may not represent the original surface on which the dinosaur walked, i.e., they are preserved as undertrack footprints, and therefore may be difficult to use for weight estimates based on deformation fields. For the interpretation of such footprints, it must be kept in mind that stresses and vertical displacements induced by surface loads decline with increasing depth while spreading laterally. Our second theoretical approach allows calculation of the deformation field with increasing depth, and thus the dinosaur’s weight, even by analyzing an undertrack footprint only. We verify our approach by the analysis of two in-situ undertracks well documented in the literature and by additional model tests in the soil mechanics lab.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

A SHARK-BITTEN HADROSAURID FEMUR FROM THE BASAL HORNETSTOWN FORMATION, NEW JERSEY, U.S.A.: ONE OF THE YOUNGEST NON-AVIAN DINOSAUR REMAINS KNOWN
SCHENK, Jason J., New Jersey State Museum, Trenton, NJ, United States; POOLE, Jason C., Academy of Natural Sciences of Drexel University, Philadelphia, PA, United States; LACOVARA, Kenneth J., Drexel University, Philadelphia, PA, United States
We report the discovery of an isolated left femur (New Jersey State Museum 22688) of a hadrosaurid dinosaur from Gloucester County, New Jersey, U.S.A. The femur is approximately 15.8 cm in length, with a midshaft circumference of 17.8 cm around the fourth trochanter and a minimum shaft circumference of 15.8 cm. The specimen can be referred only to an indeterminate member of Hadrosauridae. The ontogenetic stage of the individual is unclear.
The femur exhibits numerous straight to slightly arched grooves along its entire length, concentrated on the medial and lateral portions of the midshaft. The grooves are generally unpaired, unparallel, and sub-perpendicular to the long axis of the femur, and are consistent with tooth marks created by one or more scavenging sharks. This “bloat and float” hadrosaurid carcass was deposited in nearshore marine deposits in which shark remains are common. None of the tooth marks exhibit serration grooves, and no tooth fragments remain in the femur.

The femur was excavated from the Main Fossiliferous Layer (MFL) of the basal Hornerstown Formation. Various ages have been assigned to the MFL, ranging from latest Maastrichtian, to earliest Danian, and most recently, terminal Cretaceous. Likewise, there are multiple interpretations of the depositional history of the MFL and the taphonomic characteristics of the fossiliferous layer. Whatever the depositional setting, it is clear that these fossils exist very near to, or even in, the K/Pg boundary, making this femur one of the youngest non-avian dinosaur remains known.

RECONSTRUCTING HABITATS WITH CANNON BONES
SCHELLHORN, Rico, Steinmann-Institut, Palaontologie, Universitati Bonn, Bonn, Germany
The fused metaphyses of the third and the fourth ray in more progressive artiodactyls, like bovids and cervids, are called cannon bones. This term is used in both the fore and the hind leg, and also for the metaphyses in extant equids, where the third ray is used for walking.

It is well known, that not only teeth, but also the postcranial skeleton, especially limb elements, are useful to determine habitat preferences. For the presented study the long bones of fore and hind limbs of extant cervids and boids have been measured. The log transformed data of all long bones have been analyzed together within a principal component analysis (PCA). The result was to group the taxa with different body sizes, the more generalists. The distance between the different preferred ecological niches is still obvious in boids by plotting the PCs for metacarpals and metatarsals, at least for grassland and forest habitats. The members of the mountainous habitat cluster are plotting either in the grassland cluster or the forest cluster.

To check if the method is just working for boids the long bones of extant horses and relatives (all belonging to the genus Equus) have been measured. All equids are plotting close together within the cluster of grassland preferring boids. This is the case for the PCA based on all long bones together and the PCA’s made for the single cannon bones. The result for the cannon bones is surprising because the cannon bones of the perissodactyl horses are modified single bones, while the cannon bones of the artiodactyl boids are a fusion of formerly two bones.

The method using just the cannon bone has been tested for different fossil taxa from the Miocene to the Pleistocene. For instance the fossil horse Hippipos shows similar adaptations to grassland preferring boids, which is expressed by plotting close to grassland preferring boids and equids in the PC plots for metacarpals and metatarsals. The modified approach using cannon bones could be an additional tool to determine the fossil habitat, when other data are not sufficient.

NEOGENE CROCODILYAN MEGADIVERSITY PEAK AND FAUNAL SUCCESSION IN VENEZUELA
SCHUYER, Torsten M., Palaeontological Institute and Museum, University of Zurich, Zurich, Switzerland; AGUILERA, Orígenes A., Museo Paraena Emilio Goeldi, Coordenacion de Ciencias de la Tierra y Ecologia, Departamento de Geociencias, Belém, Brazil; FORTIER, Daniel C., Departamento de Paleontologia and Estratigrafia, CICe, UFRGS, Porto Alegre, Brazil; SÁNCHEZ, Rodolfo, Municipio Urumaco, Edo. Falcón, Urumaco, Venezuela; SANCHEZ-VILLAGRA, Marcelo R., Palaeontological Institute and Museum, University of Zurich, Zurich, Switzerland
Crocodylian remains, together with turtle shells, make up the majority of vertebrate fossils recovered from the Neogene Urumaco Sequence in Venezuela. In the Late Miocene Urumaco Formation alone, a diversity peak with up to 14 crocodylian taxa, including one previously unknown alligatoroid with posterior chewing denticulation similar to that of Caiman brevirostris, has been recovered. These findings thus constitute seven alligatoroids (Caiman brevirostris, C. lutiferus, Melanonchus aff. Paracaima, Paracaima, Melanonchus arenosi, M. cf. nativa and the possible new alligatorid taxon), four gavialoids (Gyroneus crozatii, G. jessei, Hesperogavialis cruxenti, Ignanogavialis gameroi) and probably three crocodyloids taxa (Charactosuchus mendesi and possibly two separate species of the tomostyloide Thectachampsa). Newly available stratigraphic control and refined global positioning data after a decade of collecting for crocodylian fossils indicate that regionally up to a minimum of six of the 14 known species lived sympatricly, with several of them constituting apex predators in the ecosystem (e.g. Pararhinosaurus or Gyroneus). Six taxa are thus known to occur in the Puente (Middle Member, Urumaco Fm.) and Corallito localities (Upper Member, Urumaco Fm.) respectively, followed by the El Hatillo (Middle Member, Urumaco Fm.) and Tio Gregorio localities (Upper Member, Urumaco Fm.), with five species each. Several other localities, shored with fossil data, this new eastern river basin, is the sister taxon to extant Crocodylus species. This faunal succession from the diversity peak in the Miocene Urumaco Fm. to the depleted Pliocene fauna is indicative of severe environmental changes, including important changing hydrographic courses related to the Orinoco River.

GLOSSY FEATHERS AND NOCTURNAL ACTIVITY: INFERENCE OF MICROTRAIT FEATHER COLORS USING A PHYLOGENETIC FRAMEWORK
SCHMITZ, Lars, Department of Evolution and Ecology, UC Davis, Davis, CA, United States; HINIC-FRLOG, Sanja, Departments of Biology and Earth Sciences, Carleton University, Ottawa, ON, Canada
Quantitative analyses of continuous morphological traits with explicit functional relevance provide testable models of trait inferences in fossil vertebrates, a rapidly growing area in paleobiology. In the midst of this trend a new technique has been developed to make retrictions of feather colors in dinosaurs. This technique relies on unexclusively preserved melanosomes structures in fossil feathers that record information about color. However, current interpretations do not account for phyllogenetic bias and thus may potentially misleading. In order to test whether the use of non-phylogenetic methods is justified, we developed a time-calibrated phylogenetic hypothesis for all 118 extant bird species for which data on melanosome structure are available. Next, we repeatedly subsampled the data to only include a single observation per species, creating a distribution of results. This resampling combined with the phylogenetic framework minimizes the risk of violating the assumption of independence among samples. Then, we quantified the correlation between melanosome structure and feather color (five categories) while varying the level of phylogenetic bias removal by adjusting Pagel’s lambda. We found the highest correlation between the three SCC likely reflects the great body mass and extremely long neck of sauropods. We hypothesize that this was particularly the high angular acceleration experienced by the head during neck movement that is responsible for the peculiarities of sauropod SCC dimensions. The differences between different sauropod taxa in absolute canal size and proportions also suggest different behavioral strategies such as low-browsing vs. high- browsing. These results may thus provide a better understanding of sauropod feeding strategies as well as head and neck movements but also have implications for the ongoing controversy about neck posture in sauropods.
when 7-13% of phylogenetic bias expected from Brownian motion was removed. This value was reduced to 0-5% when only two categories (iridescent vs. non-iridescent) were used, yet a small amount of phylogenetic bias remained even in this simplified case. Thus, we performed phylogenetic flexible discriminant analysis (pFDA) at the appropriate level of phylogenetic bias removal and prior probabilities obtained from trinodal data. Results from pFDA suggest that the full color model with five categories suffers from high misclassification rates (25-37%). In contrast, the simple model with two color categories (iridescent vs. non-iridescent) is robust, with misclassified proportions ranging between 8-14%. Posterior probabilities of pFDA support the inference of iridescent feathers in Microraptor as suggested previously. However, the inferred presence of glossy feathers does not contradict the reconstruction of nocturnality in Microraptor on the basis of sceral ring and orbit morphology. Nocturnal species with iridescent feathers are found in at least two phylogenetically distinct clades of extant birds (Anseriformes, Psittaciformes). It is probable that Microraptor was a nocturnal animal with glossy feathers. However, the reconstruction of feather color in other dinosaurs and basal avians needs further scrutiny, because even a small amount of phylogenetic bias may result in different classifications.

Technical Session XIV (Saturday, October 20, 9:45 am)

A DISTINCTIVE NEW ARCHOSAURIFORM REPTILE FROM THE MIDDLE TRIASSIC (LADINIAN) OF GERMANY AND ITS PHYLOGENETIC RELATIONSHIPS

SCHHOCH, Rainer R., Staatliches Museum fuer Naturkunde Stuttgart, Stuttgart, Germany; SUES, Hans-Dieter, Smithsonian Institution, Washington, DC, United States

In recent years fieldwork in late Ladinian (Middle Triassic) strata of the Lower Keuper (Erfurt Formation) of Baden-Wurttemberg (Germany) has yielded many well-preserved skeletal remains of a considerable variety of tetrapods and fishes, many of them new to science. These discoveries include partial skeletons as well as numerous isolated elements of a distinctive new armored archosauriform reptile. The dorsal dermal armor of the new taxon comprises transverse rows of four rectangular osteoderms in the cervical, trunk, and caudal regions, with the individual plates closely resembling those of Doswellia kaltenbachi from Carnian-age formations in Virginia and Texas. Ventral armor is absent but small osteoderms covered at least portions of the limbs. The long and low maxilla of the new taxon held at least 15 teeth. The labial and lingual surfaces of the teeth, only slightly recurved crowns of the maxillary teeth bear distinct vertical ridges. The cervical portion of the vertebral column is long. The anterior dorsal ribs have sharply bent shafts. Phylogenetic analysis places the new taxon as the sister taxon to Doswellia kaltenbachi in Doswelliidae. Doswelliidae is diagnosed by the coarsely reticulate, deeply incised ornamentation of osteoderms composed of central regular pits of subequal size and contour and a mostly smooth anterior articular lamina on each osteoderm. We present the phylogenetic position of this clade cannot be confidently determined more precisely than non-archosaurian archosauriforms more derived like Protosuchus, Erythrosuchus, and Euparkeria capensis. Along with recent finds from South America, the new taxon establishes that Doswelliidae was widely distributed across Pangaea during the late Middle and early Late Triassic.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

HISTOLOGY OF NORMAL AND DEFORMED ARGENTINE TITANOSAUR FEMORA

SCHROETER, Elena R., Drexel University, Philadelphia, PA, United States; LACOVARA, Kenneth J., Drexel University, Philadelphia, PA, United States

Previous histological examination of the humerus of a new titanosaur species from Argentina indicated that it was still actively growing at the time of its death, though the individual was very large (humerus length = 1.6 m) compared to other known titanosaurids. To support the hypothesis of active growth, we conducted a histological examination of the anterior side of the femur (length = 1.95 m) associated with this individual. Transverse sections of the femur showed well-vascularized, laminar fibrolamellar bone in the outer cortex that extends to the peristomial surface. Lines of arrested growth (LAGS) and amuli, if present, are not well defined. Secondary remodeling is less extensive than observed in the humerus, with isolated secondary osteons appearing deep to the peristomial surface. Though Haversian tissue becomes increasingly dense towards the medullary cavity, large areas of primary bone are retained between the secondary osteones throughout the middle cortex. The absence of an external fundamental system (EFS) or avascular, lamellar-zonal, or parallel-fibred bone at the periostal margin is consistent with the assessment of this individual as a young adult.

In addition, a second, shorter titanosaur femur (length = 1.29 m) was recovered from the same locality. The smaller femur has an elongated femoral head that is pathologically- and/or taphonomically-deformed. To test the hypothesis that this bone is from a younger individual that has been diagenetically altered, a transverse section of this specimen was examined and compared with the larger femur. It exhibits a pattern of tissue development not observed in its larger counterpart, including the following characteristic features: (1) a higher level of secondary remodeling, with more abundant and closer-spaced secondary osteons developing nearer the peristomial surface; (2) the presence of a few well-defined amuli. The presence of apparently more mature tissues in a smaller femur may be an osteological response to compensate for an injury sustained during the individual’s life, or may indicate it is a member of a distinct species. While additional investigation is necessary to determine unequivocally the origin of the histological differences, the hypothesis that the smaller femur represents a conspecific juvenile appears less likely in light of these data.

Technical Session X (Friday, October 19, 10:30 am)

MAJOR TRANSFORMATION IN MASTICATORY AND DENTAL FUNCTIONS IN EARLY MAMMALS

SCHULTZ, Julia A., Steinmann-Institut, Universitaet Bonn, Bonn, Germany

Precise dental occlusion is a key evolutionary adaptation of mammals. In combination with various modifications of the dentition, modern placentalts and marsupials developed a versatile masticatory function from pre-triobosphic Mesozoic ancestors. This important functional evolution can now be studied quantitatively for pre-triobosphic dryolestoid mammals and other mammaliforms. For the first time masticatory movements and the original wear pattern of fossil teeth can be integrated in a quantitative 3D-surface analysis for analyzing chewing biomechanics.

The mastication of dryolestids is characterized by embraceing shearing. The trigonids of the lower molars slide into the interdental spaces between the upper molars. Food is sectioned and sheared along the main shearing area, the hypoedelid groove. This groove is of great importance for the food reduction, while the hypoflexid is less involved into occlusal contacts in tritylodonts. Two directions of striations on dryolestid molars indicate that the chewing cycle consisted of two phases: an initial piercing-cutting phase followed by a shearing phase, ending with centric occlusion. In tritylodonts, centric occlusion is followed by a grinding phase in the talonid basin.

Compared to the transversal chewing movement of dryolestids, the chewing pattern of tritylodonts and multituberculates is fundamentally different. The postcanine morphology of the herbivorous tritylodonts and multituberculates is triggered by the palinal (mesial to distal) chewing movement. Two cusps rows on the lower molars interlock with three cusp rows on the upper molars. Despite the similarity of the occlusal surface, tritylodonts and multituberculates have different strategies of mastication. The cusps of tritylodonts are narrow and high with significant shearing edges, while the cusps of multituberculates are rounded without sharp edges. Food particles are cut along the series of blades in tritylodonts, while in multituberculates food is mainly sheared between large shearing areas. A similar chewing pattern occurs in muroid rodents, but shape of the cusps indicates a gradual movement (distal to mesial) of the lower jaw.

Quantification of shearing planes and collision areas are the basis for the estimation of the efficiency of various molar types. The interpretation of physical properties of food items results from the function of single elements of the occlusal surface allows acomparative and ecological comparisons. It shows that the ability of precise occlusion is mandatory to evolve highly efficient dentitions before the trisbosphic molar appeared in the mammalian history.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

IDENTIFYING THE ORIGINS AND IMPLICATIONS OF BONE PATHOLOGY IN FOSSIL REPTILES

SCHULTZE, Hans-Peter, University of Kansas, Lawrence, KS, United States; ROTHSCILD, Bruce M., University of Kansas, Lawrence, KS, United States; PELLEGRINI, Rodrigo, New Jersey State Museum, Trenton, NJ, United States

A famous 19th century physician observed that diagnosis without knowing the literature is like going to sea without charts, and suggested that lack of knowledge of history only leads to its repetition, not progress. As science develops, concepts are transformed, such that there is value in re-examining the literature in view of our current understanding of disease and its impact on the skeleton. The perspective that bone pathology was phylogeny-independent in character was tested and found valid for both recent and fossil reptiles. That is the first step in understanding pathology in the fossil record. This allowed identification of what has been clearly documented and areas for future investigation. Congenital anomalies and neoplasia (tumors) are rare and injuries and infections are predominantly reported as isolated phenomena. Decompression syndrome is found within a relatively narrow phylogenetic window, but at high frequency. Past notations of fusion of vertebrae are re-examined and compared. Whereas some are attributable to infected bites, more have vertebral bridging more characteristic of spondyloarthropathy, similar to that noted in contemporary varanids. This unique form of arthritis was recognized in Dimetrodon, Diadectes, Ctenomachus and crocodylians, as well as in mosasaurs and dinosaurs. Study of fossil reptiles provides evidence extending the ability to recognize bone pathology from a trans-mammalian perspective to a more general trans-phylogenetic phenomenon.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

A NEW PLIOSAUR (PLEOSAURIA, PLEOSAURIDAE) FROM THE CARLILE SHALE (CRETACEOUS: MIDDLE TURONIAN) OF RUSSELL COUNTY, KANSAS

SCHUMACHER, Bruce A., Denver Museum of Nature and Science, Denver, CO, United States; CARPENTER, Kenneth, Prehistoric Museum, Utah State University – Eastern, Price, UT, United States; EVERHART, Michael J., Sternberg Museum of Natural History, Hays, KS, United States

The Eulert pliosaur remains (FHSM VP-321) housed at the Sternberg Museum of Natural History (Kansas, USA) include one of the world’s best examples of a Cretaceous pliosaurs pliosaur skull. The specimen’s original assignment to Brachacetus lucasi was based solely upon the skull in dorsal view and the left lower jaw in lateral view because the specimen was embedded in a plaster mount. The history of B. lucasi is similarly problematic because the type (USNM 4989) and a referred skull (USNM 2361) were formerly visible
only in ventral and dorsal views, respectively. Further preparation and comparison of these specimens reveals new data about the arrangement of cranial elements. The Eulert pliosaur bears several distinct autapomorphies as compared to B. lucasi, including cranial proportions (pre-temporal length of palate longer, shorter temporal fenestrae), configuration of skull roof elements (frontals participate in premaxilla-parietal suture, suture occurs further to the anterior), and configuration of the palate (posterior vomers not masked by medialalar extensions of the palatines, caudal vomerian fenestrae positioned further posterior, long slit-like anterior pterygoid vacuity present). Furthermore, FHSM VP-321 possesses double-headed cervical ribs, a feature which until recently was unknown in Cretaceous pliosauria. This combination of characters merits separation of the Eulert pliosaur and a referred specimen (UNSM 50136) to a new taxon. The skull of the Eulert pliosaur and the referred specimen are 1.5 m and 1 m in length, and thus fifty and seventy-five percent larger than known B. lucasi, respectively. Reliable body proportions of pliosaurs are difficult to ascertain given the paucity of skeletons, however skull length equates to between twenty and twenty-five percent of total body length. The 1 m long skulls of B. lucasi thus equate to individuals between 4 and 5 meters in total length, animals that are certainly adult in size. Yet the Eulert pliosaur and the referred skull suggest animals ranging from minimally 6 to maximally 9 meters in total length. The marked disparity in size may have taxonomic significance, although this is difficult to assess given the small number of known pliosaur specimens. We acknowledge the seemingly problematic issue of two closely related sympatric top predators in the Cretaceous Seaway. However, we note the modern example of the killer whale Orcinus orca, a modern marine apex predator once thought to constitute only a single species, but now widely recognized to contain two or distinct subgroups which have overlapping ranges but avoid each other and do not interbreed. Thus, although unusual, sympathy of two pliosaurs in the Turonian sea should not be considered unique.

Technical Session IV (Wednesday, October 17, 3:30 pm)

MOLECULAR EVIDENCE FOR ENDOGENEITY OF DINOSAUR OSTEOCYTES

Schweitzer, Mary H., North Carolina State University, Raleigh, NC, United States; Cleland, Timothy P., North Carolina State University, Raleigh, NC, United States; Zheng, Wenxia, North Carolina State University, Raleigh, NC, United States; Bern, Marshall, Palo Alto Research Center, Palo Alto, CA, United States

The discovery of soft, transparent structures in dinosaur bone consistent in morphology with osteocytes was controversial. We hypothesize that, if original, these microstructures will have molecular features in common with extant osteocytes. We present immunolological and mass spectrometry evidence for preservation of proteins comprising extant osteocytes (Actin, Tubulin, PHOX, Histone H4) in osteocytes recovered from two non-avian dinosaurs. Furthermore, antibodies to DNA show localized binding to these microstructures, which also react positively with DNA intercalating stains propidium iodide (PI) and 4′,6′-diamidino-2-phenylindole dihydrochloride (DAPI). Each antibody binds dinosaur cells in patterns that are consistent with DNA in dinosaur cells, supporting the hypothesis that these structures were part of the once living animals. We propose mechanisms for preservation of cells and component molecules, and discuss implications for dinosaurian cellular biology.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

NEW INFORMATION OF THE EVOLUTION OF THE SHOULDER GIRDLE AND FORELIMBS OF FOSSORIAL MOLES

Schweitzer, Achim H., Steinnmann Institut, Bonn, Germany

The forelimbs of moles are highly adapted to a fossorial mode of life. Except for humeri, the second Viehhausen-specimen BSP 2008 LI 282 was assigned to Geotrypus montisasini within Scalopini by dental characteristics. The re-examination revealed a supraocular foramen, which is known of Mygalea and extant Desmanini and Scalopini. Reconstruction of the shoulder girdle and forelimb demonstrates that it was a highly fossorial mole with stout clavicle, broad humerus and a wide digging-hand. The holotype of Geotrypus montisasini SMNS 44523 from Ulm (Germany; MN 2) was reassigned as Mygalea jaegeiri to the Desmanini by humeral characters. CT-scans revealed the so far unrecognized manubrium, left clavicle and both scapulae. These bones bear desman-like characters as the supraocular foramen, wide lateral wings at the manubrium and a relatively narrow and elongated clavicle. The reconstruction shows basal, “desman-like” skeletal elements of shoulder and forelimbs. The former assignment of Mygalea to the Desmanini is confirmed.

The second Viehhausen-specimen BSP 2008 LI 282 was assigned to Proscaparus sansaniensis within Scalopini by dental characteristics. The re-examination revealed a supraocular foramen, which is known of Mygalea and extant Desmanini and Scalopini. Reconstruction of the shoulder girdle and forelimb demonstrates that it was a highly fossorial mole with stout clavicle, broad humerus and a wide digging-hand. The holotype of Geotrypus montisasini SMNS 44523 from Ulm (Germany; MN 2a) comprises fragments of toothrows, left humerus, both radii and right ulna and was assigned to Telpini. A number of undescribed bones could now be determined: A proximal fragment of the right humerus, an anterior fragment of the manubrium, a vertebra and a rib. Additionally 17 elements of the manus were found and their positions in the hand were reconstructed. SMNS 43499 from Haslach (Germany; MN 2) was assigned to Geotrypus montisasini based on the humerus. Additionally, a scapula, a radius, and a forth bone, now identified as a clavicle, are articulated to the humerus. The skeletal elements found in both fossile specimens of Geotrypus montisasini were used for a reconstruction of the shoulder girdle and forelimb with parts of the hand.

The length/width-ratio of the clavicles of Proscaparus sansaniensis and Geotrypus montisasini is ≤1 and the metacromion of the scapula is reduced in both species. Similar features are found in extant Scalopini and Telpini. The more basal Telpini Geotrypus antiquus from the Upper Oligocene does not show any of these characters, which indicates a convergent evolution of highly specialised forelimb skeletons within Scalopini and Telpini.

Posters Session I (Wednesday, October 17, 4:15 - 6:15 pm)

DENTAL MORPHOLOGY AND FUNCTION OF DIACODEXIS IN COMPARISON WITH PRIMITIVE ARTIODACTYLA

Schweitzer, Leonie, Steinmann-Institut für Palaeontologie, Universität Bonn, Bonn, Germany; von Koenigswald, Wighart, Steinmann-Institut für Palaeontologie, Universität Bonn, Bonn, Germany

The masticatory cycle of the modern selenodont artiodactyls is relatively uniform and derived with a one-phased power stroke and no centric occlusion. Their teeth, equipped with many sharp cutting edges, are ideal tools for cutting, shearing and grinding of fibrous, plant food. The dentition of Diacodexis, the first known artiodactyl, is distinctly different in morphology and function compared to the selenodont dentition of modern artiodactyls. Therefore the masticatory cycle of Diacodexis was investigated, in order to understand the evolution of the tooth pattern and the linked functional differences in mastication among the artiodactyls.

Diacodexis occurs in the lowest Eocene and has a primitive bunodont dentition with triangular upper molars and six cusped lower molars. In contrast to most other artiodactyls it has only three main cusps and no hypocone. The masticatory cycle was reconstructed by the orientation of enamel facets and the direction of striations on their surface. The results show a two-phase cycle, with Phase I and Phase II separated by centric occlusion. It combines a cutting function in Phase I and a crushing function during centric occlusion and Phase II. While the sharp, w-shaped ridges of the buccal cusps of the upper molars are suitable for breaking up leaves, the rather blunt lingual proteocine is useful for crushing brittle food items like fruits, nuts or seeds. Investigations based on digital 3D models of dentitions of Diacodexis show that the facets, that are developed during the cutting function occupy a higher percentage of the occlusal surface than the facets of the crushing function. Thus, it can be concluded that the proportion of leaves in the diet was relatively higher than the proportion of fruits, seeds or nuts. During the Eocene the artiodactyls diversified into several lineages, which show more derived bunoseolenodont or selenodont dentitions with differences in crown morphology and cusp pattern. Primitive members of the Orebontidaee, the Agriotheriidae, have a bunoseolenodont dentition with quadriruberticular molars. Their more derived relatives, the Orebontidae, have a completely selenodont dentition. The Anthracotheriidae show five cusped bunoseolenodont upper molars with three cusps in the anterior part of the teeth. In comparison the Cynotheriidae, a European endemic group, show selenodont molars, which are also five cusped but with three cusps in the posterior part of the teeth. In these groups the fundamental differences of the chewing cycle are unresolved. Based on the Diacodexis study further investigations will follow concentrating on the modification of the masticatory cycle during artiodactyl evolution.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleocology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 8:45 am)

LATE CRETACEOUS (MID-CAMPAIGN) VERTEBRATES OF THE HANNAHATCHEE CREEK SITE, WESTERN GEORGIA, A NEARSHORE MARINE BONE BED AT THE ATLANTIC/GULF TRANSITION

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During the Late Cretaceous, absent the Florida Peninsula, the Atlantic and Gulf of Mexico coastlines met in western Georgia. Campanian fossiliferous marine strata is exposed in westernmost Georgia along 2.0 km of Hannahatchee Creek, Stewart County; A 1.0 m bone-beds deposit yields fossils of at least 40 vertebrate taxa, including 29 different fish: sharks, chimaeras and osteichthyes, mosasaurs, plesiosaurs, freshwater and sea turtles, fluvialite and estuarine crocdylomians, five dinosaur taxa, and fragments of pterosaurus. This deposit comprises the stratigraphic boundary between the Blufflow and Cusseta Formations and is dated to the mid-Campanian (Zone of Exogyra erraticostata), also bracketed by nanos- and microfossils to 77.5 +/- 0.5 Myr. The concentrated vertebrate material is commonly ablated, implying that it is woreduced from the underlying unit and transported to the starved marine shelf from offshore concentrates: however, some vertebrate remains are relatively complete and appear to be deposited in situ. The admixture of fossils at Hannahatchee Creek indicates accumulation in a perimarine, distal estuarine environment. The presence of mostly marine taxa and relatively rare terrestrial fauna indicates deposition in near-normal marine salinity. However, the presence of significant non-marine taxa indicates proximity to shorelines or significant fluvial input. Non-marine fauna include an abundance of the gigante estuarine crocodylian Deinosuchus rugosus, as well as other crocodylians, freshwater turtles, riverine/estuarine fish (including gar and sturgeon), and the obviously terrestrial dinosaurs. Additional indicators of proximity to the paleo-shoreline include Teredo-bored, coalified wood, and storm-runoff beds below.
the lag deposit. Nevertheless, the common clams, snails, ammonites, sharks, and marine osteichthyes (e.g. Xiphactinus vetus, Anomoeodus phaseolus, Protostega sp., Enchodus perrotti) in the assemblage indicate normal marine environments. In contrast to most Atlantic Coastal Plain Cretaceous deposits, the dinosaur assemblage is relatively sparse and no major taxa have been identified to date, which may reflect a relatively deeper water environment than more northerly sites, or a lack of time and depth of study. However, the site has provided some correlations between Gulf/Western Interior and Atlantic biota, and is the type area for the slerorhynchid sawfish Borodinopristis. It also has provided the fossils indicating Xiphactinus vetus as a distinct species, and the North American occurrence of the African fishes Squalicorax yangicensis and Phacodus punctatus.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

LATE PLEISTOCENE EQUUS AND BISON FROM THE TULE SPRINGS LOCAL FAUNA, UPPER LAS VEGAS WASH, CLARK COUNTY, NEVADA

SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States; SPRINGER, Kathleen, San Bernardino County Museum, Redlands, CA, United States; MANKER, Craig R., San Bernardino County Museum, Redlands, CA, United States

Late Pleistocene ground water discharge deposits in the Upper Las Vegas Wash outside of Las Vegas, Nevada have yielded an abundant and diverse vertebrate fossil assemblage, named the Tule Springs local fauna. The San Bernardino County Museum has documented over 500 discrete localities from the Las Vegas Formation in this region. Stratigraphically ascending units A-E from this formation span as much as the last 225 Ka; most of these units have yielded fossils. The recovered fauna includes relatively common remains of extinct Equus and Bison. Fossils of Equus are well represented in the megafaunal sample; however, the material is not sufficiently complete to enable confident species assignments. Nevertheless, based upon body size as inferred from measurements of postcranial elements, three species of horse can be discerned in the fauna. Large and small stout-legged forms are clearly present, while some fossils suggest the additional presence of a small stilt-legged species. This latter assessment is buttressed by the occurrence of late Pleistocene small stilt-legged horses from the geographically proximate Gypsum Cave locality just outside of Las Vegas. The presence of three species of horse in the Las Vegas region at the end of the Pleistocene differs markedly from the present-day global distribution of equid species, where generally only one equid species occurs in a geographic region at any one time. Further, the presence of three equal species in the Tule Springs local fauna contrasts with recent molecular studies suggesting that only two horse lineages may have been present in late Pleistocene North America. The discrepancy may be traced to the limited sample size of the available genetic data.

The Tule Springs local fauna also contains the oldest and youngest reliably dated occurrences of Bison in the Mojave Desert and the southern Great Basin. Fossils of a long-horned form similar to Bison latifrons, as well as a smaller form in the size range of B. antiquus, are interpreted to derive from unit B3, the formation, which dates to ~47 Ka. Fossils assigned to B. antiquus are also known from unit E of the Las Vegas Formation, directly associated with a radiocarbon date of 14.78 Ka. These records effectively delimit the Rancholabrean North American Land Mammal Age in this critical region of the American southwest.

Previous studies proposed that remains of small horses were only present in the latest Pleistocene unit E, of the Las Vegas Formation, while fossils of bison were confined to the older unit B3. Our findings confirm neither of these interpretations, as newly-discovered fossils reveal that both small horses and bison are present throughout the exposed sequence. In fact, the presence and relative abundance of Bison in the youngest sediments is consistent with the record of this genus throughout the Mojave Desert and the American southwest, although this distribution differs markedly from conclusions reached by molecular studies suggesting a sharp decline in the abundance of North American bison after 25 Ka. Here, too, the disagreement may result from the somewhat limited genetic material available from late Pleistocene Bison in the American southwest.

Technical Session XVII (Thursday, October 18, 1-4:55 pm)

PHENOSCAPE: A NEW ANATOMICAL ONTOLOGY OF VERTEBRATES

SEROINO, Paul E., University of Chicago, Chicago, IL, United States; IBRAHAM, Nizar, University of Chicago, Chicago, IL, United States; MABEE, Paula M., University of South Dakota, Vermillion, SD, United States; VISION, Todd J., University of North Carolina, Chapel Hill, NC, United States; LAPP, Hilmar, National Evolutionary Synthesis Center, Durham, NC, United States

A recent explosion of anatomical, genetic and taxonomic information on vertebrates has led to major efforts to organize this data in ontologies and to make observable descriptions of phenotypes machine readable using semantic similarity tools. This has culminated in a large scale multidisciplinary, multi-million-dollar project, with the aim of creating an online, definition enabled, image linked and reference hyperlinked database – called Phenoscape. This multidisciplinary National Science Foundation project involves workers from the fields of bioinformatics, comparative anatomy and model organism research and pushes the boundaries of Anatomical Ontologies in three major areas. Firstly, it will allow users to search and compare phylogenetic and anatomical data, thus making divergent and inconsistent morphological data from character matrices testable and comparable. This is achieved by turning free text descriptions into machine understandable statements that can be compared. Secondly, using data from model organisms (zebrafish, frog, mouse), Phenoscape connects genomic and morphological data, opening avenues for research on the underlying causes of major anatomical transitions in the fossil record. At its current stage, the Phenoscpe project focuses on the fin-limb transition and the Anatomy Ontology mostly contains fish, amphibian

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The late Eocene (55-48 Ma) fossil deposits of the Green River Formation have produced tens of thousands of complete fossil fishes but very few other vertebrates. We report here on the phylogenetic affinities of a virtually complete skeleton of a new and as yet unnamed fossil bird (Royal Ontario Museum [ROM] 52665) from these deposits. We scored anatomical character states for ROM 52665 based on recently published phylogenetic matrices of stem parrots. Parsimony ratchet analysis based on 29 taxa and 105 characters recovered five most parsimonious trees with 243 steps in support of currently established clades of stem and crown parrots. Based on a strict consensus tree, ROM 52665 clusters within the stem parrot family Halcyornithidae. The placement of this new avian specimen from Wyoming within Halcyornithidae is supported by at least two shared characteristics: relatively elongate and curved humerus shaft and absence of the completely enclosed canals intersosseous distalis of the tarsometatarsus. The position of the new specimen remains unresolved with the family, however, thus this is equally closely related to Pulchropollia, Pseudasturidæ, Serudaptus, and Cyrilavis. ROM 52665 and Pseudasturidæ are both characterized by a rostrum of approximately one-third of the skull length, while the new ROM specimen shares a cup-shaped cotyla scapularis of the coracoid with Cyrilavis. In addition to similarities in relative wing and leg proportions with Pseudasturidæ and Pulchropollia, ROM 52665 also shows the presence of both medial and lateral foramina vascularia proximalis on the tarsometatarsus. Cyrilavis, Serudaptus and ROM 52665 have relatively long pedal unguals in common. In addition to shared features with members of the Halcyornithidae, ROM 52665 exhibits the following unique characteristics within the clade: lack of projection of processus supraorbitalis above the orbit and wide separation of temporal fossa on the dorsal surface of the skull. These characters are currently unknown in some members of the Halcyornithidae. Only when more material is found for the previously known genera, especially Pulchropollia, will the relationships within the family be potentially resolvable. Although the relationships within Halcyornithidae remain poorly resolved, this new bird from the Green River Formation provides more resolution for previously unknown characters within the family, such as the number of cervical vertebrae.
Cranial Anatomy of Paleogene Microsophyidae (Mammalia, Euarchonta) and Its Relevance to Understanding Euarchontan Relationships

Silcox, Mary T., University of Toronto, Scarborough, Toronto, ON, Canada; Block, Jonathan J., Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; Gunnell, Gregg F., Duke Lemur Center, Durham, NC, United States

The Microsophyidae are extinct mammals from the late Paleocene-middle Eocene of North America and the late Paleocene of Europe usually included in the “Plesiadapiformes.” While results from several recent phylogenetic analyses suggest affinities among stem primates, specific relationships relative to the most primitive members of primates are unresolved. Two undescribed specimens clarify previous interpretations of the cranial anatomy and allow for a reconsideration of the relationships of the family. The specimens are from the middle Eocene and include a nearly complete cranium of Microsopsys auctus (UW 12362), previously mentioned but never described; the best preserved for the family, and for any “plesiadapiform”) from Wyoming and a more fragmentary specimen of Microsopsys kratos (SDMNH 47729) from California that preserves part of the roof of the middle ear cavity which is damaged in all other microsophyd crania, clarifying the pathway of the facial nerve. The basicranial anatomy of microsophyids is generally very primitive featuring: 1) a transpromontorial groove for an unreduced internal carotid artery (ICA) entering the middle ear posteromedially; 2) grooves for both stapedial and promotorial arteries; 3) a foramen facialis that opens into the middle ear cavity, with the accessory nerve exiting the ear through a stylomastoid foramen pugnaceum; 4) a small postglenoid foramen that appears in the most primitive placental mammals. The lack of clear euarchontan postorbital process and a large, rugose mastoid process. In sum, the basicranial anatomy of microsophyids is only the second confident record of a scincomorph, falling out as a basal member of the clade Lacertoidea+Cordyliformes, in a sister group relationship to Squamata. The position of MN 7234-V is only the second confident record of a scincomorph from South America and the first one for the Early Cretaceous of that continent, making this the oldest record of a Gondwanan scincomorph from outside Africa. This is evidence that scincomorphs had an older and wider geographic distribution in Gondwanan continents than previously known.

Giant Theropod Eggs from the Albian-Cenomanian Wayan Formation of Idaho: Taxonomic, Paleogeographic and Reproductive Implications

Simon, D., University of Texas at Austin, Austin, TX, United States; Varricchio, David J., Montana State University, Bozeman, MT, United States; Jackson, Frank D., Montana State University, Bozeman, MT, United States; Robinson, Steve, Caribou-Targhee National Forest, Idaho Falls, ID, United States

Elongatoolithid eggs, previously known only from Asia, are often associated with embryonic or adult skeletal remains of oviraptors. These eggs are typically small, elongate, and occur in ring-shaped clutches of up to three layers. Moderate gas conductance values suggest partial burial during incubation, and associated adults are interpreted as having died while protecting or brooding the clutch. Eggs of the oogenus Macroelongatoolithus are unique within Elongatoolithidae due to their extreme size and elongation, and are the largest non-avian dinosaur eggs known. Eggs as large as 52 cm long in isolated, single-layered circular clutches with a diameter of up to 2.1 m. Preliminary gas conductance rates and exceptional size of the eggs, circular egg arrangement, and potential egg-layer raise questions about incubation of Macroelongatoolithus eggs.

Here we describe a pair of large eggs from the mid-Cretaceous Wayan Formation of Idaho. The eggs were excavated from mudstone and claystone with bands of small nodular development and rare thin beds of fine sandstone. Eggshell fragments were collected in addition to a pair of eggs measuring 38 cm long, 9 cm wide at the equator, with an average shell thickness of 1.8-2.2 mm. Ornamentation varies from dispersed tuberculate to the poles to linear tuberculate at the equator, and ramotuberculate in between. The mammillar layer to continuous layer ratio is 1:5, and prisms of the continuous layer show a woven appearance under cross polars. These features place the specimen firmly within Macroelongatoolithus, within the oofam-ily Elongatoolithidae. Significantly, this specimen represents the first intact elongatoolithid material known from North America and the first egg material of any kind known from the Lower Cretaceous of the continent. Gas conductance was estimated from tangential thin sections using Image J software to measure total pore area and pore length, assuming a temperature of 25°C. Preliminary gas conductance values, estimated for surface collected eggshell from Wayan locality, are lower than those previously calculated for other Macroelongatoolithus specimens. The Wayan eggs are paired, similar to within-clutch egg pairing seen in Chinese macroelongatoolithid specimens and in smaller oviraptorid clutches. Given the strong link between elongatoolithid eggs and oviraptors, the presence of Macroelongatoolithus in North America provides the first evidence for the occurrence of an extremely large oviraptorid outside of Asia. Additionally, this discovery implies that oviraptorids were present in North America at an earlier date than initially presumed. Sedimentology of the Wayan material suggests the egg-layer was nesting on a floodplain, however, incubation strategies for Macroelongatoolithus remain unclear.

Representing Extant Monotreme Diversity Effects Phylogenetic Results of Extinct and Crown-Group Mammals

Simon, Rachel V., The University of Texas at Austin, Austin, TX, United States

Relationships among extinct mammals from the Southern Hemisphere, and the relationships of those taxa to extant monotremes, are highly contentious. One hypothesis groups all fossil mammals from the Southern Hemisphere into a monophyletic taxon, Australosphenida, of which crown monotremes are the surviving members. Another hypothesis is that fossil mammals from the Southern Hemisphere are more closely related to placental mammals, and monotremes are a distinct clade with only a few extinct relatives. This conflict is due in part to a poor fossil record where many extinct species are known only from jaw fragments and isolated molars. Another source of complication is a lack of data from extant monotremes. Phylogenetic analyses only included Ornithorhynchus anatinus and/or Tachyglossus aculeatus to represent Monotremata, excluding the most speciose living monotreme, Zaglossus. To test the effects of monotreme diversity in a phylogenetic analysis, a published matrix of mammalian taxa was modified so that the two monotreme genera (O. anatinus and T. aculeatus) used in the analysis were collapsed into a supraspecific taxon. Variation between the two genera was scored as polyphyletic. The result split Australosphenida as polyphyletic with several australosphenidans positioned closer to therians. Additionally, resolution within Monotremata decreased when supraspecific terminals were used. Specifically, Stereodon and Oxburredon alternated positions as sister taxa to Crown Monotremata, whereas Oxburredon consistently is the sister taxa to O. anatinus in analyses using species exemplars. This test demonstrates that representation of extant monotreme diversity with species exemplars increases resolution between extinct and extant monotremes. Furthermore, these results show that clades from the published phylogeny are not supported strongly and that the amount of monotreme diversity represented in an analysis affects the topology of trees that incorporate fossil mammals.
MEASURING SPECIES SELECTION IN THE MOLECULAR PHYLOGENETIC RECORD
SIMPSON, Carl, University für Naturkunde, Berlin, Germany
Understanding historical patterns of diversity dynamics is of paramount importance for many evolutionary questions. The fossil record has long been the only source of information on patterns of diversification, but the molecular record, derived from time-calibrated molecular data to study macroevolutionary processes. For example, the magnitude and direction of species selection–differential diversification of species with varying molecular phylogenetic data in seleractinian reef coral species. Despite precise estimates of the magnitude of the molecularly derived diversification rates, the temporal patterns observed in the fossil and molecular records are highly calibrated. The result permits the use of temporal patterns in molecular phylogenetic data to study macroevolutionary processes. For example, the magnitude and direction of species selection–differential diversification of species with varying characteristics can be directly measured from the temporal patterns of diversification rates. In corals, species selection acts in opposite directions for coloniality and against photosynthetic endosymbiosis and overpowers cladogenetic and anagenetic changes in both traits.

LOCOMOTOR FORCES AND STRESS IN THE METAPODIA OF ADULT ORSTICH STRUTHIO CAMELUS AND JUVENILE ALBERTOSAURUS SARCOPHAGUS (TYRANNOSAURIDAE): CORRELATING ANATOMY, DYNAMICS AND FINITE ELEMENT ANALYSIS
SISSONS, Robin, Grand Prairie Regional College, Grand Prairie, AB, Canada; GILBERT, Meagan, University of Saskatchewan, Saskatoon, SK, Canada; SNIVELY, Eric, Ohio University, Athens, OH, United States
Three-dimensional finite element analysis (FEA) is potentially informative about locomotor stresses and performance limits in insectivores. Juvenile and adult tyrannosaurid dinosaurs are intriguing candidates for such analyses, with proportional longer limbs indicating higher muscularity compared to other large theropods. Context from extant relatives is critical for understanding methodological limits and applying biological interpretations of FEA to extinct forms. Fortunately, a wealth of anatomical, kinematic, and force data for extinct ostriches (Struthio camelus) enables grounding and refinement of FEA for studies of extinct theropods. CT, FE, and dynamics methods were integrated to compare data from Struthio with those for a tyrannosaurid of similar body mass, a juvenile Albertosaurus sarcophagus from Dry Island Provincial Park, Alberta.

The limbs of Struthio and Albertosaurus were CT scanned, to examine densities and construct biomechanical models. The program OsirX facilitated interpretation of internal structure and density. Mimics and Avizo enabled the construction of finite element models for analyses in Strand7. Quasi-static models, in 3D and simplified to the sagittal plane, estimated ankle extensor force necessary to counteract ground reaction force for a slow run (Struthio: 2453 N; Albertosaurus: 1515 N) at a mid-stance posture. These forces were used for FEA, with the metatarsus constrained at the ankle joint. Custom MATLAB programs independently calculated joint and ground reaction forces, and extensor tensions, through similar stance phase kinematics in both taxa.

Results reveal utility and limitations of FEA for studies of extinct taxa. Force magnitudes at the constraints were similar to the MATLAB-simulated joint reaction forces, suggesting the promise of FEA for estimating joint forces (similar to its use for bite/food reaction forces in feeding studies). Stress magnitudes varied little between sagitally-restricted and 3D force models for the metapod. However, errors in patterns of stress distribution are likely to be greater for more proximal elements, which deviate mediolaterally from a vertical orientation more than the metatarsus. An internal remnant of fusion between metatarsals III and IV likely resists compression in the ostrich. Finally, relative to body mass, the juvenile Albertosaurus specimen required lower extensor tension to maintain a given ankle posture than in the ostrich, suggesting the ability to impart greater angular acceleration to its metatarsus with less energy expenditure.

FOSSILS, PHYLOGENIES AND MODELS OF QUANTITATIVE TRAIT EVOLUTION
SLATER, Graham J., University of California, Los Angeles, Los Angeles, CA, United States
Evolutionary biologists are increasingly interested in assessing the fit of explicit macroevolutionary models to phenotypic data. By identifying the best-fitting model of trait evolution, such as an early burst of evolution or a biased random walk, evolutionary biologists can test explicit hypotheses regarding the tempo and mode of evolution in their clade of interest. A significant barrier to implementing these methods in palaeontological studies is the requirement of a resolved, time-calibrated phylogeny; as we often only have independently calculated joint and ground reaction forces, and extensor tensions, through similar stance phase kinematics in both taxa.

Results reveal utility and limitations of FEA for studies of extinct taxa. Force magnitudes at the constraints were similar to the MATLAB-simulated joint reaction forces, suggesting the promise of FEA for estimating joint forces (similar to its use for bite/food reaction forces in feeding studies). Stress magnitudes varied little between sagitally-restricted and 3D force models for the metapod. However, errors in patterns of stress distribution are likely to be greater for more proximal elements, which deviate mediolaterally from a vertical orientation more than the metatarsus. An internal remnant of fusion between metatarsals III and IV likely resists compression in the ostrich. Finally, relative to body mass, the juvenile Albertosaurus specimen required lower extensor tension to maintain a given ankle posture than in the ostrich, suggesting the ability to impart greater angular acceleration to its metatarsus with less energy expenditure.

Technical Session XVI (Saturday, October 20, 12:00 pm)
STABLE OXYGEN AND CARBON ISOTOPES RECORD SEASONAL VARIATION IN DRINKING WATER AND DIET OF MODERN LARGE HERBIVORES IN AMBOSELI NATIONAL PARK, KENYA
SMILEY, Tara M., University of Michigan, Ann Arbor, MI, United States; BADGLEY, Catherine, University of Michigan, Ann Arbor, MI, United States; BEHRENSMEYER, Anna K., National Museum of Natural History, Washington, D.C., DC, United States
Mammals living in seasonal habitats experience changes in environmental variables such as temperature, rainfall, and primary productivity; these changes influence mammalian feeding ecology, social behavior and timing of reproduction. Over evolutionary time, seasonal environmental variation can influence natural selection on mammalian life histories. Incremental deposition of tooth enamel records the seasonal variation in isotopic composition of water and diet ingested by mammals over time; hypsodont teeth can record an entire year. Intra-tooth variation along the growth axis of teeth thus tracks seasonal changes in the isotopic composition of drinking water as well as seasonal variation in diet due to vegetation availability or water stress. From a large sample of adult malaran collected between 1975 and 2010, we evaluated the seasonal isotopic record of enamel in zebra and wildebeest from Amboseli National Park in Kenya, a semi-arid, seasonal savanna ecosystem. During the time of year inferred as the rainy season, the enamel record reflects the seasonal precipitation signal, becoming gradually depleted in 18O as the season progresses due to the amount effect. Conversely, the dry season is represented in enamel by increasing 18O values through time. Seasonal variation in 18O is on average 2.1 permil (n=10 individual teeth), which is characteristic of mammalian feeding ecology, social behavior and timing of reproduction. Over evolutionary time, seasonal environmental variation can influence natural selection on mammalian life histories. Incremental deposition of tooth enamel records the seasonal variation in isotopic composition of water and diet ingested by mammals over time; hypsodont teeth can record an entire year. Intra-tooth variation along the growth axis of teeth thus tracks seasonal changes in the isotopic composition of drinking water as well as seasonal variation in diet due to vegetation availability or water stress. From a large sample of adult malaran collected between 1975 and 2010, we evaluated the seasonal isotopic record of enamel in zebra and wildebeest from Amboseli National Park in Kenya, a semi-arid, seasonal savanna ecosystem. During the time of year inferred as the rainy season, the enamel record reflects the seasonal precipitation signal, becoming gradually depleted in 18O as the season progresses due to the amount effect. Conversely, the dry season is represented in enamel by increasing 18O values through time. Seasonal variation in 18O is on average 2.1 permil (n=10 individual teeth), which is characteristic of mammalian feeding ecology, social behavior and timing of reproduction. Over evolutionary time, seasonal environmental variation can influence natural selection on mammalian life histories. Incremental deposition of tooth enamel records the seasonal variation in isotopic composition of water and diet ingested by mammals over time; hypsodont teeth can record an entire year. Intra-tooth variation along the growth axis of teeth thus tracks seasonal changes in the isotopic composition of drinking water as well as seasonal variation in diet due to vegetation availability or water stress.
a nearly exclusive C4 diet, with low seasonal variation (1 per mil). δ13C values change inversely with δ18O values over the annual cycle for all individuals sampled. Decreasing carbon isotopic composition of tooth enamel could indicate a shift in dietary content from the wet to the dry season or a seasonal shift in δ13C values of the C4 vegetation itself. Stable isotopic studies on modern species provide fundamental insights for reconstructing the ecology of extinct mammals and discovering the influence of seasonal changes on Cenozoic mammalian lineages and faunas.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

A NEW RHOMALEOSAURID PLIOSAUR FROM THE SINEMURIAN (LOWER JURASSIC) OF LYME REGIS, ENGLAND SMITH, Adrian S., British Geological Survey, Nottingham, United Kingdom; ARAÚJO, Ricardo, Southern Methodist University, Dallas, TX, United States

An excellently preserved partial skeleton of a rhomaleosaurid pliosaur (Sauropterygia: Plesiosauroidea) from the Sinemurian (Lower Jurassic) of Lyme Regis, England, consists of a complete cranium, mandible, and articulated cervical vertebral column. The material is taxonomically distinct and its occurrence is noteworthy because pliosaurids are rare from this stratigraphic horizon. The new taxon is diagnosed by a single autapomorphy: a pronounced pit on the posterior margin of the dorsal ramus of the squamosal. It also possesses the following unique combination of characters: premaxillary rostrum short (length and width subequal), five teeth in the premaxilla, premaxilla-maxilla sutures parallel anterior to the external nares, frontals contact on the midline, prefrontal-frontal-suture convex and gently curved medially, mandibular symphysis region spatulate and short (length and width subequal), robust rod-like axis neural spine with a circular transverse cross section, and cervical neural spines with a laterally expanded apex. The taxon shares some characters with older (Hettangian) rhomaleosaurids (e.g. *Rhomaleosaurus* megacephalus), and other characters with younger (Toarcian) rhomaleosaurids (e.g. *Rhomaleosaurus sensu stricto* and *Meyerasaurus*), and it is therefore morphologically and proportionally intermediate between these two groups.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

A RECONSIDERATION OF THE STATUS OF THE UPPER JURASSIC PTERODACTYLOID PTEROSAUR *MESADACTYLES ORNITHOSPYS* FROM THE MORRISON FORMATION OF COLORADO SMITH, David K., Northland Pioneer College, Show Low, AZ, United States; HARRIS, Jerry D., Dixie State College, Saint George, UT, United States

Pterosaurian fossils from the Upper Jurassic Morrison Formation remain fragmentary and poorly known. In the 1980s, a small synsacrum from Dry Mesa Dinosaur Quarry, Mesa County, Colorado, was proposed for the holotype for the new pterodactyloid pterosaur species *Mesadactyles ornithospys*. A number of disarticulated cranial and postcranial elements subsequently have been referred to the same taxon.

Although the referred postcranial material is certainly pterodactyloid, the synsacrum would constitute an extremely unusual element for a pterosaur. It consists of a series of fused sacral vertebrae with prominent, distally fused neural spines that dramatically decrease in height posteriorly. The vertebrae also become minute posteriorly, indicating that this animal could not have had an extensive or large tail. Micro-CT scans failed to recover any evidence of vertebrae with prominent, distally fused neural spines that dramatically decrease in height.

Principal components analysis (PCA) was conducted to compare EFT M3s to those of *E. recki* and *L. atlantica* described in the literature. Variables used in the PCA were those not substantially affected by tooth incompleteness: height, width, enamel thickness, and average lamellae thickness (a measurable reflectance of lamellar frequency). The first principal component sorted individuals by species and showed that the newly recovered M3 was more similar to *L. atlantica* than to *E. recki*, but species assessment based on PCA was unreliable because the distinction between species was unclear on the first or any axis. Qualitative criteria may be more useful for identifying species based on molars; for example, *E. recki* exhibits irregular enamel folding, usually not present on *L. atlantica* and not present on EFT molars. Overall, there is little reason to revise taxonomic assignment of EFT specimens or to refer the new molar to *E. recki*. However, if not for geographic differences and based on molar criteria, *E. recki* and *L. atlantica* might be described as members of the same genus.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

DEMENT WEAR AND LAMELLAR FREQUENCY ANALYSIS TO CONSTRAIN THE IDENTITY OF THE NORTH AMERICAN MAMMOTH SPECIES SMITH, Gregory J., Penn State University, University Park, PA, United States; GRAHAM, Russell, Penn State University, University Park, PA, United States

A mammoth skeleton found at the Newton Site, a kettle lake 15 km southeast of Towanda, Pennsylvania, has been referred to *M. columbi* on the basis of its high, narrow skull. However, the specimen’s thin enamel (1.5 mm) and moderately high lamellar frequency (9 plates/decimeter) resemble some specimens of *M. primigenius*, as well. Maps from the Neotoma database show that a Columbian mammoth inhabiting the Towanda area would be a significant outlier from the general geographic range (western US and Gulf Coast area from Florida to Texas) for this species. This record would suggest that *M. columbi* inhabited a broader range of environments than previously presumed. However, if the specimen was in reality *M. primigenius*, its location, 50 km north of the Olean drift border, would align well with the Woolly mammoth’s range.

To better ascertain the Newton mammoth’s identification, we examine herein the effects of dental wear on the morphology of mammoth teeth, especially enamel thickness and lamellar frequency. Sagittal sections of mammoth teeth reveal the tendency for enamel lobes to become more broadly spaced and enamel ridges to thicken towards the base of the crown.

Thus, an older *M. primigenius* with extensively worn molars might display thicker enamel and a lower lamellar frequency, and might therefore appear to be a Columbian mammoth on the basis of dental morphology alone. Here, we conduct an analysis of numerous *M. columbi* and *M. primigenius* molars at various stages of dental wear to determine if this phenomenon has played a role in determining the species identification of the Newton mammoth.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

PROBLEMATIC IDENTIFICATION OF PROBOSCIDES FROM THE MIDDLE PLEISTOCENE PALEONTOLOGICAL/ARCHAEOLOGICAL LOCALITY OF ELANDSFONTEIN (WESTERN CAPE PROVINCE, SOUTH AFRICA) SMITH, Mathy L., Georgia Southern University, Statesboro, GA, United States; STYNDLER, Deano D., University of Cape Town, Cape Town, South Africa

Three proboscidean species inhabited Africa in the middle Pleistocene: *Loxodonta atlantica*, *Loxodonta africana*, and *Elephas recki*. *L. africana* can easily be distinguished from *L. atlantica* and *E. recki* by the broad, lozenge-shaped wear surfaces of its molars. *L. atlantica* and *E. recki* are more difficult to distinguish on the basis of molar characteristics. These two species rarely co-occur in the African fossil record, with *L. atlantica* in northern and southern Africa and *E. recki* in eastern equatorial Africa. Consequently, taxonomic assignment of isolated molars from these species may have been based, in some cases, on geography rather than morphology. *E. recki* (EFT), a middle Pleistocene locality on the west coast of South Africa, has produced hundreds of skeletal elements referred to *L. atlantica*. Among these are 15 complete or nearly complete permanent molars, one of which is newly recovered and has not yet been referred to a species. The last taxonomic revision of EFT proboscidean material was done in the 1970s, and additional material has been recovered since then, so an updated assessment could yield new insights into the biogeography and evolutionary history of middle Pleistocene African elephants. With this goal in mind, standard molar characteristics (crown height, width, length, enamel thickness, lamellar frequency, number of enamel plates, and hypsodonty index) were recorded for EFT molars, and characteristics of M3s (n=5) were evaluated against diagnostic characteristics for *L. atlantica* and *E. recki*. EFT molars were in general more similar to *L. atlantica* than to *E. recki*, but they exhibited features of both species and could not definitively be assigned to one. Principal components analysis (PCA) was conducted to compare EFT M3s to those of *E. recki* and *L. atlantica* described in the literature. Variables used in the PCA were those not substantially affected by tooth incompleteness: height, width, enamel thickness, and average lamellae thickness (a measurable reflectance of lamellar frequency). The first principal component sorted individuals by species and showed that the newly recovered M3 was more similar to *L. atlantica* than to *E. recki*, but species assessment based on PCA was unreliable because the distinction between species was unclear on the first or any axis. Qualitative criteria may be more useful for identifying species based on molars; for example, *E. recki* exhibits irregular enamel folding, usually not present on *L. atlantica* and not present on EFT molars. Overall, there is little reason to revise taxonomic assignment of EFT specimens or to refer the new molar to *E. recki*. However, if not for geographic differences and based on molar criteria, *E. recki* and *L. atlantica* might be described as members of the same genus.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

REGIONAL PATTERNS OF MODERN SYMPATRY IN NORTH AMERICAN QUATERNARY MAMMAL FAUNAS SMITH, Michael R., Indiana University, Bloomington, IN, United States; POLLY, David, Indiana University, Bloomington, IN, United States

The temporal and regional responses of past faunas to Quaternary climate cycles provide important insights for how biotas respond to changing climates and environments. We used cluster analyses, digital range data for modern mammals, and digital climate data to determine whether faunal similarity from 27 Quaternary sites in North America was affected by site age, past climate, or biogeographic region. Cluster analysis using the Raup-Crick index was used to categorize sites based on the similarity of their mammalian faunas. Areas of maximum modern sympathy for the extant species at each site were quantitatively identified using the modern geographic. Areas of sympathy were found by counting the number of modern species shared at each 50 km grid point in North America. The climate associated with the areas of maximum sympathy were located using the digital climate data for North America (1960-1990 average). Rectilinear climate envelopes were constructed for the points with maximum sympathy using the minimum and maximum values for MAT and total annual precipitation from those points. Faunas clustered into four groups, which separate first on regional basis and secondarily on a climatic basis. The first cluster contained sites whose extant species were largely sympatric in the area of the site, the second cluster contained sites whose extant species are today sympatric in the northeast Ural Mountains or north of the Great Lakes, the third cluster contained a mixture of species that are today sympatric in the great plains or greater midwest, and the fourth with species that are today sympatric in the inter-montane west. The east extent of the faunas were highly predictive of this pattern despite the wide variety of ages, paleoclimates, and proportions of extinct fauna at the sites. Local climate and/or other geographic range controllers were mixed in these continental scale patterns indicating a need for understanding faunal dynamics on a regional scale.

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VARIATION IN THE ENDOCRANIAL ANATOMY OF THE CHARADRIIFORMES (AVES): SENSORY SYSTEM EVOLUTION ASSOCIATED WITH THE TRANSITION TO WING-PROPELLED DIVING

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Just as osseous features can provide clues regarding the behavior of extinct vertebrates, evaluation of soft endocranial tissues provides a means of making comparisons between extinct taxa and extant taxa. New data from taxa such as the Early Jurassic Avimorphae and a selection of other Early Jurassic vertebrates, including ornithischians, indicates that the brain shape of the early avian ancestor was similar to that of extant birds. The preservation of the endocranial anatomy of the Early Jurassic vertebrates allows for the first time the study of the brain morphology in this key group of avian fossils. The results from this study provide valuable information about the evolution of the brain and its implications for the understanding of the evolutionary relationships among early avian lineages.

Digital endocasts were rendered for 17 charadriiforms (15 extant and 2 flightless, extinct species). Mapping of character state changes onto a well resolved phylogeny for Charadriiformes resulted in the recognition of differences between the endocranial anatomy of wing-propelled diving Pan-Alcidae and other charadriiforms, distinctions between flightless and volant pan-alcids, and identification of characters that differentiate terrestrial and aquatic charadriiforms. In comparison with other charadriiforms, pan-alcids displayed compressed semicircular canals, indistinct occipital sinus, and indistinct cerebellar fissures. Flightless pan-alcids have relatively smaller optic lobes and more laterally expanded anterior wulsts than those of volant pan-alcids. Aquatic charadriiforms are differentiated from terrestrial species by the possession of more vertically oriented brains, wulsts that are more anteroposteriorly expanded, posteriorly expanded endocranial sinuses, and multibody endocasts with multibody lines of action. Furthermore, phylogenetic affinity of the enigmatic fossil taxon Halyornis is unlike that of any other sampled charadriiform. The implications for the evolution of the avian brain have been updated through comparisons with charadriiforms and outgroup taxa. Finally, based on these new morphological data and comparisons of relative brain volume, evaluation of hypotheses regarding charadriiform genome size and its relation to flightlessness, gregariousness, flight capability, and developmental strategy were facilitated.

FEEDING MOTIONS IN ALLOSAUROUS (DINOSAURIA: THEROPODA): MULTIBODY DYNAMICS OF THE CERVOCEPHALIC APPARATUS SUGGESTS RAPID LATERAL STRIKES BUT SAGITTAL PREY DISMEMBERMENT

SMITHEY, Eric, Ohio University, Athens, OH, United States; COTTON, John R., Ohio University, Athens, OH, United States; RIDGELY, Ryan C., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States

Allosaurus was the most common and widespread large predatory theropod dinosaur from the Morrison Formation (154-148 Ma). Tooth marks and pathologies suggest that Allosaurus was a generalist carnivore, feeding on diverse prey. Finite element studies have revealed much about its skull biomechanics, but little work has quantified feeding motions of the head and neck. We tested hypotheses of predation and feeding motions in Allosaurus with multibody dynamics simulations of a well-preserved specimen’s head and neck, using the software OpenMDADAMS. CT scanning and soft-tissue reconstruction established the two previous full-model inertial properties, joints, and muscle forces to a CT-based model of the skull and cervical vertebrae. The skeletal model enabled us to assess range of motion, and to enable forward dynamics (calculating motion from applied forces) through muscle activation. Manipulation of the model constrained possibilities for muscle lines of action.

Parameters such as geometric dimensions, material densities, and interpretation of muscle scars had varying effects on dynamics results. An anatomically complex reconstruction, incorporating sinuses, airspaces, and bone density, had minor effects on mass moments of inertia (MMI) and acceleration compared to a solid model assigned an average soft tissue density. Estimates of muscle diameter had little effect on MMI and centers of mass of neck segments, and therefore on dynamic capabilities. In contrast, acceleration results varied substantially between muscle reconstructions. M. complexus inserting onto the parietals would enable more rapid dorsiflexion than a squamosal attachment, yet still facilitate lateral flexion.

Regardless of these parameter effects, the following dynamics results reveal comparative and intrinsic aspects of Allosaurus feeding. Tentatively contradicting earlier hypotheses, lateral angular acceleration of the head for this Allosaurus specimen was twice as rapid as previously calculated for an adult Tyrannosaurus rex, although dorsiflexive accelerations were similar. Results strongly support hypotheses that Allosaurus could co-opt lateroflexive muscles (including m. longissimus capitis superficialis) for powerful ventrolateral flexion. Despite low MMI and high accelerations for turning the head alone, low lateroflexive torque, a narrow skull, and high sagittal mobility of the neck suggest that Allosaurus pulled its head straight back when dismembering large prey. Allosaurus therefore most likely dismembered prey by sagittal motions similarly to raptorial birds, and relied less on shaft-feeding than extant crocodilians and probably large tyrannosaurs.

Technical Session X (Friday, October 19, 11:00 am)

A TRANSYLVANIAN CRETACEOUS MAMMAL WITH RED IRON PIGMENTS IN TOOTH ENAMEL

SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; CODREA, Vlad, Universitatea Babes-Bolyai, Cluj-Napoca, Romania

Red pigments in tooth enamel of living mammals are known in soricomorph insectivores and murid and castoroid rodents. They are of iron composition and thought to increase the resistance of the enamel against the action of some “grinding” mammals. Here we report the presence of red pigments in the tooth enamel of a primitive Cretaceous mammal, a multituberculate from the Maastrichtian of the Hateg Basin in the southern Carpathian Mountains of western Transylvania, Romania. The red coloration is present on the anterior side of the incisors and on the tips of the cusps of most of the teeth. The pigments are also of iron composition identified on surface enamel with a low environmental scanning electronic microscope in conjunction with energy-dispersive X-ray analysis. This composition is like that presents in living placental. The mammal described belongs to the Kogionidae, one of the rare mammal families that survived the K-T crisis in Europe. Moreover, the specimen that has preserved a partial skull associated with the lower jaws allows to identify for the first time the complete dentition in kogionoidans and to solve the systematics of the enigmatic species Barbatodon transylvanicus. Based on our new specimen, B. transylvanicus differs from Kogionusungurus but the monospecific M1 with only two cusps on the lingual row in state of three, the molar M2 in state of triangular, the P4 that has about the same width on all the length of the tooth whereas the P4 of K. ungurusanu is much wider on the posterior border than it is on anterior border, the P2 that has no long posterior expansion. The new specimen presents a pattern of red pigment distribution more like in soricomorph insectivores than in rodents and importantly shows that B. transylvanicus had no ever-growing incisors.
A DEVONIAN ‘IN-GROWING’ FINSPINE: PATHOLOGICAL DEFORMITY IN A GYRACANTHID FISH
SNYDER, Daniel, Middle Georgia College, Cochran, GA, United States; TURNER, Susan, Queensland Museum Geosciences, Brisbane, Australia

Dental pathologies are not unusual, with fossil examples known even in microfossils. Most are the result of injury, some result from heterochrony, but occasionally there is a developmental cause. Because they are modified placoid odontodes, dental spines can be compared to teeth and they are formed primarily of a type of dentine called osteodentine. Dermal spines are found in sharks, acanthodians (‘spiny sharks’) and their relatives from the late Silurian onward. Fin spines sometimes show pathological damage, usually resulting from injury. Developmental or late-stage changes in keratinous structures are well known in mammals but few if any pathological changes in early vertebrate fin spines have been recorded. A unique deformed peltichthys fin spine from a glyptacnidian acanthodian, probably Glyptacnidian sheroides would-Newberry, has been found in the Upper Devonian (Famennian) Duncannon Member, Catskill Formation, at Red Hill, Clinton Co., PA, USA. The deformity has been determined to be in position on the body; rather than growing normally, apparently, the fin spine grew medially and later, and did not lengthen much further than its own area of insertion. Glyptacnidaids have no known descendants, so we review modern analogues. We conclude that injury in life is a sufficient explanation, that there is evidence of extreme trauma without breakage. Such injury supports the view of glyptacnids as fish that regularly rested, bumped and scratched against the bed of the waters where they lived, and may offer an explanation for variation seen in other, more poorly-known spine taxa (e.g., Oracanthus).

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

AERIAL ABILITY IN BASAL DEINONYCHOSAURIA
SORKIN, Boris, Queensbrough Community College, Bayside, NY, United States

The previously proposed hypothesis that non-volant derived members of the coelourosaur clade Deinonychosauria (Dinosauria: Theropoda) evolved from volant ancestors is evaluated by reviewing relevant publications subsequent to that of the hypothesis. Comparative anatomy and computer and physical modeling indicate that basal members of Dromaeosauridae, microraptoreans, and deinonychosaurine Rahonavis, possessed substantial scapulocoracoid and aerial ability, the former being capable of both gliding and active flight that utilized long penaccaceous feathers on both fore- and hindlimbs. This supports the hypothesis that the more derived non-volant Eudromaeosauria and the non-volant Unenlagiinae more derived than Rahonavis, evolved from volant ancestors. The phylogenetic positions of Tianyuraptor and Mahakala within Dromaeosauridae indicate the forward forelimb and with body size, the exceptional size of dinosaurs, and the fact that maximum size of Middle–Early Late Triassic Trascassichus predators exceedied that of contemporary herbivores, breaking a widely accepted ‘rule’ that herbivore maximum size greatly exceeds carnivore maximum size. Previously identified unique adaptations (e.g. skeletal pumatically, high growth rate) probably facilitated the exceptional size of archosauromorphs, but of these adaptations only rapid reproductive rate was likely important in facilitating opportunistic replacement of therapsids.
scansorial ability and capacity for gliding flight that utilized long penaceous feathers on fore and hind limbs in basal members of both Dromaeosauridae and Troodontidae suggests that the most recent common ancestor of Deinonychosauria is also a scansorial four-winged glider. Known morphology of basal avialans Psedopenna and Archaeopteryx suggest that the same is true of the most recent common ancestor of Paraves.

It has been previously proposed that adaptations for aerial locomotion present in the known non-volant members of the coelurosaur clade Oviraptorosauria were indicative of evolution from a volant ancestor, just as similar putative adaptations proved to be indicative of volant ancestry in derived non-volant Deinonychosauria. The morphology and phylogenetic position of yet unknown oviraptorosaurs whose future discovery would support or falsify this hypothesis are speculated on.

Technical Session XVIII (Saturday, October 20, 3:30 pm)
A VIRTUAL ENDOCAST AND ENDOCRANIAL FEATURES OF OODECTES (MAMMALIA: CARNIVOROMORPHA)
SPAUDING, Michelle, Carnegie Museum of Natural History, Pittsburgh, PA, United States; FLYNN, John J., American Museum of Natural History, New York, NY, United States

A virtual endocast of the basal carnivornorphism Oodectes herpestoides was constructed from a high-resolution computerized tomography scan (CT scan) of an exceptionally well-preserved specimen from the Bridger Formation of Wyoming, USA. This specimen is essentially undecomposed, and thus has generated the first undistorted full endocast known from a middle Eocene carnivornorphan. Natural endocasts are known from the contemporary Felidae and the late Eocene Procyonoidictis. Felidae has been found to be the sister taxon to Oodectes in our recent phylogenetic analyses, and comparing these two endocasts shows them to be more similar to one another than is to that of Procyonoidictis, but there are some key differences. Most notably Oodectes has a relatively more expanded frontal paxle with some contact with the olfactory bulbs, and a longer dorsal neocortical sulcus. Both Bridgerian taxon endocasts possess straight neocortical sulci on the cerebra, with less cerebellum contact than in Procyonoidictis.

The endocranial morphology of Oodectes is also described, providing the first endocranial morphology description for a basal carnivornorphan. Endocranial features, such as an ossified tentorium and the morphology of the dorsal surface of the petrosal, have long been incorporated in higher-level phylogenetic studies including carnivornorans, but the status of these characters in stem carnivornorphan taxon has been unknown. Oodectes possesses an ossified tentorium, but this structure is not as extensively developed as it is in crown carnivornorans. The dorsal surface of the petrosal of Oodectes has an extremely large subarcuate fossa and a sharp anterior projection – the apex paretis petrosal. This latter feature is typical of crown carnivornorans, but the size of the subarcuate fossa is not.

Recent advances in CT scanning, and steadily increasing computing power for analyzing these scans permit much faster generation and processing of high resolution CT scans than previously available. A database of more than ten scans of basal carnivornornorans is currently being assembled and this capability for “virtual preparations” is greatly expanding the potential for incorporating the morphology of the endocranial space into phylogenetic analyses focused on these Paleocene and Eocene stem carnivornorphan taxa. This will enable enhanced understanding of basal conditions and evolutionary transformations within Carnivoromorpha and across related groups (Ferae, Ostenorontia).

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)
POSTCRANIAL OSTEOLOGY OF EARLY ORNITHISCHIAN DINOSAURS AND THE ANCESTRAL BODY PLAN OF ORNITHISCHIA
SPENCER, Marc R., University of Iowa, Iowa City, IA, United States

Ornithischians first appear in the Late Triassic, but their early fossil record is sparse. The earliest known forms are relatively small, bipedal, and possess morphological features that are associated with herbivory. Furthermore, the phylogenetic position of many of these early ornithischians remains unresolved. Previous work has focused primarily on cranial anatomy because ornithischians demonstrate elaborate solutions for herbivory (e.g., tooth batteries) and possess extensive cranial ornamentation (e.g., crests). Little has been done, however, to evaluate the general postcranial body plan of ornithischians. Several of the earliest known ornithischians (e.g., Lesothosaurus, Stormbergia, Heterodontosaurus) were filmed swimming and walking at 250 frames per second and video was analyzed to use the lateral pectoral fin surface for power and support during swimming. Quantitatively, during swimming, animals had significant asymmetry in force production compared with swimming. Polypterus senegalus, an extant air breathing fish, is used to test how fins in a basal, relatively preserved actinopterygian can be used to locomote overland. Fish were filmed swimming and walking at 250 frames per second and video was analyzed to compare basic three dimensional kinematic variables. Both body oscillation and fin movements differed between walking and swimming. Qualitatively, fish used the medial surface of their pectoral fins as the primary power surface during swimming and switched to use the lateral pectoral fin surface for power and support during walking. Quantitatively, during swimming, animals had significant asymmetry in force production compared with swimming. Polypterus senegalus effectively locomote overland and do so with significantly different fin and body motions. This contrast in fin and body motion between walking and swimming suggests the pectoral fin ‘functional landscape’ is diverse. We hypothesize that it is this functional plasticity that allowed early aquatic vertebrates to co-opt their fins effectively for terrestrial locomotion.

Preparators’ Session (Thursday, October 18, 8:15 am)
FROM DISCOVERY TO PUBLIC OUTREACH: A NEW VISITOR ORIENTATED FOSSIL QUARRY AND FOSSIL PREPARATION LAB OPENS AT THE BEN REIFEL VISITOR CENTER AT BADLANDS NATIONAL PARK
STARCk, Ellen, Badlands National Park, Interior, SD, United States; MENTON, Rachel, Badlands National Park, Interior, SD, United States; HOUSEHOLDER, Mindy, Badlands National Park, Interior, SD, United States; BOYD, Clint A., South Dakota School of Mines
and Technology, Rapid City, SD, United States; PAGNAC, Darrin, South Dakota School of Mines and Technology, Rapid City, SD, United States

In May of 2010, a specimen of Hoplophorus was discovered by a visitor at Badlands National Park. The collected elements include a complete skull and five cervical vertebrae. This specimen is one of the most superbly-preserved examples of Hoplophorus collected from the White River Group, owing in part to the calcareous cement of the Middle Scenic upper sandstone interval of the Brule Formation. However, the mandible was incomplete, and the medial section of the left side was totally absent. Realizing the significance of this find, the park partnered with the South Dakota School of Mines and Technology to assist in the digital reconstruction of the mandible, including recreating the missing segment and adjusting the model to counter the effects of deformation. The resulting data were used to generate: 1) a rapid prototype of the skull, allowing study of the specimen without incurring damage to the original; and 2) the mass production of scaled casts. The importance of this specimen was realized during preparation, when several puncture wounds in the skull were observed, consistent in size and depth with that of another nimravid. This new knowledge motivated a preliminary survey of the area, producing a fairly diverse faunal list, including a marsupial (Herpetotherium); a leporid (Palaecolagus); rodents (Eumys, Ichthyomys); perissodactyls (Mesohippus, thriceratids); artiodactyls (Merycodonid, Leptomeryx); reptiles; and trace fossils. The diversity and unique preservation of these fossils led the park to open both a visitor-oriented research quarry and an interactive, fossil preparation lab, inside the adjacent Ben Reifel Visitor Center in June of 2012. Inserting a fossil preparation lab into a historic structure, utilized daily for interpretive education and visitor outreach, presents unique challenges. Concerns related to noise levels, safety, and preservation of the historical structure all had to be carefully addressed while ensuring that specimens are handled, prepared, and secured according to the highest standards. Since construction of a traditional viewing lab was impractical, a workstation was fabricated that allows specimens to be viewed by the public while also providing a sealed work space to contain fossil preparation byproducts. For the first time in park history, visitors will be able to observe and interact with scientists at a fossil quarry, a fossil preparation lab, and a visitor center, all in an easily accessible area. With continued excavation and research, via expanded palaeontological facilities and partnerships with universities, Badlands National Park plans to continue alternative, non-destructive methods of preparation and cast reproduction, in hopes of further preserving fossils for future generations.

Technical Session II (Wednesday, October 17, 11:30 am)

A NEW FOSSIL CHAR (Salvelinus) FROM MIOCENE LAKE SEDIMENTS IN STEWART VALLEY, NEVADA

STEARLEY, Ralph F., Calvin College, Dept. of Geology and Geography, Grand Rapids, MI, United States; CAVENS, Adam, Ohio State University-Department of Evolution, Ecology and Organismal Biology, Columbus, OH, United States

During middle Miocene time, between 18 and 9 Ma, the Walker Lane region of western Nevada was a high-altitude plateau undergoing transennial disassembly. Intermittent N-S drainage connections formed between adjacent downfaulted basins, possibly extending northward to southeastern Oregon. To the east, in eastern Nevada and western Utah, a rugged highland served as a drainage divide. Geologic data, including mapped ignimbrites extending across the present crest of the Sierra Nevada, indicate probable drainage connections between western Nevada and the Pacific Ocean. In Stewart Valley, Mineral County, Nevada, lacustrine sediments, the Savage Canyon Formation, reveal the presence of a lake which occupied the basin approximately 15 million years ago, as determined by potassium-argon dates, plant- and mammalian biostratigraphy. During the 1970’s through early 1990’s, University of California crews recovered fossils of a large (30+ cm), well-toothed eusalmonine from these lacustrine sediments. Non-cranial features of this eusalmonine include a small adipose fin, 58-60 vertebrae, and numerous small scales, 150 scale rows anteriorly. The most relevant cranial features diagnosing this taxon as a primitive member of a subset of species related to the genus Salvelinus include: a broad, dish-shaped hyomandibula with a long ridge for the attachment of the adductor mandibulae; a quadrant in which the anterior and posterior borders form an acute angle; and a long, flat maxilla. The lower jaw is massive. The dermohemid, exposed in sagittal section, is long and narrow and the correlated dorsal processes of the premaxillae are longer and more vertical than those of any extant salmonine. The neurocranium is not depressed; the parapophysis is straight in sagittal profile and thin. This new taxon differs from a species of Salvelinus obtained from western Churchill County, and provides more evidence for a Miocene radiation of eusalmonines in intermontane drainages of the western United States.

DRIVERS OF JAW SHAPE IN Neotoma: MANDIBULAR GEOMETRIC MORPHOMETRICS AND IMPLICATIONS FOR MORPHOLOGICAL PARTITIONING

STEGNER, M. A., U.C. Berkeley, Berkeley, CA, United States; FERRER, Elizabeth, U.C. Berkeley, Berkeley, CA, United States

The modern biodiversity crisis has generated interest in the response of species to climate change. For Neotoma, a genus that is widespread across much of the western United States, a new knowledge was generated that could be used to interpret the evolution of the genus. Neotoma is one of the most common taxa in Neogene North American fossil deposits; these woodrats are paleoecologically important because they collect bone-laden carnivore scats and raptor pellets in their middens, providing a major source of Quaternary fossil material. However, it is notoriously difficult to identify Neotoma fossils to the species level. Body size ranges overlap across most species, and body size within species is strongly correlated with climatic variables. Although teeth are often diagnostic to species in mammals, in Neotoma interspecific tooth variability among species is low, whereas within species it is high. Nevertheless, because Neotoma species partition their environment, knowing which species are present in fossil deposits is important for understanding the environmental implications of turnover and abundance changes.

We analyzed extant Neotoma jaws using geometric morphometrics to determine (1) if we could identify toothless mandibles to species, and (2) if climate and/or phylogeny correlates could be found in mandibular landmark distributions of 445 right mandibles (all individuals were adults with similar degrees of tooth wear) from nine species of Neotoma found in the Western US, and conducted a Procrustes analysis on two landmarks and four curves (60 semilandmarks). We performed a Canonical Variates Analysis (CVA) to explore the morphological relationships among species, and made pairwise Hotelling’s T2 tests comparisons (permutation test with 1000 resamplings, Holm p value adjustment) to determine which species could be differentiated based on mandible shape. Though most species were morphologically too similar to distinguish, we found that several, including N. cinerea and N. lepida, could be identified in some pairwise comparisons. We also tested for a correlation between mandible shape and both climate variables and body size (nasal length as a proxy for size) using multiple linear regression. There is no correlation between jaw shape and body size, so we were able to rule out allometric effects. Phylogenetic signals were assessed using generalized least squares (GLS). Shape was significantly correlated with local temperature across species, but within species, mandible shape depends more on infraspecific competition—this is strong morphological confirmation for the observation that, when several species of Neotoma are present in the same region, they partition dietary resources.

Technical Session VI (Thursday, October 18, 3:45 pm)

NO FIBROUS (WOVEN) BONE IN SAURUROID FIBROLAMELLAR BONE?

STEIN, Koen, Steinmann Institut fu¨r Geologie, Mineralogie und Palaeontologie, Bonn, Germany; PRONDVAI, Edina, Hungarian Academy of Sciences – Eotvos Lorand University “Lendulet” Dinosaur Research Group, Budapest, Hungary

Fibrolamellar bone is defined as a composite tissue consisting of a rapidly growing woven fibro bone matrix in which primary vascular canals are embedded in a space with a growing infilling of lamellar bone. This tissue is widely recognized in mammals, non-avian dinosaurs and birds. Here we provide histological evidence that the bone matrix hitherto interpreted as isotropic woven fibro bone transformed in transverse sections of saurupid limb bones actually has a lamellar to parallel-fibred anisotropic nature in longitudinal sections. Thin sections of long bones of well known saurupid taxa (e.g. Alamosaurus, Aptosaurus and Camarasaurus) presented as prime examples of extinct animals possessing woven bone matrix show a strong birefringence in longitudinal plane. This optical feature is identical with that of the circumferential lamellar bone generally observed in transversal sections of poikilothermic ectotherm long bones, the presence of which is thought to be a reliable indicator of a slow growing bone tissue. The anisotropic nature of primary cortical bone in longitudinal sections is consistent with recent texture analyses on saurupod bone illustrating a preferential longitudinal orientation of the long (c) axis of the fluorapatite crystals. This suggests that highly organized fibre orientation in a bony matrix does not necessarily limit growth rates; an observation that has significant implications for the interpretation of histological indicators of growth rates (Amprino’s rule) and evolution of growth strategies. The longitudinal arrangement of crystallites reflecting the original alignment of the collagen fibrils is likely an adaptation to bone matrix mechanical requirements as seen in long bones of saurupods. Based on these results, the very presence of woven bone in non-embryonic and non-pathologic long bones of saurupods is hereby contested. We hypothesize that the mistaken isotropy observed in most commonly used transversal sections is most likely the result of the random orientation of the a and b axis of the crystals along their c axis. These results again call for awareness of the three dimensional character of bone when drawing far reaching conclusions based purely on two dimensional histological thin section images.

A NEW TAXON OF DIAMANTOMYS FROM THE LATE OLIGOCENE NSUNGWE FORMATION, RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA

STEGENS, Nancy J., Ohio University, Athens, OH, United States; O’CONNOR, Patrick M., Ohio University, Athens, OH, United States; ROBERTS, Eric M., James Cook University, Townsville, Australia

Diamantomys lederitzii (Mammalia; Rodentia; Hystricognathi) was first described from localities of mid-late Miocene age in what is now Namibia, based on a lower jaw preserving three molar teeth. In the original description, the extreme distinctiveness of this taxon was remarked upon, with an arrangement of crests and cusps resembling no other rodent taxon. Hundreds of additional specimens recovered from the Miocene of southwestern and eastern continental Africa have subsequently been ascribed to the taxon. Yet discoveries from late Oligocene and early Miocene sites in eastern Africa have begun to reveal substantial early diversity in the clade, with the emergence of a handful of novel species attributed to the genus in recent years. Here we describe a new species of Diamantomys representing the largest of the Nsungwe Formation rodents, with mesiodistally elongate and distinctly crestiform molars generally consistent with members of the genus Diamantomys, yet highly size distinctive and preserving more elaborate crenation on the lower molars together with a posterior cingulid. The morphology of late Oligocene micromammals
from the Rukwa Rift Basin of Tanzania suggests that the Nsungwe fauna may provide bridge between well-documented early and mid Cenozoic hystricognath rodents. Rodent fossils from the late Oligocene interval on continental Africa are critical for linking the richly diverse early Paleogene faunas of Saharan Africa and Oman with the better-sampled Miocene faunas of Afro-Arabia and beyond.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

ALESTID FISHES FROM THE LATE Oligocene NSUNGWE FORMATION OF TANZANIA

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The Order Acharacidiformes represents a clade of approximately 1600 species of teleost fishes first recorded from the Albian of what is now Brazil. They are primarily found in fresh water settings throughout Africa and South/Central America today, but a handful of fossil taxa are reported from Europe and North America. Alisteidiae is a family of African characidiforms including 19 genera and ~105 species. Early alestid fossils are known from Afro-Arabia, with records reported from the Eocene-Oligocene Jebel Qatriani Formation of Egypt, the Eocene Mahenge crater lakes of Tanzania, and early Oligocene to Miocene sites on the Arabian Plate. Here we report the first record of alestid fishes from the late Oligocene Nsungwe Formation in the Rukwa Rift Basin of southwestern Tanzania. Radiometrically dated at ~24.95MY, Nsungwe Formation localities have revealed a diverse vertebrate fauna including mammals, birds, crocodilians, lepidosaurs, anurans and multiple clades of fishes, together with a number of novel invertebrate taxa. The specimens we describe were collected from localities spanning fluvial and shallow lacustrine paleoenvironments. Teeth were mechanically prepared and digitally imaged prior to conducting morphometric analysis. Alestid specimens recovered to date consist of isolated maxillary and dentary teeth ranging in crown height size from 0.63 – 4.32 mm. Specimens vary in morphology, ranging from simple unicuspced teeth to strikingly asymmetric teeth exhibiting up to 12 individual cusps on the largest specimen. Results indicate that based on size and overall morphology, at least two alestid taxa are represented in Nsungwe Formation localities.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

NEW MIDDLE PALEOCENE (TITANIANALMA) BIRDS FROM NORTH DAKOTA

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The fossil record of birds prior to the last ~1–1 million years of the Paleocene in North America is more poorly known than that of the latest Cretaceous. Lithornithids and rare neognathous birds represent the only known avian records from North America in the middle to late Paleocene. However, late Tiffanian (~ 58 Ma) Bullion Creek and Sentinel Butte Formation localities in North Dakota recently have produced a diverse vertebrate fauna including fishes, amphibians, reptiles, mammals, and birds. The 10 bird bones recovered from these new excavations represent at least 3 different taxa of small-bodied birds (duck-sized and smaller). None of the new bones appear referable to any of the previously named avian taxa from the Tiffanian of North Dakota and add to the known diversity of birds from the Paleocene of North America.

One of the new species represented by four bones (two coracoids, a scapula, and a humerus) is a presbyornithid approximately the same size as the early Eocene Presbyornis pervetus and significantly smaller than the contemporaneous Presbyornis tenuirostris. It has a much larger procoracoid foramen and a smaller acrocoracoid than the Eocene species. Another taxon represented by a single coracoid has a strong resemblance to the Late Cretaceous Cimolopteryx and is likely from a plesiomorphic basal avian. One other coracoid that has a procoracoid foramen, but a relatively shallow scapular cotyla that is subtriangular in outline represents a third distinct coracoid-based taxon. It also lacks a distinctly medially projecting or overlapping acrocoracoid/larucal facet (present in the coracoids of the other Tiffanian taxa), and seems to be allied to one of the higher landbird clades. It may be the oldest known record of the stem of a derived ornithuroid level clade. A tibiotarsus is from a small non-anseriform bird that appears related to gruiforms or ciconiiforms. That tibiotarsus has an elongate tuber for the attachment of part of the extensor retinaculum on the shaft that might indicate that it represents a fourth avian taxon.

The abundance of presbyornithid remains is not unexpected given the interpreted paludal/pond depositional environments and abundance of freshwater vertebrate taxa in these localities. Furthermore, one of the bird bones appears to have damage from ingestion by a carnivore (i.e. gastric etching and related damage). That ingestion also is consistent with the abundance of coprolites and broken bones previously reported from the Medora Site in North Dakota. If accurate, that bone would be the oldest known record of predation on birds in North America.

Technical Session I (Wednesday, October 17, 8:30 am)

A MULTI-ELEMENT HISTOLOGICAL ANALYSIS OF THE JURASSIC TYRANNOSAUROID GUANLONGLU WUCAI

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While knowledge of skeletal development in Cretaceous crocodylomorphs continues to grow, relatively little is known about ontogeny in their Jurassic counterparts. The basal tyrannosaurid Guanlong wucaii from the Upper Jurassic Shishugou Formation of Xining, P.R.C. is known from two penecontemporaneous fossilized individuals of differing size and ontogenetic maturity. We produced histological sections from core samples of the right humerus, femur, and tibia from the larger holotype specimen, as well as whole-element sections from the humerus, femur, tibia, and fibula of the smaller referred specimen. In addition, we examined fibular thin sections of both specimens that were produced for a previous study.

Both individuals exhibit a fibro-lamellar complex with sub-plexiform vascular organization in all examined elements, although localized fields of reticular vascularization are present, especially in the smaller individual. The frequency of longitudinally oriented primary osteons increases approaching the periosseous surfaces of hind limb elements in both specimens (consistent with a slowed rate of growth). Double and triple lines of arrested growth (LAGs) are visible in the interior cortex of the tibia in the holotype. Multiple spaced LAGs have been previously ascribed to stressful life-history events and this pattern may be relevant and of potential seasonal and ontogenetic significance in the Shishugou Formation. An external fundamental system (EFS) is present in hind limb elements of the large specimen with varying numbers of LAGs in each, but no EFS is visible in the humerus, perhaps indicating significant allometric change in limb proportions during ontogeny.

Several features indicate substantial lateral migration and remodeling of the fibula and relative stationarity of the tibial mediolateral cavity during ontogeny in the smaller specimen: (1) a marked lack of concentricity of growth lines in the fibula; (2) osteoblastic and osteoclastic activity on the lateral and mediolateral periosseous surfaces of the fibula, respectively; (3) numerous secondary osteons and large erosion rooms in the medial region of fibular cortex; and (4), the presence of extensive endosteal lamellar bone in the tibia with little evidence of peri-medullary haversian systems, Howship’s lacunae, or resorption lines. Similar patterns of fibular remodeling and migration, and/or tibial stationarity can be seen in published histological sections of Cretaceous tyrannosaurs (e.g., Tyrannosaurus, Daspletosaurus and Raptorex). These findings reveal potential biases associated with age estimates derived from fibulae, and emphasize the utility of multi-element histological studies for accurate ontogenetic assessment.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

THE EVOLUTION OF RHINO ARTHRITIS IN THE CENOZOIC

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The family Rhinocerotidae provides a natural system for understanding the evolutionary underpinnings of arthritis, because osteological evidence of arthritis increases in frequency through their evolutionary history. The severity and prevalence of arthritis in Rhinocerotidae increases substantially from 50 million years (Ma) to the present: early rhinocerotids and their relatives have arthritis rates similar to those of other mammals, but individuals of all five extant species of rhinoceros develop extensive arthritis in all of their distal limb bones before they reach maturity. Through this interval, rhinos increased dramatically in size, evolving from animals like Hyracotherium, which was about the size of a large dog (150 kg), to the one-ton, stout-legged megafauna of today. Despite this order of magnitude increase in mass, rhinos consistently displayed curvature (the habit of running) throughout their evolutionary history. These competing factors of increasing size and consistent curvature provide a possible driver for the prevalence of arthritis in living members of the clade. We have examined specimens of Hyracotherium and the extant rhinos Trigonias, Diceratherium, Menoceras, Apherelopus, Teleoceras, as well as all five species of extant rhinos on the population level. Using 2700 specimens from 12 species of rhinos, we have been able to trace the history of arthritic development in the rhino lineage, finding that arthritis changes immensely through the history of the rhinocerotid lineage, from 20% of the bones in Hyracotherium to 50% of the early Miocene Menoceras to almost 100% of skeletal elements in modern rhinos. As it increases, it goes from a phenomenon localized mostly in the feet to one found throughout the skeletal system, showing the impact of the forces experienced by the skeleton over an ever-increasing proportion of the animal’s body. The severity of arthritis also seems to increase, as indicated by indicators of greater severity of arthritis in individual joints. The frequency of arthritic development is related to increasing body size, but that there are clearly other evolutionary effects controlling its prevalence, in particular ongoing evolutionary changes in locomotion. Our results suggest arthritis was a pathology that was “allowed” to develop in lineages of rhinos in the face of more pressing adaptations. The persistence and rise of arthritis in rhinocerotids suggests that the resolution to this evolutionary tradeoff may include a surprising degree of accommodation.
Most of our knowledge regarding the loss of diversity within Crocodyliformes in the Middle and Late Eocene comes from specimens from the central Western Interior. However, crocodylians from the Middle Eocene Devil’s Graveyard Formation (DGF) of West Texas provide additional information from southern North America during that period of faunal reorganization. Here we describe a new taxon of alligatoroid from the middle member of the DGF based on the most complete alligatoroid material known from Tertiary deposits outside of the Western Interior. The precise age of the new taxon is unclear because of a lack of associated fauna or datable tuffs. However, the holotype was recovered from a stratigraphic horizon between the Late Uintan Purple Bench locality and the Duchesnean Skyline Channels localities. The new taxon is similar to alligatorine material from the Uinta Formation of Utah and shares the presence of nearly spherical tooth crowns with previously published mandibular fragments from lower in the DGF stratigraphic section. However, the new DGF taxon can be distinguished from the Uinta Formation material and all other alligatorines on the basis of several caiman-like features, including a prominent, notched, descending lamina of the pterygoid posterior to the choana and a long descending process of the exoccipital that makes contact with the basioccipital tubera. Additionally, autapomorphies of the new taxon include rounded anterior processes of the palatines and a prominent, anteriorly extending crest on the dorsal surface of the skull anterior to the orbit. Although the posterior maxillary teeth are bulbous (a feature shared with basal alligatorines), the posterior alveoli are smaller than the fourth and fifth maxillary alveoli, which is a feature shared with Alligator and another new species from the Uinta Formation. Our morphological phylogenetic analysis indicates that the new DGF taxon has potential affinities with Alligatorinae. This new taxon adds to the diversity of specialized crocodylians in the Paleogene and represents the southernmost known occurrence of a blunt-toothed alligatoroid in the Paleogene of North America. Other crocodylians known from the DGF include a pristichampine and Borealosuchus. Crocodylians are not identified from this formation, suggesting slightly lower crocodyliform diversity in West Texas than in Uintan deposits further north.

Preparators’ Session (Thursday, October 18, 9:00 am)

METHODOLOGY AND RESULTS OF A COMPREHENSIVE SPECIMEN CONSERVATION CONDITION SURVEY OF AN ACTIVE BONE BED AND STORAGE COLLECTION AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.

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The Mammoth Site of Hot Springs, SD (MSHS) poses unique challenges for collections management, conservation, and preservation in that it is both an active, on-going paleontological excavation site and a research collection. Discovered in 1974, the development of the site and the museum has paralleled the growth and development of the field of museum conservation. Over the past two decades the MSHS has applied conservation methods and materials used in the stabilization and preservation of the specimens. The museum has also undergone various assessments of its operations, developed a long-range conservation plan, and acted on the recommendations of the assessors. The comprehensive specimen condition survey, an object by object survey, is the most detailed conservation assessment available. The assessment consists of visual and tactile observations of individual specimens and recording ordinal numerical ratings of specimen and matrix condition and treatment priority. The ranking system was developed by the conservator (Storch) in collaboration with the MSHS staff (Potapaov and Wilkins). The amount of time in hours required for conservation treatments (e.g. stabilization, cleaning, reversing improper treatments, etc.) were also estimated. The bone bed and collections storage specimens were assessed in two on-site visits of ten days each. Eight hundred and thirty-five individuals were assessed and results tallied for the three metrics mentioned above. Condition assessment reports were filled out for each specimen and will be added to the more detailed collections specimen records. Images of representative conditions for each ranking were taken and included in the final project report. In the bone bed, 12% of the specimens are in the poor to fair condition categories, 68% in good, and 20% rated as excellent. The condition of the “poor/fair” specimens, and many of the elements in the “good” ranking, is due to the presence of darkened and aged cellulose nitrate and polyvinyl butyral polymer resins applied as preservatives and consolidants to the bone surfaces and matrix. Results are similar for the specimens in storage. The final project report summarizes the results within a conservation risk assessment framework of ten agents of deterioration including disassociation, or the separation of provenance information from the specimen. The project also applied the condition rankings to the specimen location information in ArcGIS for the site as an additional mapping layer so the in-situ exhibit elements can be highlighted by condition ranking for identification and preservation work planning.

Technical Session IX (Friday, October 19, 10:45 am)

SPATIAL AND TEMPORAL SHIFTS IN PALEOGENE CROCODYLIFORM DIVERSITY AND A NEW GLOBIDONT GLOBIDATOROID FROM THE MIDDLE EOCENE OF WEST TEXAS

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In 1822, the genus Mosasaurus, based on remains from the Maastrichtian of the Netherlands, became the first named taxon of mosasaur, followed in 1829 by the addition of the specific epithet to the specimen of “hoffmanni”. Mosasaurus hoffmanni (originally described as M. maximiliani) from the Upper Cretaceous of North America was the second described species of Mosasaurus, followed in 1849 by the description of M. gracilis from very fragmentary remains from the Middle to Upper Turonian (Upper Chalk) of the southeast English Coast. The type material of M. gracilis includes an associated pair of right and left dentaries, an isolated vertebra, and three articulated vertebral fragments, all from the Middle to Upper Turonian sections of the Ollham Pit, near Lewes; and a right dentary originally described as a maxillary fragment by the Chalk at Dorking. Examination of the type specimens of M. hoffmanni and M. mosauriniens, with comparisons to M. gracilis, reveals that the latter taxon does not share any generic-level anatomical features with either the generic type, or these two other species of Mosasaurus. In fact, M. gracilis exhibits more shared characters, such as a short rostrum on the dentary anterior to the first tooth, with russellosaurine mosasaurs. In addition, M. gracilis is known from Turonian-aged deposits, while other species belonging to Mosasaurus are Upper Campanian to Maastrichtian in age. Based on the evidence of shared character and contemporaneity, we suggest that M. gracilis be removed from Mosasaurus because it shares more affinities with russellosaur-like mosasaurs.

Technical Session XII (Friday, October 19, 2:15 pm)

AGE AND PALEOECOLOGY OF MOSASAURS AND PLEOSAURS FROM THE LATE CRETACEOUS SOUTH ATLANTIC MARGIN AT BENITABA, ANGOLA

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The geology of coastal Angola reflects the rifting of Africa and South America and the development of the South Atlantic Ocean. This study utilizes stable carbon isotopes derived from fish scales to constrain the age of mosasaur and plesiosaur teeth recovered from a single horizon, and uses carbon isotopic values derived from tooth enamel to refine the marine vertebrate niche partitioning. The vertebrate-bearing horizon is near the top of a marine section unconformably overlying continental syn-rift deposits. A basalt flow intercalated within the marine sequence is dated at 84.5 Ma (Santonian), and reflects a widespread magmatic interval along the South Atlantic margin. The age of the basalt tephra...
the Late Cenomanian to Early Maastrichtian. The δ13C values derived from mosasaur and plesiosaur tooth enamel range from -5 to -16‰, showing a negative trend with increasing body size. This pattern is similar to that observed in modern marine mammals, in which more negative δ13C values correlate with deep diving behavior and foraging habitats distant from the shoreline. Specimens of the mosasaur Globidens included values more severe than expected for their body size and are interpreted as reflecting long diving durations required by their durophagous feeding habit. Plesiosaur specimens yielded δ13C values between -5 to -14‰. The large range in values reflects taxonomic variation or habitat partitioning among individuals. The diversity of niches utilized by large bodied marine amniotes implied by these results suggests a high level of productivity during the Late Cretaceous across a range of habitats along the coast of Angola.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

LATE CRETACEOUS FISH OTOLITHS FROM NORTHEAST MISSISSIPPI: IMPLICATIONS FOR NORTH AMERICAN TELEOSTEAN EVOLUTION AND DISTRIBUTION

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Well-preserved and relatively abundant fish otoliths from the Late Cretaceous Ripley Formation at the Blue Springs Site (MS 73.035) in southeast Union County in northeastern Mississippi (USA) have contributed to a better understanding of teleostean evolution and distribution in North America. Extensive leaching of Cretaceous strata often destroys the aragonitic fish otoliths and limits otolith occurrence to primarily clays and marls. Fortunately, highway construction exposed a large area of the Ripley Formation, which included the Coon Creek beds that contain aragonitic remains. Ten collections were acquired from the aragonitic clay beds through bulk sampling and surface collecting. These collections resulted in nearly 800 fish for study. The number of specimens from the Blue Springs Site is quite significant in that many previous North American Cretaceous otolith studies have been based on 100 to 300 otoliths. Bulk samples were taken at four measured sections at the site with seven samples ranging from 11.5 to 25 kilograms (total of 102 kilograms). Bulk samples produced 446 otolith specimens, while three surface collections supplied an additional 355 otoliths. Statistical analysis for abundance was limited to the bulk sample otoliths.

The majority of the otoliths were sagitta, but there were lappii from several arid taxa (marine catfish). Some of the otoliths exhibited crenulated and lobated margins, which was an indication of their excellent state of preservation. The abundance and preservation of the fish otoliths contributed to the first North American Cretaceous occurrence of several taxa. Furthermore, the larger sized otoliths from the surface collections made it possible to identify several taxa with greater specificity than previously possible based on smaller, immature specimens. Otolith specimens that compare favorably with the synodontids (lizardfishes) Saurida and Synodus are reported for the first time from the Cretaceous in North America. Also, a small serrated otolith was identified as most likely belonging to Centropristis and represents the first Centropristis otolith from the North American Cretaceous. The specimen is especially significant in that it provides additional evidence for the presence of perciforms in the Cretaceous. Perciforms were long believed to be restricted to the Cenozoic, but otoliths studies from North America and Europe have clearly shown their presence in the Mesozoic. Well-preserved, larger otoliths from the surface collections made it possible to more precisely identify several forms. The otoliths previously identified as Polyxenaidae indeterminate appear to be closely related to Polyxenia, and “genus Trachichthysdarium” ostaciens may be in the genus Hoplostethus.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

COMPUTER TOMOGRAPHY INVESTIGATIONS INTO CRANIAL PNEUMATIZATION IN A SMALL OLIGOCENE SULID (STEGANOPOD) FROM CHINESE JACKDAW

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Sulidae is a family of coastal seabirds known for their ability to plunge-dive from great heights to catch prey. Extant sulids possess a series of sub-dermal air sacs and exhibit high levels of skeletal pneumatization, which together are hypothesized to cushion the bird during high-velocity impacts with the water surface. A skull from a new fossil sulid taxon reveals details of skull morphology, cranial pneumatization and neuroanatomy of a basal member of this waterbird lineage. This new taxon is smaller than any living species of Sulidae and lacks several derived features of extant Sula and Morus, suggesting it may represent a stem lineage. The fossil was recovered from deposits of the Ashley Formation of South Carolina at the Charleston Airforce Base. These deposits are Early Oligocene to Late Oligocene in age.

Computed tomography scans were taken of the skulls of the fossil sulid, the extant Sula leucogaster, and the cormorant Phalacrocorax auritus to explore the endocranial morphology of Sulidae and a closely related non-plunge-diving waterbird. Virtual endocasts were generated using the volumetric rendering program Avizo. The endocranial anatomy of the fossil sulid and S. leucogaster are highly similar, as evidenced in both the brain endcaps as well as cross sections of the skulls. Within the brain, a number of parallels can be seen: a small floculus, a well-developed optic tectum, and an expansive cerebellum. The cerebrum of S. leucogaster is more expansive than the cerebrum of the fossil sulid. Skull cross-sections reveal a high level of pneumatization in the skulls of both the fossil sulid and S. leucogaster, while there is a low level of pneumatization within the skull of P. auritus. Together with evidence from solid postcranial elements recovered from the same horizon of the Ashley Formation, the high level of pneumatization found within the braincase of the fossil sulid implies that this basal member of the sulid lineage also employed plunge-diving despite its small size.

Technical Session I (Wednesday, October 17, 9:45 am)

TYRANNOSAURID DINOSAURS FROM THE UPPER CRETACEOUS WANGSHI GROUP OF ZHUCHENG, SHANDONG PROVINCE, CHINA: COEXISTING GIANT CARNIVORES AND A TYRANT WITH A TOOTHACHE

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Since the 1960s, vast and highly productive dinosaur quarries have been known to exist near the city of Zhucheng, Shandong Province, China. Excavations at the three Upper Cretaceous (probably Campanian) sites of Kugou, Zangjiazhuang and Longgujian have yielded thousands of bones from giant hadrosaurids and a smaller number from ceratopsians. Since the 1960s, vast and highly productive dinosaur quarries have been known to exist near the city of Zhucheng, Shandong Province, China. Excavations at the three Upper Cretaceous (probably Campanian) sites of Kugou, Zangjiazhuang and Longgujian have yielded thousands of bones from giant hadrosaurids and a smaller number from ceratopsians. Of this much material remains undescribed. Tyrannosaur teeth were among the initial specimen recovered from the quarries, and were first referred to the North American Tyrannosaurus rex and later assigned with an isolated metatarsal to the new putative species “Tyrannosaurus zhuchengensis.”

Although these finds are taxonomically indeterminate, more diagnostic tyrannosaurid material has recently been collected and is being studied by our research group. An associated maxilla and dentary comparable in size and gross morphology to the corresponding elements in the Mongolian species Tarbosaurus bataar were recently described by some of us as a new large tyrannosaur, Zhuchengtyrannus magnus. Z. magnus is distinct from T. bataar in important details of the maxilla, including the lack of a subcutaneous flange, the presence of a horizontal shelf on the lateral face of the ascending process, and the shape and position of the maxillary fenestra. A second tyrannosaurid maxilla and dentary are known from the same quarry, and disarticulated postcranial bones and teeth have also been collected from the Zhucheng sites. The second maxilla is distinct from that of Z. magnus in many respects, including all three features mentioned above, but could be referable to T. bataar despite minor differences from previously described maxillae of that taxon. It is clear that two very large tyrannosaur species coexisted in what is now the Zhucheng area during the Late Cretaceous, an unusual situation that presumably required some form of niche partitioning.

The second tyrannosaurid dentary shows clear pathological features, including a swollen, medially thickened overall shape and a mound-like prominence on the medial surface below the foramen inanum/dentalis oralis. CT scans suggest that the prominence represents the surface expression of a dental abscess, from which an osteomyelitic infection probably spread diffusely and altered the shape of the entire dentary. Although a dental abscess has previously been documented in a hadrosaurid dinosaur, the presence of this type of...
pathology in a theropod is novel. Dental abscesses appear to have been uncommon in dinosaurs, but in rare cases they clearly did occur. The abscess in the dentary from Zhucheng would certainly have interfered with feeding and been detrimental to the animal’s overall health.

Preparators’ Session (Thursday, October 18, 10:15 am)

USING A GLYcerol-WATER Solution TO CONTROL RELATIVE HUMIDITY IN A CLOSED ENVIRONMENT

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Glycerin is a tri-hydric alcohol that is water-soluble, viscous, and hygroscopic. Consequently, it has many industrial uses in areas such as pharmaceuticals, food and beverages, textiles, paper and printing, among others. The hygroscopicity of glycerin (also called glycerol) is its ability to take moisture from the atmosphere and hold it. In order to achieve a desired relative humidity in an enclosed environment, a given amount of water can be added to a glycerin solution which achieves evaporative equilibrium with the enclosed atmosphere. To slowly dry fossils, we utilized glycerol’s properties to incrementally lower the relative humidity over extended time periods. Prior to this use of glycerol solutions, wet Pleistocene fossils from Saltville, VA were tested using other methods to control the rate of water evaporation. The fossils were dried at different rates (quick dry, 1 month, 3 months, and 6 months), attempting to control the rate of drying by slightly opening or adding damp towels to closed containers housing the fossils. We had remote sensors that recorded temperature and relative humidity inside each of these closed containers. A uniform decrease in relative humidity from wet (98%) to the relative humidity in collections (47%) was calculated to use as a standard for each of these time frames. Trying to match this calculated rate of drying without using glycerin was very difficult. The original method resulted in large variations in relative humidity, while the glycerol method enabled us to precisely control the relative humidity of the environment. We used a food grade glycerol product (vegetable glycerin 99.9%) for a three-month test. Glycerol placed in a beaker with no added water in a closed container equilibrated to a relative humidity of about 20% after several days. Then we then added water to create a solution that equilibrated with the closed atmosphere to a relative humidity of 98%. At this point we added the wet fossil to the container and incrementally added glycerol in order to reproduce the calculated three-month drying curve. Use of glycerol solutions has been successful in controlling the rate of drying inside the containers housing the Saltville fossils.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

MECHANISM OF THE CRUROTARSAL JOINT

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The movable astragalus-calcaneum joint is a key feature diagnosing crurotarsan archosaurs. This joint plays an important role in forming the posture of crurotarsans, whether semi-erect and/or fully-erect. The calcaneum of all crurotarsans has a large calcaneal tuber, which is thought to produce a large moment arm during plantar flexion at the ankle by sagittal movement. This morphotype of crurotarsan ankles may affect their posture and locomotory system, but the detailed mechanisms of this joint have not been investigated. In this study, six crocodile specimens (three Crocodylus porosus, two C. siamensis, and one Tomistoma schlegeli) were used to study the ankle joint mechanism of crocodiles, the sole survivor of the crurotarsans. These specimens were CT scanned at five different positions, from maximum dorsiflexion (approximately 65 degrees) to maximum plantar flexion (approximately 145 degrees). In addition, three formalin fixed crocodile specimens (two Caiman crocodilus, one C. porosus) were dissected to observe their macroscopic morphology. The dissected specimens show that the calcaneal tuber projects postero-laterally, and possesses a pulley-like central groove. The tendon of the gastrocnemius passes through the groove, and partially extrudes onto the medial surface of the calcaneal tuber. The analysis of the CT images shows that the horizontal movement is larger than the sagittal movement at the astragalus-calcaneal joint creates propulsion and generates crurotarsus semi-erect or fully-erect posture. This mechanism, however, may be less effective than the dinosaurian mesotarsal joint mechanism with fully-erect posture, in that the sagittal movement could propagate the power effectively in erect postures.

Poster Session II (Friday, October 19, 4:15 - 6:15 pm)

PARAMETRIC COMPUTATIONAL FLUID DYNAMICS SIMULATION OF THE RESPIRATORY HEAT LOSS IN SAUROPODORM PHOSAURIA: THE ROLE OF LONG TRACHEA

Sverdlov, Nina S., Ruhr-Universität Bochum, Bochum, Germany; Fechner, Regina, Ruhr-Universität Bochum, Bochum, Germany; Perry, Steven F., Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany

High metabolic rate in sauropornomorphs has been proposed and discussed in the literature. Due to the high volume to surface ratio of large sauropornomorphs, the temperature control using respiratory system gains importance. Previously measured respiratory heat and water loss and our recent computational fluid dynamics simulations of breathing cycle in domestic fowl showed that the evaporative respiratory heat loss takes place mainly in the trachea. In the present study we test the hypothesis that the remarkably long neck of some sauropornomorphs facilitate an effective system of evaporative cooling able to sustain high metabolic heat production of these extinct species. To this end we select several sauropornomorphs, for which both the neck estimates and body mass estimates are available based on the fossil material. We consider smaller sauropornomorphs (Platysaurus and Shanosaurus) with estimated body masses under 5 tons and large sauropornomorphs (Brachiosaurus, Diplodocus, Mamenchisaurus) with estimated body masses above 10 tons. For the dimensions of the trachea and respiratory parameters (tidal volume, respiration rate, and inspiration time) we use allometric relationships from avian data. The tidal volume values are obtained in two different ways: based on the allometric relationship for the tidal volume and derived from the allometric oxygen consumption rate as the amount of air that contains enough oxygen to sustain the body weight. We use these data and generate three different computational fluid dynamics models as simplified representations of the respiratory system of sauropornomorphs and simulate a breathing cycle. The tracheal diameter is varied for each model to reach the heating and humidification of air at the caudal end of trachea for different body temperatures. Our results show that allometric relationships have limitations for the determination of the geometry of the trachea of long-necked sauropornomorphs as well as for the estimation of the tidal volume, which plays an immediate role in predicting the heat loss in the system. The estimation of the tidal volume based on oxygen consumption, which takes into account the large dead space due to the long trachea, seems more meaningful and produces more realistic results. Computational fluid dynamics simulations and parametric analysis present a powerful tool for the understanding of the function of the respiratory system in temperature control due to convective and evaporative cooling, especially when the information on geometry and physiology of the system is lacking. We conclude that even though the present study relies essentially on the accuracy of the mass estimates of the extinct animals, it still gives an insight into the physiological constraints compatible with life.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

DIAGNOSIS AND PALEOVIRONMENTAL CHANGES IN NEOGEO FOSSILS AND ENVIRONMENTS FROM PANAMA: EVIDENCE FROM REE PROFILES

MacFadden, Bruce J., University of Florida, Gainesville, FL, United States; Hendy, Austin J., University of Florida, Gainesville, FL, United States; Pimentel, Catalina, University of Florida, Gainesville, FL, United States; Degracia, Carlos, Smithsonian Tropical Research Institute, Panama City, Panama

Previous studies have shown that vertebrate taxa have undetected amounts of rare earth elements (REEs) in their skeletons during life; little has been reported about fossil invertebrates. So far as is known, after death and during the early stages of diagenesis, REEs are quickly incorporated into the mineral lattice of the bones and teeth, and as reported here, shells and otoliths. The REE uptake in fossil specimens potentially can be used to determine the diagenetic environments of these fossils. The present study was designed to evaluate the REE uptake in samples taken from 69 specimens collected from the Culebra, Cucaracha, Gatun, and Chagres formations, and late Miocene strata in Darien Basin of Panama. Our overall goals were to use REE data to understand patterns of diagenesis and changes in terrestrial and oceanic environments in South America during the Miocene. The specimens were sampled using a rotary drill. The data were then used along with the laboratory protocol of the Florida Department of Geosciences’ laboratory protocol. The samples were analyzed for their bulk REE concentrations on an Inductively Coupled Plasma Mass Spectrometer (ICPMS). Because REEs can be correlated to the RE of the pore waters in which the fossils were fossilized, ratio analysis of La/Sr compared to La/Yb either confirmed paleo-depths of previous studies, or provided new evidence from the other poorly known localities. The plots of the vertebrate tooth and bone specimens from the five formations showed higher REE concentrations than those of the invertebrate plots, confirming a greater degree of porosity and relative diagenesis. The data also demonstrate that the Cucaracha and some Culebra samples were diagenetically altered in a terrestrial environment due to a continental signal, the Gatun sharks were altered in coastal environments, and the Darien and Chagres samples were altered in an oceanic environment. In contrast to the vertebrate bone samples, the Gatun smill Strontium sp., and Gatun otoliths display different REE patterns, with concentrations declining from La to Lu. These data show that the diagenetic composition. The Gatun echnoid, Encope, and oyster Hyotissa, both showed lower REE uptake indicating relatively little diagenesis. Our study demonstrates that REE analyses of fossils composed of hydroxyapatite or calcite are a useful proxy to determine early fossil diagenesis and paleoenvironment.

Poster Session V (Wednesday, October 17, 4:15 - 6:15 pm)

ADDITIONAL MATERIAL OF THE TYPE SPECIMEN OF THE TAPIROID COLDOYN KAIT (HOUGH) FROM THE SAGE CREEK BASIN, MONTANA

Tabrum, Alan R., Carnegie Museum of Natural History, Pittsburgh, PA, United States; Compton, Brian, East Tennessee State University, Johnson City, TN, United States; Perry, Steven F., Rexhine Friedrich-Wilhelms-University Bonn, Bonn, Germany; Hendy, Austin J., University of Florida, Gainesville, FL, United States; Pimentel, Catalina, University of Florida, Gainesville, FL, United States; Degracia, Carlos, Smithsonian Tropical Research Institute, Panama City, Panama

This specimen was collected in 1939 from late Uintan beds exposed in the Sage Creek basin (hough) from the Sage Creek Basin, Montana. In contrast to the vertebrate bone samples, the Gatun otoliths display different REE patterns, with concentrations declining from La to Lu. These data show that the diagenetic composition. The Gatun echnoid, Encope, and oyster Hyotissa, both showed lower REE uptake indicating relatively little diagenesis. Our study demonstrates that REE analyses of fossils composed of hydroxyapatite or calcite are a useful proxy to determine early fossil diagenesis and paleoenvironment.
Post Session III (Saturday, October 19, 4:15 - 6:15 pm)

THE FIRST RECORD OF A HESPERORNITHIFORM FROM JAPAN
TANAKA, Tomonori, Hokkaido University, Sapporo, Japan; KANO, Manubu, Mikasa City Museum, Sapporo, Japan; KURIHARA, Kenichi, Mikasa City Museum, Sapporo, Japan

Hesperornithiformes are marine foot-propelled diving birds and one of the most widely distributed group of birds in the Cretaceous. Here, we report the first record of a hesperornithiform from the Upper Cretaceous Kashima Formation (Coniacian to Santonian) of the Yezo Group, Japan. In 1996, a calcareous concretion was collected from siltstone-dominant marine deposits of the formation in Kumaosawa Creek in Mikasa City of central Hokkaido. It contained a partial, semi-articulated skeleton of a hesperornithiform and the ammnites Polyptychoceras psudogaultinum and Damesites dama, which suggest that the age of the horizon is early Santonian. The skeleton is represented by three cervical and three dorsal vertebrae, distal ends of left and right femora, and a middle part of left fibula. All of the preserved vertebrae are heterocerous with saddle-shaped articular surface. The foramen transversarium of the cervical vertebrae is large. The fibular condyle of the femur is expanded laterally as seen in many diving bird taxa (hesperornithiforms, gaviiforms, and podicipediforms). The concavitas lateralis of the dorsal vertebrae is deep, which is present only in hesperornithiforms. The combination of the characters in the dorsal vertebrae and the femur indicates that this specimen belongs to Hesperornithiformes. Prior to the Santonian, all of hesperornithiforms were reported from Cretaceous deposits in North America, except for Enaliornis from Albion of England. During the latest Santonian to Maastrichtian, hesperornithiforms appear to have radiated widely into Europe (Sweden, Russia, Ukraine, and Kazakhstan) and Asia (Mongolia). This Japanese hesperornithiform is the first report from the eastern margin of the Eurasian Continent and the oldest record outside of North America for the Cretaceous, except for Enaliornis. It also implies that the distribution of hesperornithiforms was expanded to Asia in, or prior to, the Santonian age.

Post Session IV (Saturday, October 20, 4:15 - 6:15 pm)

ANOTHER LOOK AT THE ORIGIN OF THE ENIGMATIC GANGES RIVER DOLPHIN PLATANISTA, AND THE CONTENT OF THE SUPERFAMILY PLATANISTIOIDEA (ODONTOCETI; CETACEA)
TANAKA, Yoshihiro, University of Otago, Dunedin, New Zealand; FORDYCE, Robert E., University of Otago, Dunedin, New Zealand

The history and relationships of the Ganges River dolphin Platanista (Odontoceti, Cetacea) have been contentious since Flower’s pioneering studies of “river dolphins” in the mid 1800s. Do living “river dolphins” – Platanista, Inia, Pontoporia and Lagenorhynchus – form a clade, or does the Platanista clade exclude the latter three genera? Recent osteological, paleoentomologial and molecular studies have not yet reached consensus. We are now reassessing the cladistic relationships of fossils in the odontocete families Waipatiidae, Allodelphinidae, Squalodontidae and Squalodelphinidae, to see which, if any, belong to Platanistoidea rather than to in stem Odontoceti. The study includes some new marine fossils from Oligo/Miocene rocks in New Zealand, with a total of 14 taxa (Zygoryzah, Agorophius, Allodelphis, Waipaitia, Squalodon, Platanista, Zarchaeophius, Promapotodelphis, Squalodelphis, Notocetus vanhuenendei, “N.” marplesi, un-named Notocetus-like OU 22306, Kogia and Mesoplodon), and 123 characters from previous studies by direct study of specimens (optically). The study will employ an operational taxonomic unit-based approach using both traditional and novel morphological algorithms of PAUP.4b6 producing following tree, in which 17 characters support monophyly of Platanistoidea (sensu Muizon), with this order of families: (Mesoplodon +Kogia (Allodelphinidae (Squalodontidae (Waipatiidae (paraephyletic “Squalodelphinidae” (Platanistoidea)))). If correct, this result indicates a higher diversity for Platanistoidea in the past than now, and deep (Late Oligocene) origins. Of note, “Squalodelphinidae” appears as a paraephyletic cluster immediately stem-ward of Platanistoidea, with the species of Notocetus being paraephyletic. The addition of more fossil putative plataniotids from New Zealand may better resolve the relationships of the Squalodelphinidae and Platanistoidea.

Technical Session III (Wednesday, October 17, 1:45 pm)

EAR MORPHOLOGY OF CAENOMERYS AND RELATIONSHIPS OF CAINOTHERIDS
THIEODOR, Jessica L., University of Calgary, Calgary, AB, Canada; DREGER, Sonya, University of Calgary, Calgary, AB, Canada; WOG, Jacqueline, University of Calgary, Calgary, AB, Canada; RUF, Irina, Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Bonn, Germany

The phylogenetic relationship of cainotheriids to other cetartiodactyls has been difficult to resolve, with recent analyses placing them either within Tylopoda or as basal ruminants. Previous description of a skull of Cainotherium showed several features which may bear on the question of cainotheriid relationships, but additional data on other cainotheriids was lacking.

Micro-CT investigations of the ear region of two specimens of Caenomeryx show that the preserved morphology is very similar to Cainotherium, including a greatly enlarged cancellous auditory bulla. The prominent ridge separating the endocranial and cerebellar faces of the periotic suggests that the periotic contains a massive, anteriorly directed subarcuate fossa, which faces more anteriorly than in Cainotherium. The subarcuate fossa contains a deep mastoid fossa within it. As in Cainotherium, the foramen acuminatum superius (leading into the facial canal) and internal acoustic meatus are separate, not set into a submeatal depression as in other known cetartiodactyls, suggesting that this separation of these foramina is synapomorphic for at least the Cainotheriinae, if not Cainotheriidae. On one specimen of Caenomeryx, the subarcuate fossa is less developed, the periotic bears a subarcuate fossa and a subtle flange bordering the lateral edge of the petrosal canal. This feature is similar to, but less well-marked, the condition in Cainotherium, and is not preserved in the second specimen. The sinus venosus temporalis is present, but appears to be mediolaterally compressed relative to that of Cainotherium.

The morphology of Caenomeryx based on these two specimens indicates that cainotheriid ear morphology is relatively consistent and is likely to be phylogenetically informative. The separation of the foramen acuminatum superius form the internal acoustic meatus appears to be autapomorphic for at least the cainotheriines; additional data for the oxacronine cainotheriids is necessary to verify the status for Cainotherium as a whole. The enlarged subarcuate fossa with a deep mastoid fossa is shared with a number of tylopodan taxa, including extant lamiales, Bunomeryx, anophlophorus and xiphodontids, but is also known among basal ruminants such as hyptragulids. The ventral flange bordering the petrosal canal appears to be poorly marked overall in cainotheriids and clearly differs from the overlapping condition in camelids and Bunomeryx. The overall morphology is more similar to that observed in camels, xiphodontids, and anophlophorus, but additional data will be needed to resolve the polarity of these characters.

Post Session III (Thursday, October 18, 4:15 - 6:15 pm)

SEARCHING FOR EVIDENCE OF FOSSIL FEATHER COLOR WITH SPECTROSCOPY
THOMAS, Daniel B., National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; JAMES, Helen F., National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; CARRANO, Matthew T., National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; MADDEN, Odile, Museum Conservation Institute, Smithsonian Institution, Washington, DC, United States

The history and relationships of the Ganges River dolphin Platanista (Odontoceti, Cetacea) have been contentious since Flower’s pioneering studies of “river dolphins” in the mid 1800s. Do living “river dolphins” – Platanista, Inia, Pontoporia and Lagenorhynchus – form a clade, or does the Platanista clade exclude the latter three genera? Recent osteological, paleoentomologial and molecular studies have not yet reached consensus. We are now reassessing the cladistic relationships of fossils in the odontocete families Waipatiidae, Allodelphinidae, Squalodontidae and Squalodelphinidae, to see which, if any, belong to Platanistoidea rather than to in stem Odontoceti. The study includes some new marine fossils from Oligo/Miocene rocks in New Zealand, with a total of 14 taxa (Zygoryzah, Agorophius, Allodelphis, Waipaitia, Squalodon, Platanista, Zarchaeophius, Promapotodelphis, Squalodelphis, Notocetus vanhuenendei, “N.” marplesi, un-named Notocetus-like OU 22306, Kogia and Mesoplodon), and 123 characters from previous studies by direct study of specimens (optically). The study will employ an operational taxonomic unit-based approach using both traditional and novel morphological algorithms of PAUP.4b6 producing following tree, in which 17 characters support monophyly of Platanistoidea (sensu Muizon), with this order of families: (Mesoplodon +Kogia (Allodelphinidae (Squalodontidae (Waipatiidae (paraephyletic “Squalodelphinidae” (Platanistoidea)))). If correct, this result indicates a higher diversity for Platanistoidea in the past than now, and deep (Late Oligocene) origins. Of note, “Squalodelphinidae” appears as a paraephyletic cluster immediately stem-ward of Platanistoidea, with the species of Notocetus being paraephyletic. The addition of more fossil putative plataniotids from New Zealand may better resolve the relationships of the Squalodelphinidae and Platanistoidea.
Fossilized melanin-bearing organelles (melanosomes) have recently given insight into the original coloration of fossil feathers in both extinct birds and their non-avian dinosaur relatives. Although melanin contributes part of the color palette to Neornithes, the full spectrum of modern feather color is achieved with a more diverse array of biochemicals. Therefore, expanding the color palette of fossil feathers may require analyses from a set of complementary techniques. Spectroscopic methods provide a good supplement to the existing morphological approach as they can rapidly differentiate each of the modern feather pigments without destruction of the original sample. We have explored the descriptive potential of Raman spectroscopy for analyses of modern and fossil feathers. Each of the reported feather pigments could be differentiated by in situ analyses of modern feathers, and spectral variations between chemically related pigments reflected shifts in hue. This allowed construction of a spectral library for identifying feather pigments in fossils. The presence or absence of feather pigments may be rapidly determined, and potentially provide color descriptions from point to point, or inform about the benefit of subsequent destructive analyses.

Technical Session VIII (Thursday, October 18, Thursday, October 18, 1:45 pm)

GENERIC DURATIONS OF TERRITORIAL MAMMALS IN THE OLIGO-HOLOCENE OF NORTH AMERICA AND IMPLICATIONS FOR THE UTILITY OF BODY SIZE AS A PREDICTOR OF SUPRASPECIFIC EXTINCTION RISK
TOMIYA, Susumu, University of California Museum of Paleontology, Berkeley, CA, United States

Phylogenetic comparative analyses of extinction vulnerability in mammals have typically focused on population statuses of extant species as well as biological traits of recently-extinct, predominantly insular species. In this regard, the mammalian fossil record in deep time is uniquely valuable because it potentially allows general patterns of migration and extinction (1) on continents, (2) in the absence of human impacts, and (3) at various scales of phylogeny. Here I examine the North American record of terrestrial mammals to test whether there is a general correlation between body size and extinction risk at the genus level across a body-weight spectrum that spans 7 orders of magnitude. Phylogenetic generalized least-square regression analyses of 220 Oligo-Holocene genera showed no significant correlation between their estimated body weights and sampling-adjusted durations. Thus, expectations from population-biological observations at the species level are not supported at the genus level. These findings suggest that extinction processes are distinct across levels of phylogenetic hierarchy and that prediction of future extinctions at supraspecific levels cannot simply rely on extrapolation of our current understanding of biogeographical correlates of extinction risk at the species level.

Technical Session IV (Wednesday, October 17, 2:00 pm)

ANATOMY OF ARCHOSAUR PELVIC SOFT TISSUES AND ITS SIGNIFICANCE FOR INTERPRETING HINDLIMB FUNCTION
TSAI, Henry P., University of Missouri, Columbia, MO, United States; HOLLIDAY, Casey M., University of Missouri, Columbia, MO, United States

Reconstructing joint anatomy and function of extinct vertebrates is critical to understanding their posture, locomotor behavior, ecology, and evolution. Major changes occurred in hip joint morphology during archosaur evolution, resulting in a spectrum of postures. However, the degree of soft tissue in modern taxa makes inferences of joint function difficult. Previous studies showed that bony articulation alone is insufficient for producing lifelike locomotor postures in archosaur hips. Moreover, the apparent incongruence of the bony acetabulum and femoral head of many extinct archosaurs suggests large volumes of missing soft tissue. This study describes the microstructure of crocodilian and avian hip joint and epiphyseal structures and documents osteological correlates for these structures in extinct archosaurs. Circumference and depth of the femoral head and the acetabulum were measured in basal and derived archosaurs to quantify the amount of missing soft tissues. The alligator proximal femur exhibited distinct regions of hyaline and fibrocartilaginous structures which are associated with different areas of joint contact during locomotion. A prominent bony ridge marks the junction between the metaphysis and epiphysial cartilage in fossil archosaurs. The ligamentum capsav is avascular and similar in microstructure and topology to capsular ligaments. In theropods (i.e., Allosaurus), this ligament attaches to the fovea capsav, whereas in suchians it has a cartilaginous attachment on part of the medial protuberance of the femur, which also leaves a shallow fovea on the calcified cartilage. The acetabular labrum attaches anteromediolaterally to the bony supracapectal crest in alligators, whereas in birds, the labrum comprises the dorsal border of the acetabulum, and is continuous with the antitrochanter. This suggests that supracartilaginous structures can be variably ossified at different regions of the acetabulum, perhaps in response to the primary directions of loading. In fossil archosaurs such as Postosuchus, Poposaurus, and Coelophysis, the bony supracapectal crest appears to constrain abduction and dorso-cranial dislocation of the proximal femur during paraspinal locomotion. On the other hand, the cartilaginous supracapectal labrum was likely present in derived theropods to articulate with the facies articularis antitrochantica (FAAN) of the femur, as substantial portions of FAAN lies outside of the acetabulum during reconstructed hip joint articulation. These data suggest major evolutionary transformations in the position and shape of the femoral head and acetabulum, and FAAN in different clades of archosaurs which impact our hypotheses of homology and function.
curved, and rather stout bones with a spatulate and a bifurcate end. However, they were always found as single bones, and differ from the relatively short and un bifurcated clavicles found articulated with the scapulae of basal sauroptodromorphs. Elements from the Howe Quarry (Late Jurassic; Wyoming, USA) shed new light on these interpretations. Besides the elongated, curved bones (herein named morphotype A), also pairs of symmetric, L-shaped bones were recovered (morphotype B), associated with diplopodial dorsal and cervical vertebrae. Elements resembling morphotype B - articulated between the scapulae - have recently been reported from a diplopodid found near Ten Sleep, Wyoming. Taphonomic evidence, as well as the fact that they were preserved in symmetrical pairs, therefore implies that morphotype B represents the true sauroptod clavicles. Contrary to earlier reports, morphotype A elements from the Howe Quarry, as well as previously reported specimens show a symmetry plane following the long axis of the elements. It is thus possible that the morphotype A elements were single bones from the body midline. The only such elements present in the pectoral girdle of tetrapods are the interclavicle and the furcula. Comparison with crocodilian and lactornter interclavicles indicates that the bifurcate end of the sauroptod elements might represent the reduced transverse processes of the anterior end, and the spatulate end would have covered the coracoids or sternal plates ventrally. The presence of both clavicles and interclavicles in the pectoral girdle stiffens the anterior trunk, and enhances considerably its stability. Such reinforcement might have been needed in diplopodids due to the strong lateral forces imposed on the forelimbs by the posteriorly placed center of mass (due to shorter forelimbs than hindlimbs), as well as lateral movements of the enormously elongated necks and tails. The absence of clavicles and interclavicles in titanosaurs coincides with the development of the wide-gauge locomotor system. The presence of clavicles in the megadont dinosaurs supports the recently proposed homology of the furcula with the interclavicle, instead of representing fused clavicles. Interclavicles were thus not lost, but may have remained cartilaginous or have yet to be found in basal dinosauromorphs.

Romer Prize Session (Thursday, October 18, 11:30 am)
CONVERGENT EVOLUTION AND ITS FUNCTIONAL MECHANISMS: A CASE STUDY OF BONE-CrackERS
TSENG, Zhijie J., University of Southern California, Los Angeles, CA, United States
The past 65 million years of evolution in carnivorous mammals exhibits numerous cases of convergence in ecomorphologies, stereotypical morphotypes that represent unique ecological adaptations. Such specialist niches are often occupied by unrelated species over evolutionary time and space, indicating the filling of critical ecological roles by functional convergence. To examine proposed mechanicahs explanations underlying convergence evolution of ecomorphologies, I document and review feeding specializations in one particular hypercarnivorous therian mammal clade, the bone-cracking spies. I identified and examined two bone-cracking species (Bunostegos and Gorgotherium) that evolved at least three times in Carnivora, the hyaenid, percocutid, and borophagine canine lineages. An integrative approach to the study of evolutionary change using data from skull shape, enamel microstructure, enamel microwear, and craniodental biomechanics shows that the suite of adaptive morphological characters that correlate with bone-cracking performance, and which are commonly found as a functional complex in hyaenids and canids, evolved in a mosaic manner. Microstructural differences in the enamel related to increased durophagy as inferred from microwear analysis, followed by subsequent skull shape changes toward increased robustness and strength. Following these changes, skull stress dissipation patterns began adapted to handle mechanical demands of processing larger bones. Given these findings, an updated definition of Carnivorn bone-cracking specialization is presented. This ordered evolutionary sequence of adaptive traits in a functional complex represents a flexible mode of evolution that accommodates different degrees of specialization in increasingly daphnagous lineages. Such data indicate that "partial" specialization can nonetheless enhance bone-cracking capability, and this phenomenon may serve as a logical foundation to explain a gradient of adaptations in other carnivorans and non-carnivorn mammal clades.

Technical Session XIV (Saturday, October 20, 9:00 am)
CRANIAL ANATOMY, PHYLOGENETIC RELATIONSHIPS AND BIOGEOGRAPHY OF BUNOSTEGOS AKOKANENSI S (PARAREPTILIA: PAREIASAURIDAE)
TSUIHIJI, Takanobu, The University of Tokyo, Tokyo, Japan; O'CONNOR, Patrick M., Ohio University, Athens, OH, United States
Bunostegos akokanensis is a pareiasaur reptile known from the Upper Permian Moradi Formation of northern Niger. Recently collected cranial material permits a redescription of the taxon in addition to inclusion of new information in a phylogenetic analysis of pareiasauromorphs. Bunostegos is highly autapomorphic, with diagnostic cranial features including the presence of two or three hemispherical bosses located at the anterior end of the snout, an elongate, laterally projecting supraorbital "horn" formed by an enlarged postfrontal, a large foramen present on ventral surface of postfrontal, and a hemispherical supratemporal boss located at postrostralateral corner of skull roof. We included Bunostegos in a cladistic analysis of 29 parareptilian taxa and 127 cranial and postcranial characters. The results of this analysis place Bunostegos as more derived than the South African Middle Permian forms such as Bradysaurus and Embriothosaurus, and as the sister taxon to the Upper Permian taxa including the Russian genus Deltavjatia plus Velosaurus. Characters such as the morphology of the cranial sculpture and the size and placement of the tabulars appear to be similar to more derived pareiasaurs such as Arganaceras from Morocco and Elinjia from Scotland, but the most parsimonious tree topology indicates that these features evolved independently in Bunostegos. The relationships of velososaurus pareiasaurs, including Anodoron, Nanoparia, and Scutosaurus, were consistent with those of previous analyses. Pareiasaur is important biogeographic markers within the Permian assemblage zones established for South Africa’s Beaufort Group and the occurrence of Pareiaasuchus and Anthodon in the Ruhuhu Basin of Tanzania and Pareiasuchus in the Luangwa Basin of Zambia has contributed to the regional correlation of these Upper Permian strata. The tetrapod fauna of the Moradi Formation, however, has proven difficult to correlate with other African assemblages because it contains genera unknown elsewhere (viz. Bunostegos, Morasaurus, Nigerorpo, and Saharastergo). An indeterminate gorgonopoid, the only therapsid known from Niger, suggests an Upper Permian assignment, while other taxa from the formation have Lower and Middle Permain associations. Moreover, the lack of both dicynodont herbivores and Glossospermatas in the Permian of Niger indicates a community
structure markedly different from roughly contemporaneous areas, and supports the theory that central Pangaea was geographically isolated from the rest of the supercontinent by desert-like conditions.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

ARTIODACTYLS FROM THE LATE MIocene (HEMMPHILLIAN) WYMAN CREEK LOCAL FAUNA, KEWA PAHA COUNTY, NEBRASKA

TUCKER, Shane T., University of Nebraska State Museum, Lincoln, NE, United States

VOORHIES, Michael R., University of Nebraska State Museum, Lincoln, NE, United States

The biostratigraphic record of the central Niobrara River Valley is well represented by strata younger than 4.5 million and older than 9 million years. An un-named intraformational channel fill in the uppermost portion of the Merritt Dam Member of the Ash Hollow Formation partially fills this regional gap in the rock record. Volcanic ash clasts incorporated into these unconsolidated, fossiliferous fluvial sands and gravels correspond with the Blacktail Creek Ash (6.62 ± 0.03 Ma) and establish a maximum geochronologic age for the Wyman Creek local fauna. Carnivore and rodent taxa further constrains the age of the deposit to the late Helleplian (Hb3) NALMA.

Artiodactyls make up a small percentage (3%) of the overall fauna but several dozen isolated teeth and postcranial elements are sufficiently preserved to identify seven taxa from five families. Three camelids are present in the fauna including a large cameline (Megatylus sp.) and two lamines, Pleistocene vera and an intermediate-sized taxon (7Afior). An adult female skull (total length = 328 mm) with a full complement of premolars in late wear is the only reported specimen of Pleistocene vera with its basicranium preserved. An indeterminate taxon of taxaissus is represented by several isolated teeth as well as a palate with moderately worn bunodont teeth and non-molariform premolars (P2-M3 length = 93.0 mm). The presence of the brachydont gelocid Pseudocerus documents a rare Great Plains occurrence during the late Helleplian (Hb3). In addition, the site preserves widely distributed late Helleplian taxa including the hysidodont alacriid (cf. Texoceros) and palaemeryc Pediomeryx cf. P. hemphillensis.

NEW SPECIMENS OF MIDDLE EOCENE WHALES (CETacea, PROTOCETIDae) FROM NEW JERSEY

UHEN, Mark D., George Mason University, Fairfax, USA

The Family Protocetidae was first delimited by Stromer to include the genera Protocetus and Eocetus, the only two protocetid genera known at that time. Both are from the middle Eocene (Lutetian and Bartonian respectively) of Gebel Mokattam, Egypt. The pace of discovery of protocetid fossils was extremely slow until the 1990s with only three genera (Pappocetus, Indocetus, and Babiacetus) added to the family. Since 1990, an additional 16 genera have been added to the family, greatly expanding our knowledge of their diversity, anatomy, behavior and biogeography. These additions to the family have been in Indo-Pakistan, Egypt and North America, as additional fossils of protocetids thought to be related to Eocetus are probably better interpreted as early basalsaurids. Protocetids have yet to be described from Oceania or anywhere in the Pacific Basin or Antarctica.

Here, several protocetid teeth are described from eastern New Jersey, USA. These specimens represent the northernmost discovery of protocetids in the world. These specimens were collected from the basal beds of the Kirkwood Formation (Ashury Park Member). While this unit is considered Aquitanian (= early Hemingfordian, or early Miocene) in age, these protocetid teeth, along with characteristically middle Eocene shark teeth are believed to have been eroded out of the underlying Bartonian (middle Eocene) Squankum Member of the Shark River Formation and were then incorporated into the basal beds of the Kirkwood Formation during the Aquitanian transgression represented by the basal Kirkwood. Several of the specimens described here were collected by avocational paleontologists, while others were discovered in museum collections misidentified as entelodonts, squalodonts, or indeterminate mammals. The specimens described here represent both molars and incisors of protocetids. They are similar to other contemporaneous protocetids from North America, Egypt, and Indo-Pakistan, and they lack the well-developed accessory denticles of more derived basalsaurids. Additional prospecting in the middle Eocene deposits of the mid-Atlantic of North America may yet provide more complete specimens for more in-depth phylogenetic analysis.

Romer Prize Session (Thursday, October 18, 11:45 am)

ENAMEL MATURATION AND INTRATOOTH STABLE ISOTOPE PROFILES IN ELEPHANT (LOxodonta AFRicana) MOLARS: A NEW TOOL FOR EVALUATING SEASONALITY IN TERRESTRIAL PALEOENVIRONMENTS FROM PROBOSCIDIAN TEETH

UNO, Kevin T., University of Utah, Salt Lake City, UT, United States

Multi-year stable isotope records from serially sampled fossil teeth are potential archives of an individual’s life history and the environment in which it lived. Carbon isotopes in enamel are a tool for evaluating shifts in diet resulting from seasonal vegetation change, whereas oxygen isotopes provide information about physiology and seasonality of precipitation. Proboscidian molars are attractive as archives of past environments because a single molar plate may contain up to a decade of information, and due to their large size and thick enamel, they are often well preserved in the fossil record. The formation of tooth enamel entails a protracted maturation period, leading to an attenuated and temporally shifted isotope record. Sampling geometry adds further complexity, limiting serial enamel isotope records to qualitative interpretations of seasonality.

To address this problem, I adapt existing models and determine key model parameters to describe enamel formation in modern elephant (Loxodonta africana) molars. Inverse model results produce estimated input signals (i.e., δ18O of diet and δ13C of body water) from measured isotope data in elephant molar plates, which in turn provide estimates of seasonal vegetation change and the frequency of seasonal precipitation. I establish accurate model parameters that include the growth rate of molar plates, initial enamel density, and enamel

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maturation length along a plate. Bomb-curve 14C dating of the last lower molar (m3) in two elephants reveals plate growth rates of 1.3 to 1.6 cm/yr; molar histology suggests similar rates. Micro-CT data show the initial enamel matrix is ~65% of the density of mature enamel. Coupled micro-CT and histological data indicate a maturation length of 7.6 ± 0.7 cm. The forward and inverse models are validated using remote sensing data, precipitation and oxygen isotope data sets, and by comparing synchronous, high-resolution molar and tusk isotope records in two elephants. The updated models for enamel formation in elephant molars provide a new technique for quantitatively assessing seasonality and proboscidean life history. Extension of this technique to fossil proboscidean teeth, particularly from the Neogene, will enable the study of seasonality in terrestrial paleoenvironments such as East African hominin sites or sites that bracket the late Pleistocene megafaunal extinction events. It will also be useful for studying key periods of proboscidean evolution.

Technical Session VI (Thursday, October 18, 3:00 pm)

NEW INFORMATION ON THE ANATOMY AND RELATIONSHIPS OF TITANOSAURIFORM SAUROPODS FROM THE CRETACEOUS OF EAST ASIA
UPCHURCH, Paul, University College London, London, United Kingdom; D’EMIC, Michael D., Georgia Southern University, Statesboro, GA, United States; MANNION, Philip D., Imperial College London, London, United Kingdom; BENSON, Roger B., University College London, London, United Kingdom; PANG, Qing, Shijiazhuang University of Economics, Shijiazhuang, China

There are approximately 90 valid, or potentially valid, species of titanosauriform sauropod. A significant proportion of these taxa (27%) come from East Asia, with this region yielding 17 new forms since 2000. However, many of these new taxa have received only brief preliminary descriptions; consequently their evolutionary relationships within Titanosauriformes remain problematic. First-hand examination of seven Cretaceous titanosauriforms from China (Bastiansausaurus, Borealosaurus, Gobititan, Huabeisaurus, Huanghetitan rayangensis, Ruyangosaurus and Xianshanosaurus) enables revision and strengthening of their diagnoses and a clarification of their phylogenetic positions. For example, Huabeisaurus possesses autopomorphies such as a tubercle on the anterodorsal part of the lateral surface of the coracoid and relatively short haemal blads in anterior chevrons. Moreover, some derived states occur in more than one taxon and are potentially phylogenetically informative (e.g., absence of ribs from caudal 10-11 onwards in Huabeisaurus and Alamosaurus, lateral projections at the distal ends of haemal blads in Gobititan and Huanghetitan rayangensis). Preliminary phylogenetic analyses (based on two data sets) suggests that all Cretaceous East Asian taxa are somphospondylans, but their precise relationships are sensitive to taxon/character sampling and treatment of quantitative characters. There is growing evidence for a group within Somphospondylidae that includes Extant Topus, Extinct Paralititan, Haplocanthosaurus, Huabeisaurus and several other Cretaceous East Asian taxa, characterised by derived states such as deep U-shaped bifurcation of preasural neural spines and strongly ventrally deflected cervical parapophyses. Most tree topologies suggest that several Early and mid-Cretaceous sauropods formed a monophyletic clade that was endemic to East Asia, suggesting that this region was physically and/or environmentally isolated at this time. Other taxa display unexpected similarities with derived South American saltasaurines, including the presence of somphospondylid tissue structure in the neural arches of anterior caudals and steeply reclined neural spines in anterior and middle caudal vertebral. This indicates that some of the Early and mid-Cretaceous East Asian titanosauriforms might also hold clues to the origins of one or more of the advanced titanosaur clades of the Late Cretaceous.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

MICROSTRUCTURE OF THE SERRATED MARGIN OF EXTANT AND FOSSIL SHARKS WITH ORTHODENTINE AND OSTEODENTINE
USHIMURA, Eri, University of Hyogo, Tatsuno, Japan

Serrated tooth margins have arisen a number of times throughout the evolution of carnivorous vertebrates, however, little is known about their formation. Shark teeth may provide ideal models to study serrae formation, since shark teeth are continuously replaced and both immature and mature teeth can be found in a single specimen. In this study I examined two shark and fossil shark teeth: the first type (the tiger shark, Galeocerdo cuvier, and the silvertip shark, Carcharhinus alalinigranitus) has orthodentine, in which dental pulp is localized at the center of the tooth. The second type (the great white shark, Carcharodon carcharias) has osteodentine, in which the dental pulp diverges irregularly. I also studied teeth from the fossil tiger shark G. aduncus from the Miocene of Aurora, North Carolina, US, and the great white shark C. carcharias from the Shimos Group, Middle Pleistocene. Microstructure of serrae was examined with ground sections of teeth and Pan-Scanotystylit in stained sections of jaws of the fetus shark with an optical microscope, and surface etched teeth with a scanning microscope. In the tiger sharks (extant and fossil, with orthodentine), a serra was composed of enameloid and dentine. A large triangular dental pulp was found in the center of the tooth, but not in serrae. In the great white shark (extant and fossil, with osteodentine), a serra was composed not only of enameloid and dentine, but also a divergent dental pulp entering into the center of the serra. In either type of teeth, with orthodentine or osteodentine, extant or fossil, numerous black spots, presumptive isolated odontoblasts, were found in the enamened of each serra. In Hematomys-lunaris stained sections of jaws of the fetus of the tiger shark and the silvertip shark, isolated odontoblasts were also found in the enamened in a serra.

Furthermore, before the stage of mineralization in the silvertip and great white sharks, the inner enamel epithelium was found to make folds that probably correspond to the outline of the future serra. In surface etched teeth in extant tiger shark, bonded bundles were found associated with the serrations as in the fossil carcharchiniform and lamniform sharks.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

PINNIPED TURNOVER IN THE SOUTH PACIFIC OCEAN: NEW EVIDENCE FROM THE PLIO-PLEISTOCENE OF THE ATACAMA DESERT, CHILE
VALENZUELA-TORO, Ana M., Universidad de Chile, Santiago, Chile; GUTSTEIN, Carolina S., Universidad de Chile, Santiago, Chile; VARAS-MALCA, Rafael M., Museo de Historia Natural - UNMSM, Lima, Peru; SUAREZ, Mario E., Museo Paleontológico de Caldera, Caldera, Chile; PYENSON, Nicholas D., Smithsonian Institution, Washington DC, DC, United States

Modern pinnipeds distributed along the coasts of continental South America consist almost entirely of otariids (sea lions and fur seals). In contrast, phocids (true and elephant seals) are present only on the southernmost extreme of Chile. This recent biogeographic pattern is consistent with the zoogeoeological record, but it is incompatible with the pinniped fossil record during the Neogene. From the middle Miocene to the Pliocene, true seals exclusively dominated pinniped assemblages, and they were only replaced by the fur seals and sea lions sometime after the Pliocene. Here, we describe pinniped material collected from two new localities in the Atacama Desert, northern Chile, that clarify this marine faunal faunal turnover. Specifically, these finds provide records of the first occurrence of Otariidae and the last occurrence of Phocidae in Chile, which in turn, these records constrain the timing of this turnover to the early Pliocene through to late Pleistocene interval. The stratigraphic context of these findings provide new insights into hypotheses that explain this faunal turnover in South America, and we briefly discuss them in the context of turnover events within other marine vertebrates throughout the Southern Hemisphere.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC ANALYSES OF URSIDAE ARE ABLE TO PREDICT FUNCTIONAL ADAPTATIONS OF FOSSILS VAN HETEREN, Anneke H., University of Roehampton, London, United Kingdom

Limited work has been done on reconstructing the diets of Ursus, Ursus minimus and U. rursus, because only few and fragmentary fossils are available. Three-dimensional geometric morphometrics might be able to determine the position of rare fossils in the morphospace of more abundant species, from which their diet may be inferred. To test this, the mandibular morphology of the eight extant Ursidae species, fossil U. arctos, U. spelea, and U. deningeri was analysed using 3D geometric morphometrics and the positions of Ursus, U. minimus and U. rursus determined relative to the extant morphospace. Landmarks for 3D digitisation of the mandible were chosen to reflect functional morphology relating to the temporalis muscle. Extant and extinct Ursidae, were digitised with a Microscribe G2. Generalised Procrustes superimposition was performed on the raw coordinates and allometric effects removed by regressing the Procrustes coordinates onto the individual landmarks and analysis of variance (ANOVA) conducted. Subsequently, Ursidae phylogeny was overlain onto the PCA graphs, allowing for dietary predictions for Ursus, U. minimus and U. rursus.

PCAs of mandibular landmarks differentiate between known dietary niches in extant Ursidae. ANOVA indicates that the most important food item in the diet has a highly significant effect on PCs 1 and 2. The positions of the nodes and the directions of the branches of the Ursidae phylogeny indicate that Ursus may have been adapted to increased amounts of invertebrates in its diet relative to its carnivorous ancestor Cephalogale. The diet of U. minimus is predicted to have consisted of greater intake of vertebrates relative to Ursus and U. rursus is predicted to have smaller invertebrate intake relative to U. minimus.

These results are consistent with analyses of individual teeth and two-dimensional geometric morphometrics from the literature. This indicates that overlaying a phylogeny onto morphospace can provide valuable information on taxa that are rarely or incompletely preserved in the fossil record.
Synchronic vertebrae are known in two nodosaurids (Edmontonia, Panoplosaurus) and one ankylosaurid (Saichania). Cervical fusion in ankylosaurs occurs between the first and second cervical vertebrae in all three taxa. The atlas forms a hemispherical cup-shaped cotylus that forms a ball-and-socket union with a spheroidal occipital condyle, which would have increased mobility at the cranio-cervical joint. The atlantal neural arches are fused ventrally to the centrum and posteriorly to the axial neural arches but are not fused to each other. Fusion of the single-headed atlantal rib and double-headed axial cervical rib to their respective vertebral occipit is occurs in all three ankylosaur taxa.

Currently, understanding the evolutionary patterns of the ankylosaurian synccervical is problematic because of poor phylogenetic resolution within this clade. However, the atlas-axis complex remains unfused in the nodosaurid Sauropelta and the ankylosaurid Ankylosaurus, Euoplocephalus, and Shannix in the Late Cretaceous and sauropods (all non-leptoceratopsid neoceratopsians), as well as Protoceratops and Liaoceratops, both taxa show a similar pattern. Pits are a common feature, as would be expected of a model of grinding mastication and also indicates that food on the labial side of the dentition is neither limited to leptoceratopsids nor uniformly horizontal. All taxa show a common morphology among shelves, suggesting in turn a common genesis of this structure.

When present, shelves in labial view most often take the appearance of a scalene triangle. The legs of the triangle represent distinct mesial and distal occlusal surfaces. The contribution of each surface varies across the dentition. If a single dentary tooth occluded equally with two maxillary counterparts, then the shelf has a near equilateral shape. The mesial and distal occlusal surfaces are not planar but concave in appearance, supporting a semicircular, palatal model of mastication. The labial distance that a shelf extends from the side of a dentary tooth is also variable both within a single individual and among taxa, its size a result of the amount of time since tooth eruption.

Dental microwear was recovered from shelves in both Ceratopsinae and Protoceratops, and both taxa show a similar pattern. Pits are a common feature, as would be expected of a model of grinding mastication and also indicates that food on the labial side of the dentition was moved rostrolaterally, presenting circumstantial evidence for a containing structure to prevent loss of food from the mouth.

The distinct lack of a universal horizontal orientation in the shelf supports abandoning the use of this descriptor; simply “labial shelf” is favored here. The common pattern in genesis of the labial shelf across many non-ceratopsid neoceratopsians, resulting from the incomplete shear of dentary teeth past their maxillary counterparts. The shelf was originally described based on the dentition of Leptoceratops gracilis; subsequent workers have noted the horizontal orientation of this structure, its possible function in grinding food, and its significance as a synapomorphy of Leptoceratopsidae. However, examination of Archaeoceratops, Liaoceratops, and Protoceratops (all non-leptoceratopsid neoceratopsians), as well as the leptoceratopsids Ceratopsidae, Leptoceratopsidae, and Protoceratopsidae reveals that the shelf is neither limited to leptoceratopsids nor uniformly horizontal. All taxa show a common morphology among shelves, suggesting in turn a common genesis of this structure.

Symposium: Cretaceous Faunas of Appalachia: Systematics, Paleoecology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 10:30 am)

LATE CRETAEOUS (SANCTONIAN-MAASTRICHTIAN) VERTEBRATE FAUNAS FROM THE ARCTIC OF APPALACHIA
VAREEK, Matthew J., Royal Ontario Museum, Toronto, ON, Canada; LARSSON, Hans C., Redpath Museum, Montreal, QB, Canada

Although fossil vertebrates were first discovered in the Canadian Arctic over 150 years ago by crews in search of the lost Franklin Expedition, the region has remained relatively poorly known in relation to more southerly parts of North America. We have begun a project to collect and describe fossil vertebrates from the Late Cretaceous of the eastern Canadian Arctic, and have discovered a much more diverse fauna than initially suspected. At present, we have identified seven chondrichthyan, an osteichthyan fish, a turtle, a mosasaur, a plesiosaur, a hadrosaurid, three non-avian theropods, and a hesperornithid bird from Santonian-Maastrichtian deposits on Bylot Island, Nunavut. Although some of the material is generically indeterminate, it nonetheless is a very important data set to estimate species distributions and biogeographic patterns of diversity. The eastern Canadian Arctic has a complex geographic history, one that is not currently isolated from other areas of North America, including southern Appalachia, by the inland Western Interior and Hudson seaways. During these periods when it may have been an insular landmass, it was still located above the Arctic Circle. Any terrestrial organism, such as the dinosaurs, would have been severely limited in their ability to migrate during these times. However, climatic conditions would have been much warmer and more equable, with average temperatures up to 15ºC higher than today and a smaller difference between winter and summer temperatures. The global warming at this time had a much more intense effect at the poles as well, resulting in a reduced equator-to-pole thermal gradient. Comparing the chondrichthyan diversity at the site with other regions in North America has shown that there may also have been a reduced gradient in species diversity, possibly related to the reduction in the temperature gradient. The species composition of Late Cretaceous chondrichthyan fauna of Bylot Island is intermediate between the faunas from Appalachia and Laramidia, and presents a more complex large-scale ecological pattern in North American Late Cretaceous marine chondrichthyan.
**Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)**

**QUANTIFYING BONE WEATHERING STAGES USING RA, A SURFACE ROUGHNESS PARAMETER MEASURED FROM 3D DATA**

VIETTI, Laura A., University of Minnesota, Minneapolis, MN, United States

Bone surface texture is known to degrade in a predictable fashion due to subaerial exposure, and can thus act as a relative proxy for estimating post-death/ pre-burial temporal intervals, which is relevant information for assessing time-averaging. To date, the majority of bone weathering data is collected on an ordinal scale based on observation. While this qualitative classification within the Hadar Formation as contrasted to the Koobi Fora Formation, surface analyses may provide means to quantify weathering stages. Here I test if different weathering stages are characterized by statistically distinct surface textures. Results indicate that the surface roughness parameter Ra, which is the average distance of valleys and peaks from the mean line of surface profiles measured from 3D scans, can quantitatively distinguish bone weathering stages from rib surfaces. I first determined the natural variation of rough rib surfaces by measuring the Ra from several locations on 80 unworn weathered ribs belonging to 4 mammal groups that weigh over 20kg (Equidae, Camelidae, Suidae, Cervidae). I found that all ribs are statistically similar when compared using paired Student’s-t test at a 0.05 significance threshold (Ra = 2.7 µm ± 0.08 µm). The dorsal and ventral portion of the rib are statistically different from the rest of the rib (Ra = 4.30 ± 0.22 µm) likely due to a more rugose bone texture related to tissue connectivity. After establishing natural bone texture variation, I measured Ra values from 30 weathered ribs, excluding rib heads and terminations. These same elements were also assigned a qualitative weathering stage. Paired Student’s-t tests at a 0.05 confidence level indicate that each ordinal weathering stage is statistically distinguishable. Mean Ra values for each weathering stage are as follows: Stage 1 = 4.47µm ± 0.76µm, Stage 2 = 6.82µm ± 0.76µm, Stage 3 = 13.78µm ± 0.88µm, and Stage 4 = 22.26µm ± 0.9µm. To date, this has only been applied to large mammal ribs; however, investigations are underway to determine fresh surface texture variation on other bone types and other vertebrate groups. The plan is to expand this work by analyzing additional weathered bones previously classified using the ordinal scale with this new technique. In conclusion, my results indicate that rib surface texture is similar across large mammal taxa and can thus be used for comparative bone weathering analyses. Using Ra to measure bone weathering characteristics may enable more reliable comparative taphonomic analyses by reducing inter-observer variations and by providing numerical data compatible for use in multivariate statistics.

**Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)**

**USING STABLE ISOTOPE AND TOOTH MORPHOLOGY TO RECONSTRUCT PALEOECOLOGY: A PILOT STUDY USING MICROTUSCALIFORNICUS**

VILLAVICENCIO, Natalia, University of California at Berkeley, Berkeley, CA, United States; MAGUIRE, Katlin C., University of California at Berkeley, Berkeley, CA, United States; MCGUIRE, Jenny L., University of Washington, Seattle, WA, United States

The California vole, *Microtus californicus*, has a broad geographic range from southern Oregon to Baja California and a fossil record dating to the early Pleistocene. A change in tooth morphology of the lower first molar (m1) is observed through the morphological range of the species: individuals have a more gracile and curved m1 in cooler, moister habitats typical of northern populations while those in warmer, drier habitats typical in the southern portions of its range have a more robust and straight m1. A change in morphology has also been documented through time with a loss in the robust straight morphology from cooler, moister Pleistocene times until today. These findings imply that spatial variability in precipitating factors may drive changes in vegetation and diet could drive the variation in tooth morphology observed in the California vole. Since the m1 is the most abundant fossil of *M. californicus* in the Pleistocene and Holocene record, the correlation between morphology and differences in precipitation and diet could be a potential metric for shifting functional ecological traits during times of shifting climate. In order to test the possible influence of environmental differences on the tooth morphology of *M. californicus* we used stable isotope analyses of fur in individuals from extant populations collected along the latitudinal range of the California vole. We collected samples of 35 individuals from the Museum of Vertebrate Zoology at UC Berkeley: 27 from the northern portion of the geographic range, and 8 from the southern part. Specifically we analyzed the oxygen isotope ratio to test for a correlation between morphology and precipitation. On a broad geographic scale comparing the northern population to the southern population, we find no difference between oxygen isotope values. However, when we looked at the southern specimens and analyzed the difference between individuals from different environments, we find a significant correlation between oxygen isotope values and habitat type (t-Test: p<0.009) of populations with different m1 morphologies. This suggests precipitation is influencing morphological variation at a local scale. Analyses of carbon, nitrogen and sulfur isotopes were undertaken to detect signs that the morphological variation is due to dietary differences that result from differing vegetation. This study helps determine the extent to which isotope data can be employed to understand the causes of fine-scale morphological changes.

**Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)**

**A NEW MARINE TURTLE FROM THE MAASTRICHTIAN OF ANGOLA**

VINEYARD, Diana P., Southern Methodist University, Dallas, TX, United States; MATEUS, Octávio, Universidade Nova de Lisboa, Monte de Caparica, Portugal; VIETTI, Natasha S., The University of Texas at Austin, Austin, TX, United States; POLICYN, Michael J., Southern Methodist University, Dallas, TX; United States; SCHULP, Anne S., Naturhistorisches Museum Maastricht, Maastricht, Netherlands

Well preserved skull, jaw and associated postcranial material of a new marine turtle was recovered from the mid Maastrichtian (Late Cretaceous) Mucuo Formation, Bentiba, Angola, during the 2010 Project PaleoAngola expedition. Preliminary analysis was performed showing that the new material represents a sister-taxon of *Euctaelus* based on synapomorphies such as extensive secondary palate, shovel-like mandible, low toroidal ridge, and broad skull, and places the new Angolan specimen as the most basal *Euctaelus*. This new species, *Angolachelys mbaxi*, is the second marine turtle previously unknown in the Cretaceous of Africa.

**Technical Session IX (Friday, October 19, 8:30 am)**

**VARIATION IN COMPLEX SYSTEMATIC PROBLEMS: A CASE STUDY**

VITEK, Natasha S., The University of Texas at Austin, Austin, TX, United States; BURROUGH, Robert W., The University of Texas at Austin, Austin, TX, United States

Levels of variation in one population that exceed interspecific levels known to be expressed between sister species can make species identification within a clad problematic. The situation is especially difficult in the fossil record, where levels of variation within many species remain poorly understood. Box turtles of the extant genus *Terrapene* exemplify this problem. The clade is currently split into six species and ten subspecies. Morphological variation has been noted in many of these taxa, but remains poorly characterized. The situation presents a clear problem; characterizing variation across the temporal and geographic range of the clade remains intractable until lineages can be separated and studied individually, but lineages are interconvertible and evolvable with time, and a lack of understanding of variation. In systemsatics, this problem can translate into poor understanding of apomorphies and a lack of resolution in phylogenetic analyses. We used Pleistocene and recent specimens of *Terrapene* as a test case to approach the problem of variation and systematic resolution in phylogenetic analyses that include fossils. We used specimen-level phylogenetic analyses to explore whether variation between specimen-level terminals still allowed for species-level resolution. We scored multiple specimens of extant species of *Terrapene* as well as multiple fossils from several localities. We hypothesized that specimens would cluster in polytomous assemblages by species, if variation had a minimal effect on resolution. However, in our analysis not all specimens clustered together into species assemblages. Examination of character distribution indicated that coding specimen-level, as opposed to species-level, terminals caused signal from
intraspecific variation to overwhelm potential apomorphies that were traditionally used to separate species. We then collapsed recent specimens into species-level terminals and fossil specimens into locality-level terminals. That approach resulted in traditionally recognized clades.

Our results indicate that the complement of species- and specimen-level analyses provides a starting point for elucidating different sources of variation that affect systematic resolution. In this case, we find that currently recognized apomorphies for species of *Terrapene* are insufficient to separate specimens describing atop of clad similarity and intraspecific variation. In this context, reliable, apomorphy-based identification of isolated specimens in the fossil record is currently impossible. Adding extinct ‘species’ known from only single specimens to an analysis presents a comparable situation. Some currently recognized species and subspecies are not immune to this problem.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm) 

**INSIGHTS FROM A NEW SPECIMEN OF THE GAVIALOID CROCODYLIAN *THORACOSAURUS NEOCESARIENSIS* FROM THE MAASTRICHTIAN-DANIAN HORNERSTOWN FORMATION, SEWELL, NJ**

VOEGELE, Kristen K., Drexel University, Philadelphia, PA, United States; PATEL, Athena K., Drexel University, Philadelphia, PA, United States; ULLMANN, Paul V., Drexel University, Philadelphia, PA, United States; SCHEIN, Jason P., New Jersey State Museum, Trenton, NJ, United States; LACOVARA, Kenneth J., Drexel University, Philadelphia, PA, United States

A recently discovered specimen of the gavialoid crocodylian *Thoracosaurus neocesariensis* from the Inversand Company glauconite pit in Sewell, NJ, yields new phylogenetic and ontogenetic information about this rare taxon. Collected from the end-Cretaceous Main Fossiferous Layer (MFL) thanatocoenosis of the Hornersstown Formation, these fossils represent a disarticulated but associated subadult individual, roughly half the size of those previously published. This new specimen includes a nearly complete lower jaw and the first well preserved articular, tabia, and ischium for *T. neocesariensis*. Novel taxonomic insights from the lower jaw include: 1) the angular-sural-suture passes broadly along the ventral margin of the external mandibular fenestra; 2) uniform size of teeth alveoli in the dentary posterior to the 4th alveolus; 3) anterior processes of the surangular are unequal in length; 4) surangular does not extend posteriorly to the tip of the retroarticular process of the articular; 5) presence of a dorsoventrally oriented sulcus between the articular and surangular anteriorly. The lateral three features are synapomorphic with congenic *T. macrorhynchos*. With respect to previously described larger *T. neocesariensis* specimens, this fossil individual possesses two unique features: 1) a linear frontoparietal suture between the supratemporal fenestra instead of a concavocovex suture, and 2) the 3rd and 4th dentary alveoli are not confluent and are equal in size, instead of separated with the 4th alveolus larger than the 3rd. The linear frontoparietal suture of this specimen is similar to that of *T. macrorhynchos*. In addition, the lingual foramen for the articular artery and alveolar nerve is solely on the articular in this individual, while for close phylogenetic relatives, including *T. macrorhynchos*, the lingual foramen is on the surangular entirely. These differences may reflect ontogenetic variation within *T. neocesariensis* and possibly independent evolution among gavialoids in the case of the location of the lingual foramen.

Symposium: Phylogenetic and Comparative Paleobiology: New Quantitative Approaches to the Study of Vertebrate Macroevolution (Friday, October 19, 12:00 pm) 

**THE IMPACT OF CORAL REEFS ON FISH DIVERSIFICATION**

WAINWRIGHT, Peter, University of California, Davis, Davis, CA, United States

Coral reefs harbor spectacular organismal diversity in a wide range of metazoan groups. Perhaps nowhere is this more conspicuous than teleost fishes where one in every six species lives on reefs and a stunning range of ecotypes and morphological specializations are found. But, did this diversity accumulate on reefs or have reefs been the site of this evolutionary creativity? We set out to explore the impact of reefs on cophylogenetic diversification in two major reef radiations of teleosts. Over 500 of the approximately 600 labrid species live on reefs, and the group includes spectacular ecological diversity, including detritivorous parrotfishes, cleaner wrasses, coral mucous feeders, zooplanktivores and a wide range of generalizedinvertivores. Patterns of diversification in the iconic labrids were contrasted with Haemulidae, which, although an important component of New World reef faunas, is actually more species rich in non-reef habitats and shows modest trophic diversity on reefs. Using an analysis pipe-line that accounted for phylogenetic relationships among species, the time available for diversification and model uncertainty we compared the rate of evolution of functional morphological traits associated with feeding and locomotion in reef and non-reef lineages. We found that reef lineages occupy about 68.6% more trophic morphospace than non-reef species and have rates of trait evolution that are on average twice as fast as non-reef lineages. Remarkably, when we remove species representing niches only found on reefs we find that currently recognized apomorphies for species of *Terrapene* are insufficient to separate specimens describing atop of clad similarity and intraspecific variation. In this context, reliable, apomorphy-based identification of isolated specimens in the fossil record is currently impossible. Adding extinct ‘species’ known from only single specimens to an analysis presents a comparable situation. Some currently recognized species and subspecies are not immune to this problem.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm) 

**ASYMMETRIC VANES OF LIVING AND FOSSIL BIRD FEATHERS INDICATE MECHANICAL FUNCTION RATHER THAN FLIGHT ABILITY**

WANG, Xia, University College Dublin, Dublin, Ireland; DYKE, Gareth, University of Southampton, Southampton, United Kingdom

In modern bird feathers, vane asymmetry is caused by the rachis lying towards the leading edge, which is thicker, narrower and stiffer. Asymmetry is thus found in feathers with leading edges in close contact with the airflow in flight. A great deal of attention has been directed at the aerodynamic function of vane asymmetry and it has been suggested that degree of asymmetry is related to flapping flight. The mechanical role that vane asymmetry plays has never been explored before.

We measured vane asymmetry (trailing-vane width: leading-vane width) at 25%, 50% and 75% of feather length from first or second primaries in the wings of 38 living species. Species were grouped by different flight styles, wing beat frequency, and flexural stiffness. ANOVA was conducted to determine if these parameters can be predicted from asymmetry. Results show that neither mean vane asymmetry (mean asymmetry value of the three points) nor vane asymmetry at any of the three points we measured is significantly different in birds classified with different flight styles (P>0.13) or wing beat frequency (P>0.64). However, mean vane asymmetry and vane asymmetry at the 25% point do differ significantly between birds that have markedly different feather flexural stiffness.

This research does not support the long-held dogma, “*Archaeopteryx* must have been a flapper because it has asymmetric feathers”; alternatively, data suggest that the least asymmetric feathers of this fossil bird, compared with those of modern birds, indicates that *Archaeopteryx*’s feathers were relatively more flexible. Because direct correlations between flight style and vane asymmetry cannot be established, conclusions about dinosaur flight capabilities from the vane asymmetry of fossils should be treated with caution.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm) 

**EXPLORING UNCERTAINTY IN THE CALIBRATION OF THE MOLECULAR CLOCK**

WARNock, Rachel C., University of Bristol, Bristol, United Kingdom; JoyCe, Walter G., Institut für Geowissenschaften, University of Tübingen, Tübingen, Germany; parHarm, James F., Alabama Museum of Natural History, University of Alabama, Tuscaloosa, AL, United States; lYson, tyler R., Department of Geology and Geophysics, Yale University, New Haven, CT, United States; DonoGhJue, Philip C., Department of Earth Sciences, University of Bristol, Bristol, United Kingdom

Calibration is a critical step in every molecular clock analysis but it has been the least considered. Bayesian approaches to divergence time estimation make it possible to incorporate the uncertainty in the degree to which fossil evidence approximates the true time of divergence.
We explored the impact of different approaches in expressing this relationship, using Testudines as an example for which we established novel calibrations. We demonstrate that the parameters distinguishing calibration densities have a major impact upon the prior and posterior of the divergence times, and it is critically important that users evaluate the joint prior distribution of divergence times used by their dating programs. We also show that the inclusion of informative fossil taxa increases concordance between raw palaeontological and molecular estimates of divergence times—however, the timescale always remains sensitive to the choice of calibration priors. This highlights the urgent need for innovative ways of incorporating palaeontological knowledge into molecular clock analyses.

Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)

DINOSAURIAN OOFEAUNA FROM THE UPPERMOST CRETACEOUS NEMEGT FORMATION IN MONGOLIA

WATABE, Mahito, Hayashibara Museum of Natural Sciences, Setouchi, Japan; TSOGTBAATAR, Khishigjав, Mongolian Palaeontological Center, Ulaanbaatar, Mongolia

Dinosaur eggs and nests are abundant in Cretaceous beds, especially in the Upper Cretaceous. The oofeaun from these beds are widely diverse, especially in China and North America. The uppermost Cretaceous Nemegt Nekonticaly yields many dinosaur fossil bones and has been intensively searched for dinosaur eggs and nests. These eggs and nests were carefully collected from the ground surface, and detailed geologic and geographic records were made. The surveyed dinosaur fossil localities of Nemegt age are: Bugin Tsav, Gurilin Tsav, Khaichin Ula I, Tsaagaan Khusbhu, Ulaan Khusbhu, Altan Ula II, III, and IV, and Khervmeen Tsav (Upper White Beds with Nemegtian dinosaur fossil assemblage).

The dinosaur bone fauna of the Nemegt Formation is represented by: theropods (Tarsarbasus, Gallimimus, alvarezsaurus, the oviraptorid Nomingia, and Aivinimus), sauropods, hadrosaurids (Saurolophus and Barbohild), an ankylosaurid (Tarchoia), and a pachycephalosaurid. The dinosaur ichnofauna (footprints) from the formation is characterized by: variably-sized bipedal forms (small to large theropods), large to medium-sized bipedal ornithopods, and medium and large-sized quadrupedal forms (sauropods and a possible ankylosaurid).

The dinosaur oofeauna of the bed contains: dendorostolith (variantly-sized forms), spherolithid, elongatoolithid (variantly-sized forms), and laevisoolithid (thin-shelled forms) eggs. Other egg groups belonging to the dinosaurusoid basic type, faveoololithids (usually assigned to sauropods), and ovaloololithid (ornithopods) eggs are absent, in spite of the existence of sauropods in the associated bone fauna. Eggs assigned to ankylosaurids have not yet been reported.

More intensive and careful searching for, and collecting of, dinosaur eggs is necessary in order to collect sedimentologic and geographic data associated with those eggs. Additionally, morphological variations in egg ultrastuctures between individuals and within the same egg need to be understood as a basis for further comparisons and the erection of new ootaxa. Such careful methods will provide a concrete basis for bone-egg-footprint correspondence among the Nemegt dinosaurs.

D. tridactylum

The degree to which ontogenetic data can facilitate our understanding of phylogenetic relationships has long been a subject of contention in evolutionary biology. In vertebrate paleontology the availability of fossil specimens at multiple developmental stages has permitted studies on the ontogeny of extinct taxa, a topic of growing interest in the field. However, morphological changes associated with ontogeny are generally considered a hindrance for resolving phylogenies in paleontological studies due to their confounding effects on taxonomic identification and the tendency of juvenile individuals to exhibit plesiomorphic features. Nevertheless, whether the patterns, or trajectories, of ontogenetic changes are phylogenetically informative remains to be tested. Here, we used extant members of Crocodylia to investigate whether the trajectories that describe the morphological changes associated with ontogeny contain significant phylogenetic signal. Using three-dimensional landmark-based geometric morphometric methods, we digitized the crania of ten extant crocodilian species and generated allometric trajectories for each sampled species to test whether the similarities in the orientation of these trajectories correlate with phylogenetic relatedness. Crucial to this study was the availability of molecular phylogenies that provided phylogenetic reconstructions independent from morphological data, with which the phylogenetic signal of these trajectories could be tested. I employed a suite of methods, including (1) the K-statistic; (2) a likelihood ratio test based on Pagel's lambda; (3) permutation of regression residuals; (4) topological comparisons between the dendrogram constructed from a clustering method and the molecular phylogeny; and (5) a Mantel test. All tests produced a non-significant result, indicating that the shape changes associated with growth are not phylogenetically informative. Interestingly, the topology of the dendrogram constructed from a clustering algorithm also differs markedly from the topology of published morphological trees, which suggests that the underlying signal in these trajectories is largely uncorrelated with similarities in adult cranial morphologies. The results of this study counter the assumption that patterns of morphological changes that occur throughout ontogeny contain significant phylogenetic signal and give caution to the use of ontogenetic data for phylogenetic inference.

Regionally Extensive Lansian Seismite Serves as a Time Synchronous Stratigraphic Marker for Mapping Dinosaur Bonebeds in Northeastern Wyoming

WEEKS, Summer, Southwestern Adventist University, Keene, TX, United States; CHADWICK, Arthur, Southwestern Adventist University, Keene, TX, United States

The Lance Formation in northeastern Wyoming and other correlative Upper Cretaceous deposits in the region are notoriously resistant to stratigraphic studies. The beds can change character completely over a few meters, and it is not unusual to find an entire change in sequence over a rock fall or a stream. An informal stratigraphic look at the Lance Formation leaves the impression that prominent sandstone ledges could serve as stable marker beds, but these are secondarily cemented with carbonate, and they can disappear and reappear at a higher or lower stratigraphic position without consistency. Without a dependable stratigraphic framework, it is difficult to correlate remote bone outcrops with the main quarry area. In the past, the most useful stratigraphic marker had been the major bonebed which is exposed for several hundred meters. The persistence of the bonebed suggested to us that a stratigraphic framework was possible. During the 2011 season, we identified a prominent seismite in the region of our quarries that is traceable across the extent of the quarries. The seismite is a tan, fine-grained, immature sandstone which exhibits distorted, undulating to crumpled bedding features and overlies an undisturbed sandstone. A flat, undisturbed sandstone lies above the seismite. We have thus far been able to map the seismite over an area of 50 square kilometers and we are presently working to ensure the seismite is everywhere a single event and to extend the seismite as far as possible. Using this time synchronous bed as a mappable horizon, we have been able to tentatively establish the relationship between the thirteen quarry sites we have worked. The majority of the quarries (eleven) occur in the main bonebed at a horizon 27 meters below the seismite. A microturbulent sequence is 15 meters below the seismite and a unique bonebed is 37 meters below the seismite. While the eleven quarries are paucispecific Edmontosaurus sites, the unique bonebed is remarkable in that excavation find (500 bones, teeth and mappable fragments) has revealed no Edmontosaurus remains, but bones and teeth from most other taxa of dinosaurs reported from the Lance (Pachycephalosaurus, Triceratops, Nanotyrannus, Tyranosaurus, Dromaeosaurus, nodosaurids, Struthiomimus, and several not yet identified) as well as remains of turtles, lizards, frogs, crocodiles and mollusks. We now know the stratigraphic relationship of this bed to the main bonebed, and we are now working to piece together a more comprehensive taphonomic model for the entire site.

STORAGE CLEANING EVENT

WEILLER, Matthew W., University of North Dakota, Grand Forks, ND, United States; SCHUMAKER, Karw K., University of North Dakota, Grand Forks, ND, United States; HARTMAN, Joseph H., University of North Dakota, Grand Forks, ND, United States

Museums and other institutions frequently have specimens hiding in field jackets for decades on back shelves in storage rooms. The collection facilities at the University of North Dakota (UND) are no exception, but have some extra challenges to overcome. First, UND has no staff fossil curator, which means this responsibility falls to the main paleontology professor and student volunteers. Second, is the lack of space for large vertebrate fossils, both in terms of cabinet space and jacket storage. As a result, specimens are stored in numerous places throughout the building. Third, UND has a history of hiring invertebrate paleontology faculty, which can result in vertebrate fossil specimens receiving less attention. These factors led to the peculiar situation of an Oligocene rhinoceros (UND-PC 16162), collected in 1966, being rediscovered in the North Dakota Geological Survey (NDGS) Wilson M. Laird Core and Sample Library in 2012. UND-PC 16162 is from the Brule Formation, White River Group, Stark County, North Dakota. Some elements of the specimen were collected with partial field jackets, while other elements were simply wrapped in newspaper. The specimen was placed into two wooden crates, brought back to UND and never prepared. The specimen was moved to the NDGS Core Library during the mid-1980s. The specimen remained in storage, with no record of the move, until 2012, when the crates were rediscovered in a cleaning effort at the NDGS Core Library. Once rediscovered, the search began for any field notes in order to determine the specific geographic location and stratigraphic horizon of the specimen. During this time, preparation of the fossil was undertaken with limited vertebrate fossil preparation equipment. To overcome the lack of equipment, a local orthodontic clinic was contacted and a surgeon volunteered the use of a spare cast cutter. A few UND paleontology students prepared the specimen and were able to involve one of the orthopedic doctors from the clinic in the process. Once prepared, the goal is to create a display with the specimen at the orthopedic clinic in order to promote paleontology, and positive interactions between the public and the paleontology program at UND. The rediscovery of the thricerops specimen is fortuitous in that the specimen represents Diceratherium tridactylum, which prior to this study was known in North Dakota only from specimens from the Arkáreea Formation. UND-PC 16162 is the first D. tridactylum specimen recovered from the Brule Formation of North Dakota and could assist with refinement of the biostatigraphic zonation of the Brule Formation in North Dakota.
SYMPOSIUM: Cretaceous Faunas of Appalachia: Systematics, Paleocology and Taphonomy: A Symposium Dedicated to the Memory of Donald Baird (Thursday, October 18, 9:30 am)

HADROSAURIDS FROM THE ‘LOST CONTINENT’ OF APPALACHIA
WEISHAMPEL, David B., Johns Hopkins School of Medicine, Baltimore, MD, United States; SARTIN, Catherine E., Johns Hopkins School of Medicine, Baltimore, MD, United States; NABAVIZADEH, Ali, Johns Hopkins School of Medicine, Baltimore, MD, United States

During the Cretaceous, dinosaurs in America occupied both Laramidia and Appalachia. A great deal of attention has been given to the former, to the extent that the latter might be regarded as a ‘lost continent’. In this study, we refocus attention on the Cretaceous Appalachian ornithopod dinosaur fauna, specifically the hadrosaurs. We begin an examination of their available material by focusing on three specimens: first, the first dinosaur skeleton ever put on exhibit, Hadrosaurus foulkii from the Woodbury Formation of Haddonfield, NJ, to which we add several new autapomorphies; second, a putative subadult hadrosaur from the Navesink Formation of Sewell, NJ, which we conclude to be from Edmontosaurus on the basis of the morphology of the pubis; and third, a robust humerus suggests the presence of a lambeosaurusine in Appalachia. We then use this information to explore the biogeography of hadrosaurs (and proximate outgroups) as it pertains to Appalachia, Laramidia, Asia, Europe, and elsewhere.

Technical Session XVI (Saturday, October 20, 10:30 am)
COLLAPSE OF THE EASTERN AFRICAN LARGER CARNIVORE GUILD: CAUSES AND CONSEQUENCES
WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden

For this study I analyzed the history of the eastern African carnivore guild using a set of 16 craniodental variables. This dataset was subjected to correspondence factor analysis to create a morphospace that could be further analyzed, focusing in temporal patterns of variation. The variables derived for analysis were functional richness (size of morphospace) and functional evenness (distribution of taxa in morphospace). These were compared in a series of time slices from 3.5 Ma to the present. The results show that the larger carnivore guild (species ≥21 kg) suffered a collapse of functional richness that began at or slightly before 2 Ma and is historically extreme today, with only a handful of hypercarnivores in the guild. Functional evenness has also changed, in that prior to 2 Ma, species were significantly positively associated (clumped) in morphospace, whereas today they tend to be randomly distributed or negatively associated (dispersed). Neither of these effects is seen in smaller carnivores. Thus, both the size and structure of the present day larger carnivore guild suggest that it is far from a naturally occurring assemblage. These changes do not in any way resemble changes to carnivore guilds associated with different climatic or environmental regimes today. The beginning of the collapse coincides broadly with the evolution of hominins with derived dietary strategies (Homo erectus sensu lato) that came to be in ever increasing competition with large carnivores during the course of the Pleistocene. This may represent the first instance of major environmental impact of the human lineage. These guild changes are likely to have had important consequences for the structure of herbivore guilds as well, though these still remain to be explored. My results show that the African larger carnivore guild is not as pristine as it is often made out to be. The consequences for the conservation of the African biota, given the disequilibrium of the larger carnivore guild, are likely to be considerable.

Technical Session VII (Thursday, October 18, 3:00 pm)
HOW DOES A ‘TYPICAL’ MAMMAL GROW? SAMPLING AND THE INTERPRETATION OF FOSSIL BONE TISSUE
WERNING, Sarah, University of California, Berkeley, CA, United States

Extant marsupials grow at slower rates than placental mammals of similar body size and ecology. Their ossification patterns also differ; marsupials delay epiphyseal fusion much longer than placentals do. Because placentals and marsupials have different growth strategies, their bone microstructure might be expected to differ in important ways; although vague trends can be seen, leporid δ13C records from soil organics in various localities in Texas reveal noticeable fluctuations in the ratio of C3 and C4 vegetation since the Last Glacial Maximum. Generally speaking, C4 productivity decreased drastically multiple times during the late Pleistocene and gradually increased since then, peaking at approximately 6 ka. Hall’s Cave in central Texas contains a well-dated sedimentary record that spans the last 20,000 years, encompassing the interval during which these changes took place. The cave is also extremely fossiliferous and rich in bone, which allows the opportunity for study of the relationship between terrestrial taxa and a terrestrial fauna. It is clear that the presence of these characteristic species in both terrestrial and marine environments is correlated with each other in terms of their skeletal structure. The presence of these characteristic species in both terrestrial and marine environments is correlated with each other in terms of their skeletal structure.
A RE-EVALUATION OF TOROSAURUS UTAHENSIS: IMPLICATIONS FOR MAASTRICHTIAN CERATOPSIS DIVERSITY IN WESTERN NORTH AMERICA

WIERSM, Jelle P., Natural History Museum of Utah and Dept of Geology and Geophysics, University of Utah, Salt Lake City, UT, United States; LOEWEN, Mark A., Natural History Museum of Utah and Dept of Geology and Geophysics, University of Utah, Salt Lake City, UT, United States; IRMIS, Randall B., Natural History Museum of Utah and Dept of Geology and Geophysics, University of Utah, Salt Lake City, UT, United States

There is considerable ongoing debate about taxonomy and ontology of late Maastrichtian chasmosaurine ceratopsid dinosaurs from western North America (e.g., Triceratops and Torosaurus latus). However, recent studies have all but ignored another coeval taxon, Torosaurus utahensis from the North Horn Formation of central Utah. We conducted a comprehensive re-analysis of ceratopsid specimens from the North Horn Formation; five diagnostic specimens were identified as Torosaurus utahensis, and three others are assignable to Torosaurus sp. We conclude that T. utahensis is a valid taxon based on two autapomorphies and a unique combination of character states. Autapomorphies for T. utahensis are proximally “waisted” postorbital horncores and with an anterior margin autapomorphies and a unique combination of character states. Autapomorphies for character state descriptions.

The presence of anterior supernumerary scales, a well-developed scalloped shell margin and comparisons provide new details on an exceptionally well-preserved plesiosaur and will help clarify the taxonomic position of this taxon through future studies.

A SOLUTION TO THE “LONGIROSTRINE PROBLEM”? A PHYLGENETIC REAPPRAISAL OF THALATTOSUCHIAN RELATIONSHIPS AND ISSUES SURROUNDING THEIR LABILITY

WILBERG, Eric W., University of Iowa, Iowa City, IA, United States

One of the most persistent issues affecting our understanding of crocodylomorph phylogenetics is the “longirostrine problem.” Several groups of long-nosed crocodylomorphs, traditionally thought to be unrelated are recovered as a clade in some analyses, but distantly related in others. Thalattosuchians, an early occurring group of marine- adapté crocodylomorphs, live in the mesopelagic environment. In contrast, diagnostic ceratopsid specimens from the North Horn Formation are assignable only to Torosaurus, a relative abundance which would be aberrant if it were simply an old adult of Triceratops. This could be an artifact of low sample size; however, the probability of finding only eight Torosaurus specimens from a Hell Creek-like relative abundance distribution of Torosaurus and Triceratops is <<0.001, indicating that the North Horn assemblage is significantly different from that of the Hell Creek. Two possible hypotheses could explain these data: first, T. utahensis is an adult of Triceratops, and only old adult animals are preserved in the North Horn Formation; or, T. utahensis and T. latus are valid and sister taxa, and the lack of Triceratops specimens in the North Horn Formation is a real biogeographic difference. We suggest the latter hypothesis is more likely.

FURTHER CONSIDERATIONS OF THE OSTEOLOGY OF TERMINONATATOR PONTEIXENSIS

WILHELM, Benjamin C., McGill University, Montreal, QC, Canada; TOKARYK, Timothy T., Royal Saskatchewan Museum Fossil Research Station, Eastend, SK, Canada

Terminonatator ponteixensis is known from an exceptionally well-preserved and mostly complete sub-adult holotype, lacking only portions of the skull, vertebral column, and most of the pectoral girdle. A second specimen, consisting of 12 adult posterior cervical vertebrae, has also been tentatively referred to Terminonatator. Here we describe previously unprepared material of the holotype including portions of the braincase, the atlas/axis complex, 20 vertebrae from various regions of the vertebral column, and elements of the pectoral girdle. This new material fills in many of the missing details of the anatomy of Terminonatator, and provides additional overlapping material with the second specimen. Comparison of these specimens provides further support for the referral to Terminonatator ponteixensis of the morphology and the preservational state of foramina subcentralia in the posterior cervical vertebrae. The large number of new vertebrae also allows us to provide an updated length estimate for the sub-adult holotype. Using the adult material referable to Terminonatator, we can scale this estimate to determine the size of an adult individual. Lastly, we provide new details on previously described elements of the type specimen, including the pathological femur and mass of gastroliaths. These descriptions and comparisons provide new details on an exceptionally well-preserved plesiosaur and will help clarify the taxonomic position of this taxon through future studies.

A PALEONTOLOGICAL AND NEONTOLOGICAL INVESTIGATION OF THE CLAIM THAT THE PTEROSAUR SCAPHOGNATHUS CRASSIROSTRIS SURVIVED INTO THE SEVENTH CENTURY

WILLIGNS, Pondanesa, Fayetteville State University, Fayetteville, NC, United States; SENTER, Phil, Fayetteville State University, Fayetteville, NC, United States; WILKINS, Pondanesa, Fayetteville State University, Fayetteville, NC, United States

In an attempt to discredit evolutionary theory by “proving” that humans and pterosaurs coexisted until recently, some young-Earth creationist (YEC) authors claim that a skeleton exhibited in Italy in the seventeenth century was that of a recently-killed pterosaur, specifically Scaphognathus crassirostris. It is important that paleontologists not simply dismiss such claims but instead investigate them and publish the results of the investigations. This is because YEC literature shows that the YEC community generally accepts the results of such investigations and drops falsified claims (e.g. alleged human footprints in Cretaceous limestones near Glen Rose, Texas) from its arsenal of anti-evolution claims. The skeleton in question was exhibited, and an anatomically detailed drawing of it was published in 1685, in which it was claimed that the specimen was a dragon that had recently been killed in the marshes near Rome. According to recent YEC literature, the winged skeleton’s cranial crest and long tail diagnose it as the pterosaur S. crassirostris. We compared the skeleton to that of S. crassirostris and note that its skull shape, dentition, hindlimb morphology, and tail vertebrae differ markedly from those of S. crassirostris and all other known pterosaurs. Furthermore, S. crassirostris has no crest; the YEC claim that it is crested is based on misidentification of an uncrusted frontal bone on a juvenile S. crassirostris fossil. Osteological comparison with extant animals reveals that the skeleton that was originally exhibited is a taxidermic composite. It combines the skull of a dog; the mandible of a second, smaller dog; and the tail of an eagle. It’s “hindlimb” is actually the forelimb of a small bird. False skin covers and conceals junctions between bones of different animals. The wings are fake and do not resemble pterosaur wings in shape. The claim that S. crassirostris survived until three centuries ago can therefore be put to rest, thanks to a combination of paleontological and neontological investigation of osteology. This piece of anti-evolution “evidence” is therefore invalid.
region experienced periods of drought. In addition, the fact that all of the turtle mass death assemblages from the Hell Creek of North America (N~6) are predominantly made up of baenid turtles indicates that these freshwater aquatic turtles were not well adapted for such environmental stresses.

**Technical Session XIII (Friday, October 19, 2:30 pm)**

NEW DISCOVERIES OF PRIMATES FROM THE EARLY PALEOCENE NACIMIENTO FORMATION (TORREJONIAN NALMA), SAN JUAN BASIN, NEW MEXICO: A WINDOW ON THE FIRST PRIMATE ADAPTIVE RADIATION

WILLIAMSON, Thomas E., New Mexico Museum of Natural History & Science, Albuquerque, NM, United States; SILCOX, Mary T., University of Toronto Scarborough, Toronto, ON, Canada

Primates were one of several mammalian orders that underwent a rapid period of diversification following the mass extinction of the p4 of some specimens of T. wiliami, which supports previous inferences about a close relationship to Plesiostes problematicus. This new sample considerably enhances our knowledge of the poorly understood “Palaechthonidae”, and about the biostatigraphy, biogeography, and early evolution of North American primates. In particular, the rarity of paromomyids, the continuing absence of purgatoriid, plesiadapid and carpolestid plesiadapiforms, and the presence of a number of endemic “palaechthonid” species in the SB are all contrasts with contemporaneous deposits to the north. These contrasts suggest that already by the latter part of the Early Paleocene primates had developed not only an impressive diversity, but patterns of regional endemism.

**Poster Session III (Friday, October 19, 4:15 - 6:15 pm)**

AGE AND GROWTH IN MYLEDAPHUS BIPARTITUS, A LATE CRETACEOUS FRESHWATER GUITARFISH FROM ALBERTA, CANADA

WILSON, Aloisia E., Robert T. Bambach,-Augusta, Drumheller, AB, Canada; NEWBREY, Michael G., Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; BRINKMAN, Donald B., Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; NEUMAN, Andrew G., Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada

The freshwater guitarfish, Myledaphus bipartitus, is commonly recognized by teeth and vertebral centra in the Late Cretaceous (Campanian, 75 Ma) deposits of North America. The species was first described in 1876, but until now, very little was known about its ecology. With respect to the “Palaechthonidae”, the current report includes a partial rostrum that preserves parts of the zygomatic arches, maxillae, palate, and P3 through M4. The braincase, basiocciput, and petrosal morphology are also preserved, although some aspects of the skull are badly crushed, and not all parts are preserved on both the left and right sides. The semicircular canals of the inner ear are complete on the right side only. Based on dentition, NDGS 431 represents a small individual of a young adult.

**Technical Session X (Friday, October 19, 11:45 am)**

A PARTIAL SKULL OF DIDELPHODON VORAX FROM THE LANCIAN-AGE HELL CREEK FORMATION OF SOUTHWESTERN NORTH DAKOTA, U.S.A.

WILSON, Gregory P., University of Washington, Seattle, WA, United States; EKDALE, Eric G., San Diego State University, San Diego, CA, United States; HOGANSON, John W., North Dakota Geological Survey, Bismarck, ND, United States

Late Cretaceous mammals from North America are known mostly from large collections of isolated teeth and dentulous jaw fragments. Though considerable data about the taxonomy, phylogeny, community structure, and ecomorphology of these mammals have been gleaned from these collections, fossil skulls and postcranial elements would provide a complementary and, by some accounts, more phylogenetically informative source of data to illuminate this critical interval of mammalian evolution.

A partial cranial of the stagodontid metatherian Didelphodon vorax (NDGS 431) was recovered from a sandstone unit in the Hell Creek Formation near Marmarth, North Dakota. This unit has also produced a typical Lancia vertebrate microfossil assemblage. NDGS 431 includes a partial rostrum that preserves parts of the zygomatic arches, maxillae, palate, and P3 through M4. The braincase, basiocciput, and petrosal morphology are also preserved, although some aspects of the skull are badly crushed, and not all parts are preserved on both the left and right sides. These semicircular canals of the inner ear are complete on the right side only. Based on dentition, NDGS 431 represents a small individual of a young adult.

**Technical Session XI (Friday, October 19, 4:00 pm)**

SMALL THEROPOD DINOSAURS FROM THE LATEST CRETACEOUS OF INDIA

WILSON, Jeffrey A., University of Michigan, Ann Arbor, MI, United States

Records of small theropod dinosaurs from southern landsmasses are rare, but such remains have been known from India for nearly a century. Excavations by Charles Matley in Upper Cretaceous (Maastrichtian) sediments at Bara Simla, central India in 1917 and 1919 produced vertebral and limb elements that historically have been separated into at least six species (Compsosuchus solus, Laeviuscus indicus, Jubbulpuria tenus, Coelurosauria Largus, Ornithomimodes mobiile, O. baeumkennia) or left as indeterminate ‘coelurosaurians.’ Relatively recent discoveries of the small theropod species Noasaurus leali and Masiakasaurus knopfeli from contemporaneous rocks in South America and Madagascar, respectively, and advances in basal theropod systematics have led to a revised interpretation of several of these small theropod specimens as noasaur abelisauroids. Here we present a revision of some of the small theropods from the latest Cretaceous of India, based on study of the Matley collection at the Indian Museum (Kolkata) and newly collected material from Pisdura, central India. Remains attributed to Laeviuscus and Jubbulpuria are approximately the same size, bear diagnostic features, and differ in features attributable to intracolumnar variation. It is likely that they are the same or closely related species, but the current absence of morphological overlap between them precludes testing that hypothesis. Coelurosauria, Coelurosauria, and Ornithomimodes pertain to individuals slightly larger than Laeviuscus/ Jubbulpuria. The latter two are morphologically distinct from Laeviuscus/ Jubbulpuria and share autapomorphies with one another suggesting that they can be grouped together as Coelurosauria, the first-named of the two genera. The new remains collected from Pisdura include a partial dentary that bears the characteristic procumbent dentition of Masiakasaurus, which appears to be absent in the Noasaurus maxilla. Likewise, the syntypic cervical vertebrae of Laeviuscus indica more closely resemble those of Masiakasaurus than Noasaurus. These data imply that the Indian and Madagascar noasaurids are more closely related to each other than either is to the South American form. The Bara Simla sediments were deposited during chorn 29R, and the Pisdura sediments during chrons 30N-29R. To date, no small theropod remains have been reported from relatively rich localities in western India (chon 30N), where hundreds of sauropod and theropod bones have been collected, nor among the numerous bones recovered from Late Cretaceous Pab Formation in Balochistan, Pakistan, whose precise age relative to the Indian localities is unknown.
The palaeoecology of
models in tandem with
of cichlids (East Africa) and 40 species of notothenioids (Antarctica). By examining extant
based on the same morphometric protocol and comprised representatives from 61 species
in the context of an adaptive speciation model. Our comparisons for extant species were
the palaeobiology of
which will be used to aid delimitation of unidentified materials, and for reconstructing
abundant, well-preserved fossils. Our results show a diversity of opercule shape, and
( Switzerland), a key locality from which four species have already been described from
and for modern day attempts to assess the impact of biodiversity loss. The actinopterygian
is of particular interest because among 'model' extant teleosts such as sticklebacks its
limited and have been only partly examined and a quantitative approach has rarely been

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)
QUANTITATIVE ANALYSIS OF THE TAPHONOMIC PATTERNS OF VERTEBRATE ASSEMBLAGES FROM THE Oligocene POLESLIDE MEMBER OF THE BRULE FORMATION, BADLANDS NATIONAL PARK, SOUTH DAKOTA
WILSON, Paige K., Dartmouth College, Hanover, NH, United States; MOORE, Jason R., Dartmouth College, Hanover, NH, United States
The spectacular fossil assemblages preserved in Badlands National Park have long been a
great interest for palaeontologists and a paleoenvironmental study of the fauna of the White River Group.
The paleoecological study of White River Group faunas is, however, made more complex by the potentially confounding variation of taphonomic biases in both time and lithology. In this study taphonomic and paleoecological data were collected from four mammal-dominated fossil assemblages (two mudstone hosted and two sandstone hosted) from the Poleslide Member of the Brule Formation, in the less well studied Palmer Creek Unit of Badlands National Park, South Dakota. Previous work in the region has confirmed that the two major lithologies represent fluvian- and fluvial-dominated depositional environments, respectively.
A suite of quantifiable taphonomic and ecological variables were recorded for each of the
more than 600 specimens. Variation in taphonomic patterns was assessed using a range of
bivariate and multivariate statistical techniques, and the ecological structure of the
assemblages was compared using standard diversity metrics. Results revealed distinctly
different patterns of taphonomic biasing between the aeolian and fluvial samples, with some
variability between all four sites. Little conclusive change in overall faunal composition
was exhibited between the mudstone and sandstone samples, however. This suggests that
when species composition did not respond to changes in environment, differences
could have been caused by the preservation of the different materials
seen in the sedimentological record, the differing preservational environments produced a noticeable
inhomogeneous taphonomic overprint on the samples during and after fossilization.

Technical Session III (Wednesday, October 17, 3:45 pm)
HABITAT STRUCTURE AND HINDLimb FUNCTIONAL MORPHOLOGY IN AN EARLY MIOCENE EQUID FROM PANAMA
WOOD, Aaron R., Florida Museum of Natural History, Gainesville, FL, United States; RINCON, Aldo F., Florida Museum of Natural History, Gainesville, FL, United States; MORENO RODRIGUEZ, Federico, Smithsonian Tropical Research Institute, Panama City, Panama; BLOCH, Jonathan I., Florida Museum of Natural History, Gainesville, FL, United States; JARAMILLO, Carlos A., Smithsonian Tropical Research Institute, Panama City, Panama
Paleoenvironmental conditions of the Las Casadas Formation of Panama are relatively
unknown but are integral to understanding the evolution of the oldest terrestrial assemblage
of vertebrates (middle-late Arikareean) in southern Central America. Here, we describe
postcrania of an abundant equid taxon from the Las Casadas assemblage and apply a
morphology-based proxy to infer habitat structure during the early Miocene of Panama. The Las Casadas equid is tentatively identified as a small (45-55 kg via regression analysis of
limb dimensions), primitive parahippine based on dental morphology. Postcraniaal elements
discovered in a single quarry include a scapula, proximal radii, femora, tibiae, astragals, calcanea, a third metatarsal, and several phalanges. Qualitative comparisons with the well-
studied, time-averaged population of "Parahippus leonensis" from the Hemarksfjord of
central Florida reveal functionally-relevant dissimilarities between the taxa: 1) the femoral head and neck are rotated more anteriorly relative to the long axis of the femur, 2) the astragalar neck is shorter and more perpendicular to the axis of the tibiae, 3) reduced lateral and medial ligamentous attachments sites on the astragals, and 4) a more pronounced development of the astragalar facets on the tarsal bone relative to the plantar plane. These features
suggest a more flexed neural posture of the hindlimb in the Las Casadas equid as well as a
reduced lateral component of ligament-mediated stability during locomotion. Our paleoenvironmental proxy, measured using three-dimensional geometric morphometric (3DGM) techniques, is built on the observed correlation between mammalian tarsal
morphology and substrate complexity, which differs between open and closed habitats.
3DGM analysis of Miocene equid astragals shows the Las Casadas equid outside the
morphospace occupied by predominantly closed-habitat, early Miocene morpotypes but
within the region occupied by mixed open/closed habitat horses from the late Miocene. These results, combined with abundant volcanoclastics of the Las Casadas Formation, suggest a mosaic of open and closed habitats created by intense volcanic disturbance of
tropical forests during the early Miocene of Panama.
high browsers) such as Brachiosaurus, lack any neural spine bifurcation. Recently it has been proposed that neural spine bifurcation in Diplodocoidea is ontogenetic, suggesting that the origination of bifurcation in Diplodocus is a response to the increasing weight from the horizontally extended cervical column. As there are no terrestrial vertebrates with massive, horizontally extended necks alive today, extant forms with large cranial masses were examined for the presence of neural spine bifurcation. Here we demonstrate and report on for the first time, the soft tissue surrounding neural spine bifurcation in a terrestrial quadruped through the dissection of three Ankole-Watusi cattle. With horns weighing up to a combined 90 kg, the Ankole-Watusi is unlike any other breed of cattle in terms of horn weight and presence of neural spine bifurcation. Specifically, in regards to the soft issue, the presence of bifurcated neural spines is most vividly expressed in the form of a highly modified and specialized nuchal ligament. Inferred from the information attained from the Ankole-Watusi, it would appear that neural spine bifurcation is critical when supporting a large mobile weight positioned off of the shoulders, which may explain the presence and absence of bifurcation within Diplodocus and Brachiosaurus. During this study neural spine bifurcation was also observed in several additional families of sauropods, within several other clades of avian and non-avian dinosaurs, and within numerous extinct and extant species of mammals. Contrary to the previous hypotheses that neural spine bifurcation was a basal feature that was evolutionarily lost in many clades, bifurcation should now be recognized as a critical anatomical component for potentially any terrestrial vertebrate with a large, mobile weight positioned off of the shoulders.

Technical Session XV (Saturday, October 20, 9:45 am)

PALEOBIOLOGICAL IMPLICATIONS OF GROWTH HISTORY AND HISTOVARIBILITY IN A POPULATION OF THE HADROSAURID DINOSAUR MAIA SURA PEEL BESORUM

WOODWARD, Holly N., Museum of the Rockies and Department of Earth Sciences, Montana State University, Bozeman, MT, United States; HORNER, John R., Museum of the Rockies and Department of Earth Sciences, Montana State University, Bozeman, MT, United States; FARLOW, James O., Indiana Purdue University Fort Wayne, Fort Wayne, IN, United States

Forty-eight tibiae of the hadrosaurid dinosaur Maiasaura peeblesorum were used in a histologic analysis to assess the ontogenetic and individual variation present within a non-avian dinosaur. Tibial measurements reveal strong relationships (R² > 0.9) between tibia length and diaphyseal circumference, cortical area, and bone wall thickness, and histology shows woven tissue was present throughout ontogeny, indicating growth was rapid until skeletal maturity was attained. A switch in vascular arrangement between lines of arrested growth (LAGs) similar to that recently described in Arctic Edmontosaurus was also found between the two years of age and older. Immediately following a LAG, vascular canals were relatively small and longitudinal, and then became reticular, laminar, or plexiform for the majority of the zone. The presence of this vascular pattern in a taxon found far from the Arctic Circle casts doubt on a correlation with polar endemism. Apposition rates and growth curves illustrate that approximately half of the 7 m adult body length was attained within the first year of growth. Adult size, signified by the presence of an external fundamental system, was attained between 9–10 years of age by three individuals. Ontogenetic growth rates of Maiasaura were directly compared with the ontogenetic growth rates of skeletonally mature captive male alligators by scaling the adult cortical growth of each taxon. Annual cortical increase is low and constant for the alligators, while Maiasaura cortical increase is very high early in life and steadily decreases to skeletal maturity. By directly comparing the taxa, it becomes evident that even alligators raised in optimal conditions never attain the elevated growth observed in Maiasaura, providing additional evidence that the presence of LAGs in non-avian dinosaurs is not an indicator of eothecomy or reduced growth rates. Additionally, both standard and scaled Maiasaura growth curve demonstrate that there is considerable variation with regard to body size each year, which is often a lurking variable within ontogenetic studies of dinosaur taxa due to inadequate sample sizes. Finally, the age-size frequency distribution of tibiae suggests a high mortality rate for yearlings and those individuals approaching skeletal maturity. In fact, over half of the sample is from individuals a year or less in age, suggesting that even forty eight specimens are not sufficient to fully assess the histovariability present within this taxon. Regardless, this detailed population histovariability analysis contributes to the already well-studied hadrosaur Maiasaura, making the ontogenetic history of this taxon one of the best understood of all non-avian dinosaurs.

Technical Session XVI (Saturday, October 20, 9:15 am)

3D BIOMECHANICAL MODELLING OF MARSUPIAL AND PLACENTAL SABRE-TOOTHS: A DIFFERENT KIND OF BITE FOR AN EXTREME POUCHED PREDATOR

WROE, Stephen, University of New South Wales, Kensington, Australia; CHAMOLI, Upkar, University of New South Wales, Sydney, Australia; PARR, William, University of New South Wales, Sydney, Australia; RIDGELY, Ryan C., Ohio University, Athens, OH, United States; WITMER, Lawrence M., Ohio University, Athens, OH, United States

Questions surrounding the striking morphology of sabre-tooths and the presumably deadly purpose to which it was put, has long excited the attention of anatomists. Among the dozens of known sabre-toothed species, the iconic North American placental, Smilodon fatalis, and the bizarre South American marsupial, Thylacoleon atlatus are by far the most specialised forms. The two are prominent in discussions of convergent evolution. Here we apply a 3D computational approach to determine the extent of convergence in terms of mechanical performance. Both jaw closing and neck depressing musculatures were simulated. We found that, in many respects, the marsupial and placental were more similar to each other than to a living conical-toothed cat. Predicted bite forces were relatively low particularly at wide gaps and in simulations where jaw muscle forces were scaled to match bite forces expected of living sabre-tooths. Sabre-tooths’ skulls showed high stresses. Simulations involving head depressing musculature adjusted for size differences revealed relatively low stresses in both. Although broadly comparable in these respects our study also demonstrates differences that were likely reflected in the modus operandi of the kill. Jaw adductor driven bite forces were extremely weak in the marsupial and its skull was even better adapted to resist stress induced by neck driven muscles. Considered together with the fact that the centre of the arc described by the canine teeth was close to the jaw joint in S. fatalis our results are consistent with the hypothesis that both jaw closing and head depressing musculature played a role in prey dispatch for the placental. However, for T. atrox the jaw adducting muscles probably played no major part in the killing bite and we suggest that the marsupial presents a more complete commitment to the already extreme sabre-tooth lifestyle.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

A BASAL S AURICHTHY FORM (ACTINOPTER Gi) WITH A PECULIAR NEUROCRANIUM AND JAW MECH ANISM FROM THE MIDDLE TRIASSIC OF SOUTHWESTERN CHINA

WU, Feixiang, Institute of Vertebrate Paleontology and Palaeoanthropology, Chinese Academy of Sciences, Beijing, China; SUN, Yuanlin, School of Earth and Space Sciences, Peking University, Beijing, China; HAO, Weicheng, School of Earth and Space Sciences, Peking University, Beijing, China; JIANG, Da-Yong, School of Earth and Space Sciences, Peking University, Beijing, China

A new saurichthyiform is reported here from the Middle Triassic (Anisian) Guanling Formation of Guizhou Province, China, based on an exceptionally 3-D preserved braincase and other material of the lower jaw and pectoral girdle. This taxon provides considerable morphological data, especially those of the neurocranium and the jaws. It displays several primitive features, such as the presence of lateral pillar, paired posterior myomeres, parabasal canal, and convergence of the ramus ophthalmicus trigemini and lateralis in orbital region, etc. This new fish also possesses a series of unique derived traits: the posterior ethmoidal region (covered by vomer) bulging downward, the orbital tectum broad, some denticles delimiting the posterior edge of the spiracular groove, a large deep fossa present in the rear part of orbit housing the origin of some mandibular adductor muscle, the surangular extensively prolonged, the angular partaking in the mandibular symphysis and the posteroventral process of the triradiate cleithrum long. Phylogenetic analysis places Thylacoichthyasus in a clade of the North American placental sabre-tooths and strongly supports the monophyly of this order, which is the sister group of the Acienceratheres. As for the anatomical features, special interest is the association of the large deep fossa in the orbit with the prolonged opening of the mandibular adductor fossa, constructing a peculiar jaw mechanism reminiscent of some specializations in that of Polypterus. This, together with its blunt crushing-type dentition and downward bulging anterior mouth roof, suggests a different ecologically adaptive strategy in the saurichthyiforms during the rapid radiation period after the end-Permian mass extinction.

Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)

ANATOMY, SYSTEMATICS AND TAPHONOMY OF AN ALLIGATOROID CROCODYLIAN SKELETON FROM THE KAIPAROWITIS FORMATION (LATE CAMPANIAN) OF SOUTHERN UTAH

XU, Albert, The Webb Schools, Claremont, CA, United States; HENN, Madison, The Webb Schools, Claremont, CA, United States; WOODWARD, Samuel, The Webb Schools, Claremont, CA, United States; FARKE, Andrew A., Raymond M. Alf Museum of Paleontology, Claremont, CA, United States

Although the dinosaurs of the Kaiparowits Formation (late Campanian) are more widely known, continued fieldwork by several institutions within Grand Staircase-Escalante National Monument of southern Utah is greatly improving the previously fragmentary record of crocodyliforms from these strata. In 2011, the Raymond M. Alf Museum of Paleontology (RAM) collected a partial skeleton of an alligatoroid crocodiliform from the upper portion of the middle unit of the Kaiparowits Formation. The specimen, RAM 14527 consists of 49 osteoderms, a mid-cervical vertebra, dorsal vertebra, two ribs, left humerus (length=94 mm), right femur (length=167 mm), and both lower jaws. The specimen was disarticulated but closely associated across 3 m² of the 6 m² excavated area, at the base of an indurated tabular sandstone overlying a mudstone containing abundant plant fragments. Associated fauna included rare lepisosteid fish scales and disarticulated unionid clam shells. We tentatively interpret the site as a pond deposit overlain by a crevasse splay. Phylogenetic analysis recovers RAM 14527 as an alligatoroid, potentially representing a previously undescribed taxon. The largest dorsal midline osteoderms (52 mm in maximum dimension) are square, with slight keeling, arching, and no anterior process. The dentary measures 345 mm long, with the symphysis extending to at least the seventh alveolus. The preserved dentary teeth, representing positions from throughout the length of the tooth row, are elongate and conical. The anterior processes of the surangular are sub-equal in length, and the surangular-dentary suture extends to the posterior corner of the external mandibular fenestra. All of these features are consistent with identification of the specimen as an alligatoroid, but the combination of characters appears to be unique among previously described taxa. Because associated skeletons of alligatoroids (and crocodylians in general) are comparatively rare in the Kaiparowits Formation, RAM
NEW INFORMATION ON SEXUAL DIMORPHISM AND ALLOMETRIC GROWTH IN THE PACHYPLEUROSAUR KEICHOUSAURUS HUI FROM THE MIDDLE TRIASSIC OF GUIZHOU, SOUTH CHINA

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Sexual dimorphism and allometric growth of the pachypleurosaur sauropterygian Keichosaurus hui from Middle Triassic of Xingyi, Guizhou, south China, has been previously described but briefly without details of the precise criteria used. After measuring 22 new specimens of K. hui and 15 previously described specimens of the same taxon, we gained new information for discriminating between the two sexual forms and describing the ontogeny. The morphology of the ulna has not previously been used as a criterion to determine the sexual form. However, after measurement we found that the proportion of the length of the ulna versus the length of the radius in most specimens of the sexual form y is less than 0.92, whereas it is greater in the sexual form x and subadult, even reaching 1.06, complementing the previous standards which mainly depended on the ratio of the humerus relative to the femur. Furthermore, the proportion of the width of ulna versus the length of ulna is generally greater in the sexual form x than in the sexual form y.

In the aspect of ontogeny of Keichosaurus hui, we found several promising equations to quantify the process of allometric growth, using the model of \( y=a+b\exp(c+x+d) \) to fit the graph, in which two formulas stand out. One represents the change of the width of skull versus the width of glenoid compared to the growth of trunk, and the other represents the change in the length of skull versus glenoid-acetabulum distance with the growth of trunk. The \( r^2 \) of the former formula is 0.91554 while the latter is 0.94419, being significant, and both of them indicate a more rapid growth in incipient stage which decreases to zero during ontogeny. This result corroborates the hypothesis about the model of growth published before. We also examined the development of glenoid and acetabulum and found that during ontogeny, the width of the two parts changes relatively more rapidly than growth of trunk indicating the development of locomotion. The glenoid is particularly rapid and support for the forelimbs develops more rapidly than that for the hindlimbs, especially in the sexual form y.

Edwin H. and Margaret M. Colbert Prize Competition (posters displayed October 17 - 20, judging occurs Thursday, October 18)

EFFECTS OF DIETARY DIFFERENCES BETWEEN TWO EXTANT RUMINANTS IN SYMPATRIC HABITAT ON ENVIRONMENTAL RECONSTRUCTION BY MSOWEAR ANALYSIS

YAMADA, Eisuke, Kagoshima University, Kagoshima, Japan

Mesowear analysis, a method used to reconstruct diets based on facet development on the occlusal surface of cheek teeth, has been mainly applied to reconstruct the food habits of extinct species and the paleoenvironments they lived in. However, little is known about the effects of dietary differences in a sympatric environment. This limitation can introduce errors when applying the method to fossil assemblages. The aim of this study is to determine the sensitivity of mesowear analysis. An interspecific comparison of mesowear variables (i.e., frequencies of occlusal relief and cusp shape) was conducted using wild populations of the Japanese serow (Capricornis crispus, \( n = 37 \)) and the sika deer (Cervus nippon, \( n = 55 \)) in the deciduous broad-leaved forest of the Nikko National Park, central Japan. Mesowear variables between the two populations were significantly different (Fisher’s exact test: \( P < 0.05 \)). The Japanese serow population was classified as browsers and the sika deer population was classified as mixed feeders by hierarchical cluster analysis and principal component analysis. As previous ecological studies provide good support for these results, we validated mesowear analysis in sympatric species and the paleoenvironments they are expected to have a low f-number. The f-numbers of three genera of mosasaurs, Tylosaurus, Platecarpus, and Clidastes were calculated from the measurements of their skulls and sceral rings. We compared two methods to estimate the optical axial length. One method estimated the axial length from the width of the skull and the lateral margin of the frontal, which forms the dorsal rim of the orbit. The second method uses the external diameter of the sceral ring for the calculation of the optical axial length. Size of the maximum entrance pupil diameter was estimated from the internal opening diameter of sceral rings. We examined two Platecarpus, one Tylosaurus, and one Clidastes specimens. Among them, only the Clidastes specimen was not available for the first method due to the poorly preserved frontal. The f-numbers calculated with the first method were 2.95 in Tylosaurus, 1.22 and 1.31 in Platecarpus, whereas those calculated with the second method were 2.47 in Tylosaurus, 1.49 and 1.75 in Platecarpus, and 1.68 in Clidastes. In both methods, the f-numbers of Tylosaurus were larger than those of Platecarpus; the f-number of Clidastes was between those of Tylosaurus and Platecarpus, and within the range of two Platecarpus specimens. From these results, we can conclude that Platecarpus and Clidastes could see objects in darker environments, or deeper sea than Tylosaurus. Because the two genera are known from the same horizon of the same area (Santonian- Campanian of the Western Interior Seaway), their different f-numbers are possibly indicative of resource partitioning among these reptilian predators in terms of the water depth, particularly between Tylosaurus and the other two genera.

Poster Session I (Wednesday, October 17, 4:15 - 6:15 pm)

A NEW SPECIES OF QUANICHTHYSOSAUR (REPTILIA: Ichthyosauria) FROM XINGYI FAUNA (LADINIAN, MIDDLE TRIASSIC) OF GUIZHOU, SOUTHWESTERN CHINA

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During a half-year’s excavation in Wusha, Xingyi, Guizhou, Southwestern China, a middle-sized and well preserved ichthyosaur was discovered from the Zhuganpo Member of the Falang Formation (Late Ladinian, Middle Triassic). It can be referred to Quanichthysosaurus according to the following characters: tooth crown enamel without longitudinal striations; propodials and epipodials longer than wide; well-developed epipodial foramen; long, well-developed haemal spines; notching present on both leading and trailing edges of flippers; the femur distally remarkably expanded and slightly longer than the humerus; rod-like ilium, without anteromedial process; centra discoidal, but elongate; dorsal rib articulation mainly...
bicipital. However, it also bears some characters that are different from the type specimen of *Qianichthysaurus zhoui*: much longer snout, making up nearly 68.2% of the skull length while the ratio in *Qianichthysaurus zhoui* is only 54.2%; relatively smaller orbit, accounting for 25% of the skull length while this portion is 30.4% in the type specimen; premaxilla is a long process extending posteriorly and forming most of the ventral margin of the external naris; fibula with a posterior process in the middle peripheral margin; absence of obturator foramen on sub-triangular pubis. Counting these differences, this new specimen found in Wusha probably can be referred to a new species of *Qianichthysaurus*. The new species is stratigraphically older than the type species, which is from the Carnian (Upper Triassic) Wayao Member of the Falang Formation in Guanzhi, China. *Qianichthysaurus* from Southwestern China and *Toretoconemus* from the Carnian Hosselkus Limestone of California had formed a monophyletic clade as *Toretoconemidae* in previous research. The new finding indicates the first appearance of *toretoconemids* should be earlier than the Carnian, at least down to the Ladinian of the Middle Triassic.

The new finding establishes that *Qianichthysaurus* existed both in Xingyi and Guanzhi, as with the case of previously reported *askopetosaurus thalattosaurus* *Anthussaurus* and *shastasaurus ichthyosaur Guichouxichthysaurus*. This suggests a closer relationship between Xingyi Fauna and Carnian Guanzhi Biota.

**Technical Session XIX (Saturday, October 20, 2:45 pm)**

**EFFECTS OF PLEISTOCENE CLIMATIC REGIMES ON DIETARY NICHES AND ENVIRONMENTAL HETEROGENEITY IN FLORIDA**

YANN, Lindsey T., Vanderbilt University, Nashville, TN, United States; DESANTIS, Larisa R., Vanderbilt University, Nashville, TN, United States

Stable oxygen and carbon isotopes from fossil tooth enamel can be used to better understand mammalian responses to climate change and the impact of interglacial warming on the dietary niches of Pleistocene taxa. Previous work at two Pleistocene sites in Florida, identified as glacial (*Inglis 1A*) and interglacial (*Leisey 1A*) based on geologic data, demonstrate dramatic dietary responses to interglacial warming. To further test the hypothesis that differing climatic regimes affect mammalian dietary niches, we examined two additional Pleistocene sites (*Haile 8A* and *Tri-Britton*) with multiple sympatric taxa. Mean oxygen isotope values of the most evaporation sensitive taxa (i.e., camels and deer) are greatest at *Tri-Britton* (*camelids: 3.2‰*), followed by *Leisey 1A* (*camelids: 0.6‰*, *Odontocles*: *0.8‰*). Demonstrating that *Tri-Britton* is warmer and/or more arid than *Leisey 1A*. *Haile 8A* is intermediate between *Leisey 1A* and *Inglis 1A* with *camelid* and *Odontocles* values of *-0.5‰* and *-0.2‰*, respectively, indicating a transitional site between glacial and interglacial conditions. Rank orders of mean and maximum oxygen isotope values in *camellids* and *Odontocles* demonstrate identical patterns, further supporting these climatic designations. Environmental heterogeneity, based on *δ¹³C* values, is greatest at *Leisey 1A*, *Tri-Britton*, and *Haile 8A*, all with statistically greater values than *Inglis 1A* (*p<0.002*). *Tapirus, Palaeolama*, and *Equus* *δ¹³C* values from *Tri-Britton* are greater than those present at any other site (all yield *p<0.046*). Increased *δ¹³C* values indicate the presence of more open forests (*Tapirus, Palaeolama*) and abundant *C₄* grasses (*Equus*). Grazers at both sites are statistically greater than browsers (*t-test with n=2, p<0.035*), but there are no statistical differences within dietary categories. Despite previous interpretations of *Mammuthus* as an obligate grazier, *δ¹³C* values indicate a mixed diet at *Tri-Britton* that is not significantly different from browsers, grazers, or other mixed feeders. All *Haile 8A* *Odontocles* and *Hemiauchenia* *δ¹³C* values are statistically indistinguishable from *Inglis 1A*, and *Mylohyus* and *Equus* are statistically indistinguishable from *Leisey 1A*, reinforcing the idea of a transitional environment. Increased heterogeneity at *Tri-Britton* may also be responsible for the absence of closely related taxa (e.g., two peccaries and two camels), similar to *Leisey 1A*. Although *δ¹³C* values represent a potential evolutionary history, it still documents the increase in taxonomic diversity on *Tri-Britton*, and greater heterogeneity than glacial sites. This research further supports the idea that interglacial warming or transitional periods support a more heterogeneous environment, which allows increased diversity of dietary niches among resident fauna.

**Technical Session XVIII (Saturday, October 20, 2:00 pm)**

**NEW DATA FOR EVALUATING FUNCTIONAL MORPHOLOGY IN PHILODONTIDAE (ALLOHERIA, MULTITUBERCULATA) USING DIGITAL PREPARATION**

YAPUNCICH, Gabriel S., CUNY Graduate Center/NYCEP, New York, NY, United States; PREPARATION

*Tapirus* exhibits short, robust manual intermediate phalanges relative to its pedal intermediate phalanges, a pattern no extant arborealist exhibits. Rather, similar proportions characterize saltatorialists such as most macropodids, macroscelideans, and lagomorphs. As in cursorial and saltatorial animals, *Tapirus* exhibits metapodials with cylindrical heads, which limit abduction and adduction and extend the metapodial-phalangeal joints. Additionally, the distal phalanges are mediolaterally broad and dorsoventrally shallow, resembling terrestrialists more than arborialists, as demonstrated by multivariate comparisons. Finally, arboreal taxa with prehensile tails are characterized by caudal vertebrae that are mediolaterally broad. In contrast, the caudal vertebrae of *Tapirus* are dorsoventrally deep and mediolaterally narrow, a combination that does not enhance tight tail flexion and is not found within prehensile-tailed animals. The length of caudal vertebrae is not significantly correlated with tail function in our sample, bringing the previously supposed significance of long caudals in *Tapirus* into question. These results suggest that arboreal activities did not dominate the lifestyle of *Tapirus*, although some similarities to saltatorialists such as scandentians and sciurids do not preclude facultative tree climbing. Instead, the examined morphology indicates that *Tapirus* was most likely a terrestrial or semiaquatic mammal that progressed via saltation, potentially similar to Asian multituberculates.

**Poster Session IV (Saturday, October 20, 4:15 - 6:15 pm)**

**RECONSTRUCTION OF INNER EAR SHAPE AND SIZE IN MOSSAUSARS (REPTILIA: SQUAMATA) REVEALS COMPLEX ADAPTATION STRATEGIES IN SECONDARY AQUATIC REPTILES**

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Mossasaurids were top predators in the Late Cretaceous oceans. They are a secondarily aquatic clade, phylogenetically allied to varanid lizards. Morphologically, mosasaurs reach ten times the size of extant *Varanus*, and demonstrate distinct aquatic adaptations, including modified fin-like limbs and tails. Previous studies of postcranial suggest mosasaurs as agile swimmers, but discussions on their skull modifications in relation to aquatic lifestyles remain scarce. This study reconstructs the bony labyrinth in mosasaur brains, especially the semicircular canals, to quantitatively evaluate their locomotory adaptations compared to their terrestrial sister group. Semicircular canals are vertebrate balance organs that are reduced in length and sensitivity in secondary aquatic mammals (*Varanus*). Quantitatively, lengths of the three semicircular canals in *Platecarpus* (scaled to skull length) was not significantly different from the lengths predicted by a linear regression model based on *Varanus* data, suggesting that sensitivity to rotation in *Platecarpus* was statistically the same as that in *Varanus*. The results further indicate that, compared to cetacean mammals, *Platecarpus* mosasaurs utilized a different strategy in their adaptations to balance in aquatic environments, and their semicircular canals are modified more in shape than size in response to an aquatic lifestyle.

**Technical Session IX (Friday, October 19, 10:30 am)**

**CRANIODENTAL ANATOMY AND FEEDING MECHANICS OF DAKOSAURUS MAXIMUS AND PLEISOSUCHUS MANSELLII, TWO CONTEMPORARY LARGE-BODIED, MACROPHAGOUS METRIORHYNCHID CROCODYLOMORPHS FROM THE LATE JURASSIC OF EUROPE**

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Metriorhynchidae was a peculiar but long-lived group of marine Mesozoic crocodylomorphs adapted to a pelagic lifestyle. Two contemporaneous species from the Late Jurassic of *Dakosaurus maximus* and *Pleiosuchus mansellii* reached sizes up to 45 meters (in total length) and macrophagous (fed on large-bodied prey). We redescribed the anatomy and reassessed the systematics of both species, which allows for a better understanding of their phylogeny and dietary ecology. Both taxa are diagnosed by several apomorphies. For *D. maximus* these include strongly ornamented maxillae, mesial/distal tooth wear and extensive crown breakage, and for *P. mansellii* strongly convex palatines with a pronounced ridulation and quadrate distal articular surfaces not separated into two condyles. Phylogenetic analysis places *D. maximus* as the sister taxon of the South American *D. andinensis*, while *P. mansellii* is placed in a polytomy at the base of the *Geosaurini*, the subclade of macrophagous metriorhynchids that includes *Dakosaurus*, *Geosaurus* and *Tortorovesutes*. Craniodental morphology indicates that *D. maximus* and *P. mansellii* were macrophagous, but may have fed in distinct ways. *D. maximus* had tightly fitting, vertical occlusion, as indicated by receptor pits along the upper and lower tooth rows, vertically oriented crenations that were in close contact during occlusion, and vertical microwatt striations extending along the mesial and distal margins of the teeth, obliterating the carinae and denticles due to shearing occlusion. Enamel thickness does not seem to be specialized in this group however, possibly reflecting tooth developmental constraints.
recently suggested to be unique for archosaurs. Furthermore, *D. maximus* possesses craniofacial features observed in extant suction-feeding odontocetes, most specifically the false killer whale, including: shortened tooth-row, amblygnathous (“bullet-shaped”) rostrum and a very short mandibular symphysis. We hypothesize that the skull and dentition of *D. maximus* were optimized for cutting large prey items into portions small enough to swallow. *Plissiosuchus manelsii*, by contrast, possesses a non-amblygnathous rostrum, a longer mandibular symphysis and microphidodont serrations, and lacks spalled or broken tooth apices and mesial/distal wear facets. Lack of crown breakage and wear suggests this species fed on soft-bodied prey. The difference in optimum gape (gape at which multiple teeth come into contact with a prey item) between *P. manelsii* and *D. maximus* is considerable. As *Plissiosuchus* had a large gape and non-worn teeth, the extant sperm whale may be a good analogue. Craniodental differentiation and niche partitioning enabled these two large-bodied species to coexist in the same ecosystem.

**Poster Session II (Thursday, October 18, 4:15 - 6:15 pm)**

**INFERRING GROWTH IN GIANT PENGUINS FROM THE PALEOGENE OF ANTARCTICA AND THE NEogene OF SOUTH AMERICA**

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Birds evolved high rates of growth, reaching full size within one year, which histologically results in the absence of LAGs (annual lines of arrested growth) that are usually developed by endotherms. With the exception of a very few cases such as the moa and the kiwi, birds lack LAGs. Today the Emperor penguin *Aptenodytes forsteri*, one of the largest extant penguins, is considered to be the faster vertebrate to reach full adult size. Fossil representatives of penguins are known to easily exceed the size of Emperor penguins, so their patterns of growth has remains obscured even with the large amount of research and interest in fossil penguins in the last decade. We studied thin sections of four representatives of extinct giant penguins: fossil bones referred to the genus *Palaeeudyptes* or *Anthropornis* from the Eocene of the La Meseta Formation, Seymour Island, Antarctica, the species *Pygoscelis antarctica* and *Spheniscus urbaini*, from the late Miocene—Pliocene of the Bahia Inglesa Formation, northern Chile. We also included the Humboldt penguin *Spheniscus humboldti*, an extant species, and the genus *Palaeeudyptes* from the middle Miocene of Argentinian Patagonia, both medium size penguins. The Antarctic species belongs to the high diversity of basal penguins while the Chilean ones are extinct representatives of an extinct genus in the crown group Spheniscidae. The Argentinian representative is an outgroup to the crown group. Histology shows that fast growth in penguins is common across the entire phylogenetic sample. As is common in other birds, fossil penguins do not developed the outer circumferential layer that is negatively correlated with size. As the majority of neornithines, they reached full growth within one year. Fast growth, sometimes considered in penguins an adaptation to cold, is a plesiomorphic character to this order of birds.

**Technical Session I (Wednesday, October 17, 8:00 am)**

**A NEW GIANT CARChARODONTOSAURIAN ALLOSAUROID FROM THE LOWER CRETACEOUS CEDAR MOUNTAIN FORMATION OF CENTRAL UTAH**

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The terminal Early Cretaceous was a time of major faunal reorganization in western North America. Localized extinction of remnant Jurassic megafauna (e.g., sauropodomorphs and allosaurid theropods) co-occurred with establishment of neoceratopsians and advanced members of several coelurosaurian subclades, a transformation long attributed to faunal interchange with Asia. Here we report on a new theropod from the Lower Cretaceous Cedar Mountain Formation of Utah, representing the last surviving allosaurid species yet reported from the North American continent.

The new taxon is known from a partially preserved skeleton, including portions of the axial column, pelvis, and hind limb. Preliminary phylogenetic analysis substantiates referral to Carcharodontosauridae based on extreme axial pneumatization, including camellate vertebral structure, slit-like dorsal pluercocells, and heavily pneumatized hypaptrum, as well as deep peg-and-walnut iliacischial articulations. The new taxon exhibits shared morphology with neovenatorids including transversely compressed, cranialmost dorsal centra bearing a prominent ventral keel, as well as transversely inflated, quadrangular hypaptrum similar to the condition observed in *Aerosteon*. However, cranialmost dorsal centra are distinctly elongate, a feature not otherwise observed in the clade. More caudally positioned dorsal vertebrae exhibit weakly developed, flange-like lateral extensions of the postzygapophyses as in *Neovenator* and *Aerosteon*; a hypertrophied caudal centrodipophyseal lamina; distinct, alariform, ventrolaterally trending hypophyses unlike the sheet-like condition of carcharodontosaurs; and compact neural spines (in contrast with the approximately coeval North American carcharodontosaurid *Acerocantherosaurus*). The ilium possesses a hypertrophied acetabular shelf and autapomorphic morphology of the ventral postacetabular wing.

The new specimen derives from silty mudstone of the uppermost Mussentuchit Member, 8-9 meters above a smectitic ash horizon previously dated to 98.39 +/- 0.07 Ma and 6-7 meters below the contact with the Upper Cretaceous Dakota Formation. The presence of a new taxon refutes prior hypotheses of homogeneity in the allosaurid fauna of the continent during this interval. The new taxon also confirms both an extended temporal overlap and marked body mass discrepancy between carcharodontosaurians and advanced tyrannosaurids of the Early Cretaceous of western North America. The extinction of allosaurids as apex predators in late Mesozoic terrestrial ecosystems of western North America may have allowed opportunistic invasion of this niche by tyrannosaurids, which proceeded to dominate terrestrial ecosystems in this region until the terminal Cretaceous extinction event.

**Technical Session III (Wednesday, October 17, 2:45 pm)**

**THE WESTERNMOST TARSIER: A NEW GENUS AND SPECIES FROM THE MIocene OF PAKISTAN**

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As the closest living sister group of anthropoids, tarsiers (family Tarsiidae) are an important group in primate evolution. However, their fossil record is poor: only four species have been described, two from the Eocene of China and two from the Miocene of Thailand. All are from outside the range of the living species, which occur only on the islands of Southeast Asia.

Here, I describe the first fossil tarsier from Pakistan, a significant range extension. This record consists of two lower molars, an upper molar, and three fragmentary upper anterior teeth found in the Miocene Manchar Formation of Sindh Province, southern Pakistan. The lower molars are recognizable as tarsiers by their high crown, prominent paracodon, and distinct cingulum. However, they are characterized by a relatively narrow shape and the possession of an anterolabial cingulum. The single upper molar is identified as an M3. It is distinct in showing a broad buccal shelf, with the paracone and metacone relatively lingual in position. In addition, the lingual cingulum is weak.

The Pakistani tarsier is morphologically distinct from all living and fossil tarsiers, but most similar to the Middle Miocene Thai species *Tarsius thailandicus*. Though living tarsiers have traditionally been classified in a single genus, a recent revision proposed a division into three genera. The differences that separate the Pakistani tarsier from other known species are of the same order of magnitude as those between the living genera, and we have found no evidence to support a close relationship between the Pakistani tarsier and any one of the extant genera. However, the Pakistani tarsier appears to be similar to *Tarsius thailandicus*, for which the upper molars are unknown. Thus, we propose that the Pakistani tarsier and *T. thailandicus* should be placed in a new tarsid genus.

This discovery broadens our understanding of the geographic range and morphological diversity of Miocene tarsiers and helps put the living tarsiers into their evolutionary context.
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