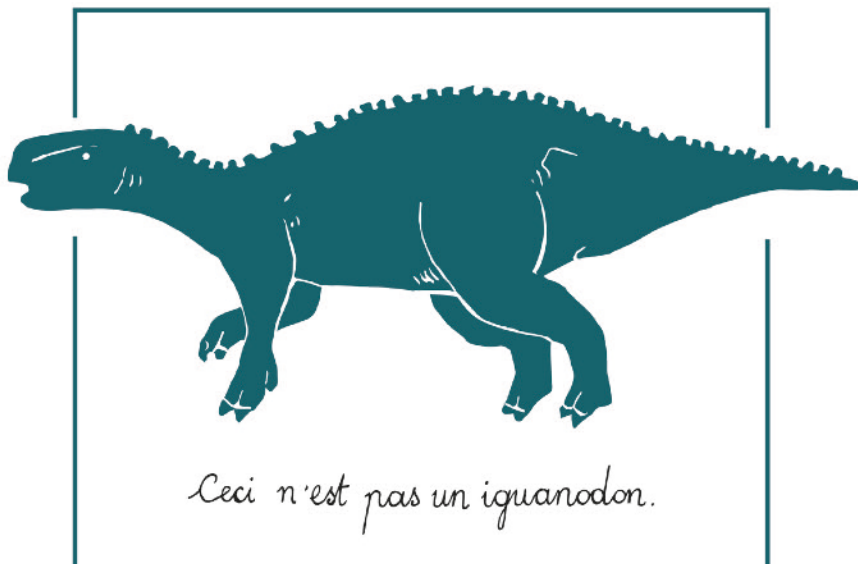




17th Conference of the EAVP • 2019 • Brussels



July 2 • 3 • 4 • 5 • 6 – Royal Belgian Institute of Natural Sciences

Program and abstracts  
XVII Conference of the EAVP – Brussels, Belgium  
2 – 6 July 2019



# GENERAL PROGRAM



	Mon. 01 July	Tue. 02 July	Wed. 03 July	Thu. 04 July	Fri. 05 July	Sat. 06 July
9:00 - 9:30	Bernissart workshop and field trip	Workshops and roundtables	Welcome			Field trip to Rumst area
9:30 - 11:00			Technical Sessions			
11:00 - 11:45			Coffee Break / Poster Session			
11:45-13:00			Technical Sessions			
13:00 - 14:00			Lunch Break			
14:30 - 16:00			Technical Sessions			
16:00 - 16:45			Coffee Break / Poster Session			
16:45 - 18:00			Technical Sessions			
Evening events		Ice Breaker: 19:00–22:00		EAVP assembly + Auction 18:00–22:00	Dinner 19:30–22:30	





# ORAL COMMUNICATIONS PROGRAM



## Wednesday

## Thursday

## Friday

09h00  
09h30

### Welcome and general address

09h45

Anquetin & Püntener

THE SAUROPOD, THE TURTLE, AND THE TREE: A JURASSIC FABLE

10h00

Bolet et al.

THE IMPORTANCE OF THE JURASSIC PERIOD IN LEPIDOSAUR EVOLUTION: INSIGHTS FROM DISPARITY ANALYSES

Jovells-Vaqué et al.

BIOMAGNETOSTRATIGRAPHY OF THE EARLY MIOCENE MAMMAL RECORD OF THE VALLÈS-PENEDÈS BASIN (CATALONIA)

Solé et al.

CRITICAL ANALYSIS OF THE CARNIVORAN MAMMAL SUCCESS IN EUROPE DURING THE PALEOGENE

10h15

Báez

THE TAXONOMIC DIVERSITY OF THE BARREMIAN ANUROFAUNA OF THE IBERIAN PLATE: OLD FINDS, NEW TAXA

Ghezzi et al.

SATELLITE IMAGERIES FOR FOSSIL DETECTION: MATERIALS AND METHODS

Kovalchuk et al.

THE EARLY PLEISTOCENE ICHTYOFAUNA FROM COPĂCENI (DACIAN BASIN, SOUTHERN ROMANIA)

10h30

Jacobs

A NEW ICHTHYOSAUR (REPTILIA, ICHTHYOPTERYGIA) FROM THE LATE JURASSIC KIMMERIDGE CLAY FORMATION OF DORSET, UK

Göhlich & Mandić

THE DROWNING SWAMP OF GRAČANICA – A NEW MIDDLE MIOCENE VERTEBRATE LOCALITY IN BOSNIA-HERZEGOVINA

Villa & Rabi

A NEW GECKO FROM THE EOCENE OF GEISELTAL (GERMANY)

10h45

Barrett

A 'CRYPTO-SPECIES' OF EUSMILUS AND A NOVEL PHYLOGENY FOR THE NIMRAVIDAE RECOVERED BY BAYESIAN TIP-DATING

Iannucci et al.

DOWNSIZING IN THE LATE PLEISTOCENE: SUS SCROFA (SUIDAE, MAMMALIA) IN THE APULIAN PENINSULA (SOUTHERN ITALY)

Sorbelli et al.

ECTOTHERMIC VERTEBRATES FROM PIETRAFITTA (ITALY, EARLY PLEISTOCENE) AND THE LAST OCCURRENCE OF LATONIA IN EUROPE

11h - 11h45

11h45

Cincotta et al.

TAPHONOMY OF THE DINOSAUR BONE BEDS FROM THE MIDDLE JURASSIC OF KULINDA (SOUTHEASTERN SIBERIA)

During et al.

A SPRING APOCALYPSE AT THE K-PG BOUNDARY

Foth et al.

A NEW AVIALAE FROM THE LATE JURASSIC OF SOUTHERN GERMANY

12h00

Battista & Schultz

TAPHONOMY "IN THE BOX": HOW MUCH INFORMATION IS FORGOTTEN IN A COLLECTION? A CASE STUDY FROM TRIASSIC OF SOUTH BRAZIL

Capobianco & Friedman

EARLY PALAEOGENE MARINE BONYTONGUE FISHES (TELEOSTEI: OSTEOGLOSSIDAE) AND MARINE FAUNAL RECOVERY AFTER THE K-PG EXTINCTION

Spiekman & Scheyer

REVISION OF TANYSTROPHEUS TAXONOMY

12h15

Eck & Frey

THE TAPHOCOENOSIS OF THE FISCHSCHIEFER (RUPELIAN/OLIGOCENE) AT RAUENBERG (BADEN-WÜRTTEMBERG/GERMANY) – TAXONOMY, TAPHONOMY AND PALAEOECOLOGY

Liston et al.

NOT JUST THE FOOD MARKED FOR VEGETARIANS: GILL RAKERS AS AN UNEXPECTEDLY UBIQUITOUS AND POWERFUL MORPHOLOGICAL TOOL TO EXPLORE PHYLOGENY ACROSS A GROUP OF DIVERSE DIETS

van den Ende et al.

NEW PALAEOPEIDAE FROM THE EARLY PALEOGENE OF MOROCCO DOCUMENT A MARINE RADIATION

12h30

Barrios-de Pedro, et al.

A LATE BARREMIAN ECOSYSTEM SUSTAINED BY FISH AND SHRIMPS: EVIDENCE OBTAINED FROM THE STUDY OF THE LAS HOYAS COPROLITES

Maridet et al.

REINVESTIGATION OF GLIRUDINUS AFF. LISSIENSIS, A GLIDING RODENT FROM THE LATE MIOCENE OF SAINT-BAUZILE (ARDECHE, FRANCE)

Williams et al.

RADIAL SPOKE-LIKE TRABECULAE PROVIDE STRENGTH IN HYPER-ELONGATE PTEROSAUR VERTEBRAE

12h45

Kaskes et al.

TAPHONOMY OF A UNIQUE MULTIGENERATIONAL TRICERATOPS BONEBED FROM EASTERN WYOMING (USA): NEW INSIGHTS FROM A MULTI-PROXY PERSPECTIVE

Mannion et al.

DWARFS AMONG GIANTS: RESOLVING THE SYSTEMATICS OF THE TITANOSAURIAN SAUROPOD DINOSAURS FROM THE LATEST CRETACEOUS OF ROMANIA

Unwin & Martill

IDENTIFYING PTEROSAUR INTEGUMENTARY STRUCTURES – A CRITICAL ANALYSIS

13h - 14h30



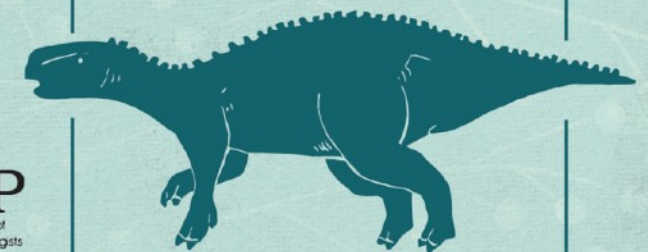
## Wednesday

## Thursday

## Friday

14h30			Reumer et al.	HOMO ERECTUS (S.L.) LIVED IN EUROPE DURING THE EARLY PLEISTOCENE AS PART OF THE MIDDLE / LATE VILLAGRANCHIAN ECOSYSTEM	Vidal et al.	EUSAUROPOD SACRA: THE CORNERSTONE OF THEIR BODY PLAN AND, AN EVOLUTIONARY INNOVATION?
14h45			Frey et al.	PRE-FORMATIVE HUMAN REMAINS FROM BOLIVIA: UNEXPECTED DIVERSITY AND MANY OPEN QUESTIONS	Virág & Szabó	COMPUTER-ASSISTED EDGE DETECTION AND POINT ACQUISITION: THE FUTURE OF LANDMARK ANALYSIS?
15h	Chiarenza et al.	DINOSAUR LATITUDINAL BIODIVERSITY GRADIENT REVEALS THE PALAEOGEOGRAPHIC SIGNATURE OF SAUROPOD THERMOPHYSIOLOGY	Laurin et al.	WHAT DO OSSIFICATION SEQUENCES TELL US ABOUT THE ORIGIN OF EXTANT AMPHIBIANS?	Sookias	IMPROVING THE USE OF MORPHOLOGICAL DATA IN INFERRING PHYLOGENY
15h15	Pardo-Pérez et al.	PALAEOPATHOLOGICAL SURVEY OF ICHTHYOSAURS FROM THE MIDDLE TRIASSIC BESANO FORMATION (NORTHERN ITALY AND SOUTHERN SWITZERLAND)	Meyer et al.	ENIGMATIC TETRAPOD TRACKS FROM THE EARLY JURASSIC ZAGAJE FORMATION OF POLAND	Tschopp et al.	COMPARISON OF WEIGHTING STRATEGIES FOR SPECIMEN-LEVEL PHYLOGENY BASED ON SKELETAL MATERIAL OF LIZARDS (SQUAMATA)
15h30	Jentgen-Ceschino et al.	CASES OF PATHOLOGICAL BONE GROWTH IN ISANOSAURUS AND SPINOPHOROSAURUS (SAUROPODA): PERIOSTEAL REACTION AND TUMOR-LIKE CONDITIONS IN DINOSAURS	Suraprasit & Bocherens	A NEW PLEISTOCENE MAMMAL LOCALITY FROM PENINSULAR THAILAND: IMPLICATIONS FOR THE SAVANNA CORRIDOR HYPOTHESIS DURING GLACIALS	Young et al.	INSIGHTS INTO THE LAND-TO-SEA TRANSITION: MARINE CROCODYLOMORPH (CROCODYLOMORPHA: THALATTOSUCHIA) VASCULATURE AND SINUS SYSTEM ADAPTATIONS
15h45	Bertoza, et al.	PALAEOPATHOLOGY OF IGUANODON SPECIMENS FROM MUSEUMS IN BELGIUM AND BRITAIN, AND A COMPARISON WITH PATHOLOGICAL RATES IN HADROSAURIDAE	Plastiras et al.	FEEDING ECOLOGY OF PLIO-PLEISTOCENE PALEARCTIC CERCOPITHECIDS	Wings	CROCODYLIFORM GASTROLITHS: A NEW APPROACH TO SOLVE THE ENIGMA OF THEIR FUNCTION
16h - 16h45						
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17h	van Heteren et al.	3D GEOMETRIC MORPHOMETRIC ANALYSES OF MIDDLE PLEISTOCENE CAVE BEAR (URSUS DENINGERI) SKULLS AND MANDIBLES: IMPLICATIONS FOR DIET AND EVOLUTION	Rybakiewicz et al.	HADROSAURS FROM CAÑADA ANCHA (CERRO DEL PUEBLO FORMATION; UPPER CAMPANIAN), COAHUILA, MEXICO	Zverkov	FISHING FOR AN ICHTHYOSAUR: REASSESSMENT OF THE "INACCESSIBLE" HOLOTYPE OF LATE JURASSIC NANNOPTERYGIUS ENTHEKIODON HELPS TO RESOLVE A LONG-STANDING TAXONOMIC TANGLE
17h15	De Esteban-Trivigno	VARIABILITY IN SKULL SHAPE OF ARMADILLOS AND GLYPTODONTS (CINGULATA)	Sanguino & Buscalioni	SPINOSAURIDAE VS CROCODYLOMORPHA. THE CHALLENGE OF DISCRIMINATING HIGHLY CONVERGENT ISOLATED TEETH		
17h30	Mallison et al.	A NEW T. REX 3D SKELETON USED FOR HIGH-FIDELITY 3D MUSCLE MODELLING	Serrano-Martínez et al.	EVOLUTION OF THE INNER SKULL CAVITIES IN EUSUCHIA		
17h45	Demuth et al.	3D LIMB BIOMECHANICS OF THE STEM-ARCHOSAUR EUPARKERIA CAPENSIS	Czepiński et al.	THE LATE TRIASSIC VERTEBRATE LOCALITY WITH ARCHOSAUR AND TURTLE REMAINS IN KOCURY, POLAND		

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*Ceci n'est pas un iguanodon.*

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36	STRONG BITES IN A LIGHTWEIGHT HEAD. INNER COLUMNS ON THE ROSTRUM OF PREJANOPTERUS CURVIROSTRIS REVEAL SUPPORT CAPACITY AGAINST TENSION	Navarro-Lorbés et al.
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55	CT ANALYSIS REVEALS NEW INFORMATION ON THE DIVERSITY OF SMALL THEROPODS OF THE KEM KEM BEDS, SOUTHEASTERN MOROCCO	Smyth et al.
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# A POSSIBLE ANHANGUERAN PTEROSAUR MANDIBLE FROM THE LOWER CRETACEOUS OF GERMANY

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**Key words:** *Pterosauria*, *Anhangueria*, *Cretaceous*, *Valanginian*

Presentation type: poster

Cretaceous pterosaur fossils are rare in Germany. The specimens documented to date are limited to only a few fragmentary body fossils and footprint traces from different Lower Cretaceous strata. Here we add to this sparse, but palaeobiogeographically significant record with the description of an incomplete mandible from marine sediments of the lower Valanginian Stadthagen Formation of Sachsenhagen in northern Germany. The remains are represented by the posterior section of a gracile symphyseal rostrum with a delicate midline ridge along its ventral edge. A pronounced lateral longitudinal groove also extends below the alveolar rim. Broken tooth crowns are preserved in the mesiodistally elongate alveoli, which are widely spaced (increasingly so posteriorly) and labially inclined without raised rims. Although precise generic affinities are uncertain, the shape and arrangement of the alveoli are reminiscent of *Camposipterus nasutus* Seeley 1869, from the Albion of England (which was defined on the basis of an incomplete cranial rostrum), as well as mandibles of the putative anhangueran taxon *Cearadactylus atrox* Leonardi & Borgomanero 1985, together with the unequivocal anhanguerids *Anhanguera piscator* Kellner & Tomida 2000, *Tropeognathus mesembrinus* Wellnhofer 1987, and *Ludodactylus sibbicki* Frey et al. 2003, (all of which additionally share the presence of a symphyseal ridge). We therefore conclude that the Stadthagen Formation pterosaur potentially constitutes one of the stratigraphically earliest occurrences of Anhangueria, and is at present the only known exemplar of this recovered from Germany.



# The Sauropod, the Turtle, and the Tree: A Jurassic Fable

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**Keywords:** *taphonomy, dinosaur, sauropod, turtle, Thalassochelydia*

Presentation type: oral communication

In the past two decades, the Canton of Jura in NW Switzerland has been the theatre of a unique experiment. During the construction of the A16 Transjurane Highway, palaeontological remains were systematically collected and their stratigraphical context recorded, leading up to a collection of more than 40,000 Mesozoic and Cenozoic fossils, as well as to the measurement of more than 14,000 dinosaur footprints. As conclusion to the study of the Late Jurassic turtles from this collection, we report two unique cases of fossil preservation and discuss their taphonomical context. The first case consists of a sub-complete turtle shell found embedded in Late Jurassic dinosaur-track-bearing laminites. The preservation of the shell suggests that it was trod on by a sauropod dinosaur after the death of the turtle. Examples of such non-predatory interactions are rare, or rarely reported, in the fossil record. The second case consists of an assemblage of more than 180 disarticulated shell bones and a turtle skull found together in a block of Late Jurassic limestone entangled in the roots of a tree deracinated by a storm. The accumulation of so many turtle bones in such a small block of rock remains unexplained and unprecedented in an otherwise well-explored stratigraphical layer. These remains can be attributed to a new species of coastal marine turtle.



# THE TAXONOMIC DIVERSITY OF THE BARREMIAN ANUROFAUNA OF THE IBERIAN PLATE: OLD FINDS, NEW TAXA

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**Keywords:** *Anura, Cretaceous, Spain, Costata, osteology*

Presentation type: oral communication

The Early Cretaceous continental successions of the Iberian Peninsula have yielded a significant number of well-preserved remains of plants, invertebrates, and vertebrates as a result of the intensive prospecting of recent years. Among vertebrates, remains of anurans have been recovered from many Barremian sites. Some of these finds consist of fragmentary bones whereas others furnish evidence on the skeletal morphology and proportions of the represented taxa. Notwithstanding, most of these records have been ascribed to the relatively basal extant costatan clade based on insufficient data. Revisions of some of these materials have demonstrated the presence of traits presumably plesiomorphic and unknown in living costatans, thereby casting doubts on their phylogenetic placements. Herein, undescribed incomplete, but articulated, specimens from the late Barremian Las Hoyas Konservat- lagerstätte are thoroughly discussed. One of them (MUPA LH 00004) is referred to the genus *Wealdenbatrachus* recorded in the nearby, coeval fossil site of Uña, and, thus, probably outside the costatan clade according to a recent study. The other specimen (MUPA LH 11392) is now known only from a photograph and a cast; based on the available evidence it has a combination of characters that differs from those of other known specimens from the same bearing beds and also from other Barremian localities, indicating that it pertains to an additional taxon among the anurans of Las Hoyas. Moreover, this combination is unknown within crown Costata and it likely places the taxon outside its basal node, although its position remains uncertain due to the incompleteness of the material.



# A 'CRYPTO-SPECIES' OF *EUSMILUS* AND A NOVEL PHYLOGENY FOR THE NIMRAVIDAE RECOVERED BY BAYESIAN TIP-DATING

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**Keywords:** *Nimravidae*, *Barbourofelidae*, *crypto-species*, *Bayesian*, *Tip-Dating*

Presentation type: oral communication

The Nimravidae is an extinct family of Late Eocene to Late Miocene carnivorans commonly referred to as 'false sabretooth cats.' A newly described Oligocene member of this family is represented by specimens that are not new, but have been known (and published upon) by researchers for the past 86 years under a variety of names, such as c.f. *Eusmilus*. This 'crypto-species' eluded diagnosis, due largely to taxonomic difficulties in the family and inaccessibility to specimens (until recently) on permanent display. The phylogenetic position of this species was assessed relative to a near-comprehensive set of Eocene-Miocene taxa. Specifically, I implemented a Bayesian tip-dated analysis with the fossilized birth-death (FBD) model incorporating morphological (134 characters) and stratigraphic occurrence data. The analysis yields a dated phylogeny placing the entirety of the Nimravidae in a novel arrangement. The clade is split into two highly-supported subfamilies (posterior probability of 1.0), one of which displays a pattern of character acquisition convergent on feline morphology, while the other on extreme sabretooth features. Within the latter, all "barbourofelid" taxa were recovered as sister to earlier-occurring Eocene and Oligocene derived sabretooth taxa. These "barbourofelids" are in turn split into the historically posited tribes Afrosmilini and Barbourofelini. The results of this analysis illuminate the problems of 'dark data' (curated specimens that have largely been unaccessed) in museum collections and the new methodologies applicable to phylogenetic analyses of enigmatic taxa.



# **A LATE BARREMIAN ECOSYSTEM SUSTAINED BY FISHES AND SHRIMPS: EVIDENCE OBTAINED FROM THE STUDY OF THE LAS HOYAS COPROLITES**

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**Keywords:** *Early Cretaceous, microprobe, scales, thin sections, trophic interactions*

Presentation type: oral communication

The Early Cretaceous locality of Las Hoyas (Cuenca, Spain) contains a wide floristic and faunistic diversity interpreted as characteristic of a wetland biota. The biodiversity is also reflected in the number of distinct coprolites, which vary in shape and in the type and density of inclusions. Thin sections of twenty coprolites, corresponding to seven of twelve described morphotypes, were studied to infer trophic interactions in the ancient ecosystem. Petrographic and electron microprobe analyses indicated that all coprolites have a microcrystalline phosphatic groundmass, and three coprofabrics were recognized. The fish-scales coprofabric was observed in cylinder and elongated morphotypes; scale fragments frequently show a thin enamel layer enriched in Na relative to the rest of the scale. The decapod-cuticle coprofabric (in straight-lace and thin-lace morphotypes) is characterized by abundant decapod cuticle and occasional bony chips. The cuticle fragments are distinctively laminated, and resemble filiform scraps and rings that likely represent cross sections of appendages. The cuticle is richer in Na and Mg than the fish scales. The third coprofabric corresponds with matrices almost void of inclusions, in cylinder and irregular coprolites. The coprolite evidence suggests that the trophic structure of the Las Hoyas wetland was represented by: (1) ichthyophagous animals that fed on medium to large Semionotiforms and Macrosemiidae *Propterus* preys, and (2) animals that consumed shrimps, and probably small fishes. Coprolite matrices without inclusions might correspond with producers that digested food more efficiently. Fishes and crustaceans thus helped support the biomass of this diverse Late Barremian lacustrine ecosystem.



# NEUROANATOMY OF MOSASAURS: AN OVERVIEW FROM THE MAASTRICHTIAN TYPE AREA

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**Keywords:** *Mosasaurs, (palaeo)neuroanatomy, inner ear, latest Cretaceous, Maastrichtian*

Presentation type: poster

In recent years, powerful computer tomographic imaging and three-dimensional visualisation techniques have generated renewed interest in the neuroanatomy and sensory adaptations of extant and extinct taxa. However, the neurovascular data set for secondarily marine reptiles remains poor.

Mosasaurs represent one of comparatively better-studied groups, with rare examples of endocranial descriptions for rhycolosaurines (Tylosaurinae + Plioplatecarpinae).

Here we present 3D neuroanatomical renderings for some mosasaur taxa from the type Maastrichtian, including *Plioplatecarpus marshi*, *Mosasaurus hoffmannii* and *Prognathodon* cf. *sectorius*. This sample augments the temporal resolution, by adding Maastrichtian taxa, provides the first *Prognathodon*-type endocast and adds a larger and more complete inner ear for *M. hoffmannii*.

As noted in other derived mosasaurs, the inner ears appear to be dorsoventrally compressed and anteroposteriorly lengthened to a certain degree in all taxa. Furthermore, comparison of immature and adult specimens of *M. hoffmannii* has revealed the presence of a similar neurovascular architecture in the premaxilla before it reaches an enormous size. The cranial endocast of *P. cf. sectorius*, although laterally deformed, seems to indicate large inner ears relative to the endocast, in comparison to other taxa such as *Platecarpus*.

The patterns observed here are in part comparable to those of extant cetaceans, where a reduction in the radius of the semicircular canals has been postulated to allow for agile manoeuvring in the aquatic realm. Simultaneously, adaptations within the quadrate would suggest a trend towards higher directional sound sensitivity. Changes in olfactory acuity may also have led to the need for a highly sensitive premaxillary neurovascular system. (250)

**Acknowledgements:** Special thanks to Jeroen J.F. Kroll (MUMC+, Maastricht, the Netherlands) for allowing us to scan the specimens during Christmas time! Also we owe much gratitude to all NHMM volunteers and staff members involved in the preparation, storage and recovering of the specimens.



# TAPHONOMY “IN THE BOX”: HOW MUCH INFORMATION IS FORGOTTEN IN A COLLECTION? A CASE STUDY FROM TRIASSIC OF SOUTH BRAZIL

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**Keywords:** *Carnian, diagenetic features, palaeontological collections, Santacruzodon AZ, taphonomic bias*

Presentation type: oral communication

Taphonomic studies are often associated with palaeontological and archaeological fieldworks, and only in a second phase with laboratory work. Here, we present the preliminary results of a revaluation of fossil specimens, from a taphonomic point of view, housed in the palaeontological collection of the Vertebrate Paleontology Laboratory of the Federal University of Rio Grande do Sul (Porto Alegre, RS - Brazil). All studied specimens come from the Schoenstatt Sanctuary site (Santa Cruz do Sul, RS), from a deposit of the lower Carnian (*Santacruzodon* AZ, Santa Maria Supersequence). In a previous study, and based on a presumed dominance of cranial elements and a lack of clear evidence of hydraulic transport, this fossil assemblage has been proposed to be the result of a selective predation. The present work focuses on reviewing over 100 bone elements (from articulated to fragmentary) collected in the early 2000s, to test this taphonomic model.

The percentages of skeletal elements (using Voorhies Groups), obtained from the revision of the collection, suggest the possibility of some degrees of transport in the origin of the deposit, which presents a greater amount of post-cranial elements. Furthermore, PCA and cluster analysis of exclusively bone diagenetic features (mineralogical concretions and volume increase) support the hypothesis that the Schoenstatt deposit is probably the result of several deposition events, rather than the previous interpretation of an accumulation strictly related to selective predation and scavenging.

The above shows how necessary it is to review the collections before proposing taphonomic or palaeoecological models based on quantitative data.

# NEW AND OLD MATERIALS OF THE MIDDLE-LATE TRIASSIC PSEUDOSUCHIAN *PRESTOSUCHUS CHINIQUENSIS* AND THE VALIDITY OF “PRESTOSUCHIDAE”

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**Keywords:** *Rauisuchia*, Upper Triassic, Brazil, archosaur evolution

Presentation type: poster

The largest predators of Triassic continental ecosystems were represented by the ill-defined group “Rauisuchia”. One of the earliest described members of the group was *Prestosuchus chiniquensis*, from the Santa Maria Supersequence (Brazil), which thus became a reference taxon for “Rauisuchia” for being one of the best preserved and more complete specimens at that time. Although new specimens have recently been referred to this taxon, the original type material has received little attention since its first description, and needs further scrutiny.

The lectotype of *Prestosuchus chiniquensis* includes cranial fragments, partial articulated mandibles, some cervical, dorsal, sacral and caudal vertebrae and rib fragments, gastralia, complete and articulated pectoral girdle, partial humeri, partial pelvic girdle, and hindlimb. The taxon can be diagnosed by two autapomorphies, the presence of an oval incision in the coracoid-scapula suture and a small distal incision between the obturator plate and the ischial shaft, and a unique combination of non-autapomorphic characters. Based on this diagnosis, several other specimens can be confidently referred to *Prestosuchus chiniquensis*, including the paralectotype (BSPG-AS-XXV 7), the paralectotype of *Prestosuchus loricatus* (BSPG-AS-XXV 24, 25, 42, 4), the holotype of *Procerosuchus celer* (BSPG-AS-XXV 131-139), and several posteriorly referred specimens (UFRGS-PV-152, 156, 629, CPEZ-239b, ULBRA-PVT-281), including complete crania and large parts of the postcranial skeleton. These materials make *Prestosuchus chiniquensis* one of the best-known “rauisuchians” and provide a wealth of anatomical information for phylogenetic analysis in order to clarify the affinities of basal loricatans, such as *Prestosuchus*, *Luperosuchus*, *Saurosuchus*, *Stagonosuchus*, and *Fasolasuchus*, re-evaluating the validity of “Prestosuchidae”.



# MANDIBULAR SHAPE DISPARITY AND CONVERGENCE IN ICHTHYOSAURS AND TOOTHED CETACEANS

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**Keywords:** *convergence, disparity, ichthyosaur, cetacean, mandible*

Presentation type: poster

Numerous tetrapod lineages have independently evolved to live in the water during the Mesozoic and Cenozoic, offering some of the best-known examples of convergent evolution. In particular, modern toothed cetaceans are often compared to ichthyosaurs, a diverse clade of extinct marine reptiles that also evolved a ‘fish-shaped’ body plan with tail-propelled locomotion. Both are predominantly raptorial marine tetrapods with long evolutionary histories and good fossil records, yet surprisingly the ecological convergences and the macroevolutionary pathways behind them are poorly understood. This project aims to investigate convergences of ichthyosaur and cetacean skulls on similar morphologies and ecological functions. Here we present results of a preliminary analysis focusing on mandible shape from a sample of archaeocete and odontocete cetaceans and parvipelvian ichthyosaurs. Landmarks and semi-landmarks were placed onto photographs of specimens or 3D models made with a handheld scanner. The resulting coordinates were subjected to a principal components analysis in R to show mandibular shape disparity, with preserved stomach contents and tooth shape data used to correlate how this morphological variation might relate to ecological function. Up-to-date phylogenies can be superimposed to show convergences and trajectories of evolutionary change in the two groups through time. Using these ordination techniques, an adaptive landscape can be created to show which areas of the morphospace (‘peaks’) are colonised more frequently. These results will form part of the first detailed quantitative analysis of ecomorphological convergence between ichthyosaurs and cetaceans.

# **PALAEOPATHOLOGY OF *IGUANODON* SPECIMENS FROM MUSEUMS IN BELGIUM AND BRITAIN, AND A COMPARISON WITH PATHOLOGICAL RATES IN HADROSAURIDAE**

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**Keywords:** *Ornithischia, Ornithopoda, Osteopathy, Cretaceous*

Presentation type: oral communication

The study of distribution and occurrence of fossilised injuries and diseases can unveil aspects linked to the behavior of the affected species, as well as their interaction with the environment. Palaeopathologies are preserved when they affect the skeleton, and the injured animal survived long enough for the immune system to react and start the healing process. For this reason, palaeopathological analyses were, and often still are, confined to case-studies. Hypotheses regarding ecological and phylogenetic influences can be assumed, however, using a substantial database of pathologies from a selected clade. Among Dinosauria, Ornithopoda is the clade that shows the highest prevalence of pathologies. In the analysed *Iguanodon* material from NHMUK and RBINS, 90 pathologies have been identified, comprising traumae, infections, spondyloarthropathies and developmental anomalies. The pathologies have been subdivided by body region, with the highest number found in the dorsal vertebrae (17), middle region of the tail (14), pelvic girdle (8) and the pes (19). Of the total number, however, 18 lesions are considered as possible pseudo-pathologies. The injuries recorded are notably lower than those occurring in Hadrosauridae, where almost one thousand are currently recognized. Nonetheless, conclusions can still be drawn even when preservation and collection biases are considered: the tail was the area that suffered most from injuries (24 in *Iguanodon*) in both clades, while osteochondrosis (aka, cartilage developmental failure) extensively affected hadrosaurid pedal phalanges, with no evidence in non-hadrosaurid iguanodontians. Analyses of further collections will extend the current palaeopathological database, thereby enhancing behavioral and ecological interpretations.



# ISOTOPIC TRACKING OF LARGE UNGULATE ECOLOGY IN MIDDLE EOCENE PONDAUNG FORMATION (MYANMAR)

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**Keywords:** *Eocene, ungulates, palaeoecology, isotopes, Myanmar*

Presentation type: oral communication

During the Cenozoic, Myanmar has been a key area for mammalian evolution, this region having seen the emergence and diversification of several major groups of eutherian mammals such as anthropoid primates as well as ruminant and hippopotamoid cetartiodactyls. While a very rich mammalian diversity has been described from this region, very few studies have focused on paleoecological and paleoenvironmental aspects related to these mammalian communities. The present study uses carbon ( $\delta^{13}\text{C}$ ) and oxygen ( $\delta^{18}\text{O}$ ) isotopic tracking in tooth enamel to reconstruct the paleoecology of Anthracotheriidae, Amynodontidae, Brontotheriidae and the chalicothere *Eomoropus* during the Middle Eocene of the Pondaung Formation. We investigated niche partitioning among the ungulate groups, forest cover in Central Myanmar, possible semi-aquatic ecology of Anthracotheriidae and Amynodontidae, as well as the occurrence of monsoon-like climatic pattern. The carbon isotopic results indicate that all the studied large ungulates were C3 browsers predominantly living in open woodland ecosystems. Niche partitioning occurred among ungulate families but also within them, pointing out to some ecological differences at a lower taxonomic level. A semi-aquatic ecology could not be confirmed for the analysed Anthracotheriidae, but is not excluded for some Amynodontidae with low oxygen-18 abundances. Furthermore serial isotopic analysis of tooth enamel provides evidence for a monsoon-like climatic pattern already during the Middle Eocene in this region, but the foraging strategy does not seem to be affected by the climatic seasonality.

# THE IMPORTANCE OF THE JURASSIC PERIOD IN LEPIDOSAUR EVOLUTION: INSIGHTS FROM DISPARITY ANALYSES

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**Keywords:** *Lepidosauria, Rhynchocephalia, Squamata, macroevolution, disparity*

Presentation type: oral communication

Lepidosaurs, mainly represented today by squamates ("lizards", snakes and amphisbaenians), are an important component of land vertebrate assemblages, but a very patchy fossil record has hampered discussions on the early evolutionary history of the group. We report here some results of disparity analyses applied to morphological cladistic datasets. When analysed in the light of the fossil record as currently known, disparity results suggest a burst of expansion of morphospace by the middle-late Jurassic, when representatives of the main morphotypes (rhynchocephalians, snakes, anguimorphs and other squamates with a more conservative morphology) are recorded. Importantly, the datasets are biased towards complete specimens because it was initially assembled to infer phylogenetic information, and our analyses probably underestimate early morphospace occupation and disparity when groups have a known early fossil record represented by fragmentary material not included in the data matrices. In this sense, the putative Jurassic records of other groups (not included in our analyses) and the presence of ghost lineages, as derived from currently accepted molecular phylogenies, provide further support for this interpretation, because additional highly derived groups were possibly present by that time. We acknowledge that some important groups of squamates appear in the late Cretaceous, but our results suggest that the main phase of morphospace occupation of lepidosaurs occurred much earlier.

A. Bolet is a Newton International Fellow (NF170464).



# SMALL AND MEDIUM-SIZED MAMMALS FROM THE EARLY MIOCENE SITE OF MOKRÁ - TURTLE FISSURE (MORAVIA CZECH REPUBLIC)

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**Keywords:** *Mammalia, Early Miocene (MN 4), Mokrá, Czech Republic*

Presentation type: poster

Miocene mammal localities from Central Europe are quite common. Mokrá open-cast mine (Moravia, Czech Republic) represents a unique fossil site with an extraordinary abundance and diversity of mammal remains. From there, different fissures have been discovered, the oldest ones (1/2001 Turtle Fissure and 2/2003 Reptile Fissure) dating from the Early Miocene. Later works have been mostly focused on the herpetofauna, including the description of a new species of *Varanus*. On the other side, only preliminary studies of small mammals from 1/2001 Turtle Fissure have been published. In this work the small and medium-sized mammals from the 1/2001 Turtle Fissure are described in detail for the first time. The rodent remains include material assigned to *Paleosciurus sutteri*, *Melissiodon dominans* (representing one of the last appearances of the genus) and remains attributed to *Megacricetodon* cf. *primitivus*. The presence of the two latter genera has allowed the assignation of the assemblage to the late Early Miocene (MN4). Regarding insectivores several teeth recovered are ascribed to *Galerix* sp. The presence of the mustelid *Martes laevidens* is also relevant, as well as the remains of ruminants like *Procervulus* sp., *Lagomeryx* sp. and *Lagomeryx pumilio*, constituting one of the first appearances of this genus in the Early Miocene. Further studies of 1/2001 Turtle Fissure and the other two fissures from Mokrá site will notably improve our knowledge about the mammal assemblages and its paleoecological implications during the Early Miocene in Central Europe.

Acknowledgements: This work was carried out with financial support from the APVV grant agency of the Slovak Republic (contract APVV-16-0121: Geodynamics of the Alpine-Carpathian junction constrained by dating of the Cenozoic evolutionary phases in the Vienna and Danube basins), from the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (contact VEGA 1/0164/19: Biostratigraphy of terrestrial deposits from the Cenozoic Era in the Slovak territory of the Western Carpathians); and partly by RVO67985831 of the Institute of Geology of the Czech Academy of Sciences.

# A PHYLOGENY OF THE GENUS *NYCTEREUTES* TEMMINCK, 1838 (MAMMALIA: CARNIVORA: CANIDAE), INCLUDING A NEW SPECIES FROM ÇALTA (TURKEY)

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**Keywords:** *Nyctereutes*, phylogeny, mammal paleontology, Turkey

Presentation type: poster

The phylogenetic relationships of the raccoon-dog, *Nyctereutes procyonoides*, were matter of debate in the last decades. Morphological phylogenies recognized some affinities between *Nyctereutes* and some South American canids, e.g. *Cerdocyon*, whereas more recent molecular studies support the inclusion of the raccoon-dog in the tribe Vulpini together with the genera *Vulpes* and *Otocyon*. The present study reports the first most-parsimonious analysis on extant and fossil species of *Nyctereutes* using a dataset of 115 *ad hoc* selected cranial, dentognathic, cerebral and postcranial characters, analyzed through the freeware software TNT v. 1.5. The resulting strict consensus tree (tested with bootstrap and decay techniques) shows the presence of two clades: one made up by the African *N. lockwoodi* and *N. terblanchei*, and one composed of the enigmatic *N. barryi* from Laetoli, all the other Eurasian species and also *N. abdeslami* from Morocco. The resulting arrangement partially confirms previous hypotheses on the relationships among the fossil *Nyctereutes*, although it points out several unexpected pattern to the intricate taxonomic tangle of fossil raccoon-dogs. The results supports the development of two different models to explain the dispersal of the ancestors of this genus from North America into the Old World. Lastly, the analysis reveals the peculiarity of the *Nyctereutes* from Çalta (Turkey). Previous descriptions related this taxon to *N. donnezani*. Our analysis points out a closer affinity to morphologically derived *Nyctereutes*, therefore, we suggest the ascription of the taxon to a new species.



# THE PERMIAN TETRAPOD TRACE FOSSIL LOCALITY OF MAMMENDORF (GERMANY): STATE OF KNOWLEDGE AFTER THREE YEARS OF COLLECTING

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**Keywords:** *burrowing behaviour, Reptilia, Southern Permian Basin, Therapsida, Rotliegend*

Presentation type: poster

Sedimentary rocks of late Middle to Late Permian age, outcropping at Mammendorf quarry in northern Saxony-Anhalt, Germany, yielded an assemblage of continental trace fossils including reptilian and therapsid tracks, scratches and scrabbling traces, invertebrate burrows and plant root traces. Since the first finds in May 2016 ca. 90 individual slabs with trace fossils (four tons of rock) have been collected and stored at the Museum of Natural History in Magdeburg. About the half of the material came from the systematic excavation of a particularly fossiliferous sandstone horizon which was carried out in summer 2016. Tetrapod scrabbling traces turned out to be much more abundant than footprints. They occur in different morphologies: (I) individual sets of four or five parallel toe marks, (II) paired sets of (left and right) toe marks that can form short and half-oval or elongate rail-like structures, (III) oval or kidney-shaped interruptions of the mudstone lamina (holes), (IV) sets of paired toe marks transitional to holes and (V) bilobate structures with two parallel scratched furrows separated by a shallow middle wall. The last two years of collecting brought forth several larger clusters of scrabbling traces varying in shape and a couple of relatively narrow traces (8 - 16 cm in width) that occurred together with broader traces made by larger individuals (16- 28 cm). Due to the occasional co-occurrence of a conspicuous therapsid footprint type, we assume that the scrabbling traces were produced by medium-sized therapsids and that they represent a probing or search behaviour in a rather inhospitable environment.

# EARLY PALAEOGENE MARINE BONYTONGUE FISHES (TELEOSTEI: OSTEOGLOSSIDAE) AND MARINE FAUNAL RECOVERY AFTER THE K-PG EXTINCTION

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**Keywords:** *early Palaeogene, K–Pg extinction, marine fishes, Osteoglossidae, recovery fauna*

Presentation type: oral communication

The early Palaeogene is a key interval for understanding the evolution of modern marine fish faunas. Together with familiar fish lineages characteristic of contemporary oceans, early Palaeogene marine deposits worldwide feature the occurrence of osteoglossid teleosts (bonytongues). Their presence is surprising, as these fishes are otherwise strictly associated with freshwater environments, both in other parts of the fossil record and modern settings. Despite its possible relevance in the context of faunal recovery after the K–Pg extinction, the Palaeogene marine osteoglossid radiation has been relatively understudied. Here we present new fossil osteoglossid specimens from early Palaeogene marine deposits of Greenland, Morocco and Pakistan that expand the known diversity of marine osteoglossids and help to characterize the temporal and geographic range of this unusual radiation. It is likely that the transition from freshwater to marine environments occurred around the K–Pg boundary, possibly related to ecological replacement of predatory fish lineages that went extinct at the end of the Cretaceous. We propose that marine osteoglossids represent a striking example of a short-lived recovery fauna, diversifying during the Paleocene and going extinct in marine environments after a relatively short amount of time, probably around the middle Eocene.

# NEW DINOSAUR TRACKS FROM THE LATE JURASSIC OF THE LUSITANIAN BASIN (PORTUGAL)

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**Keywords:** *ornithischian, ornithopod, Kimmeridgian, Tithonian, Consolação sub-basin*

Presentation type: poster

The Sociedade de História Natural in Torres Vedras (Portugal) houses a significant collection of yet undescribed dinosaur tracks from the Late Jurassic. The footprints have been collected from different geological formations that outcrop across the different sub-basins of the Lusitanian Basin. Within the Consolação sub-basin stand out several localities where Late Jurassic (Kimmeridgian-Tithonian) deposits from the Praia da Amoreira-Porto Novo, Alcobaça and Bombarral formations crop out. The footprints are mainly preserved as isolated natural casts and were collected in different localities at the base of the cliffs, thus the specific stratigraphic level is unknown. The ichnoassemblage is mainly dominated by small, medium and large sized tridactyl tracks, quite symmetric with high interdigital angle and low mesaxony. The smaller footprints resemble *Anomoepus*-like tracks typical from the Early Jurassic but also identified in other Late Jurassic areas of the Iberian Peninsula (e.g: Asturias). This ichnogenus has been associated with basal ornithischian dinosaurs. The medium sized footprints resemble *Dineichnus*, which have been described from a Late Jurassic nearby locality in São Martinho do Porto, and have been associated with dryosaurid tracks. The larger footprints can be considered as large ornithopod footprints (Iguanodontipodidae) which are more typical for Lower Cretaceous tracksites. Interestingly, the Upper Jurassic ornithopod record from the Consolação sub-basin has yielded both small-sized and medium-sized ornithopod remains such as the dryosaurid



*Eousdryosaurus* (Praia da Amoreira-Porto Novo Formation, Kimmeridgian) and a rich fauna of camptosurids, including *Draconyx loureiroi* (Bombarral Formation, Tithonian).

# REVITALISING THE NHM FOSSIL BIRD COLLECTION TO ATTRACT MORE RESEARCH

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**Keywords:** *fossil birds, taxonomy, digitisation*

Presentation type: poster

This internationally important Fossil Bird Collection storing over 13,500 specimens including *Archaeopteryx*, ratite eggs, over 650 type specimens and approximately 4,500 from the UK has upgraded major areas of taxonomy e.g. the Eocene birds of the London Clay and developed a digitisation, e-cataloguing and 3D printing programme to raise the profile and use of the collection for research by delivering electronic documentation on REMU, a comprehensive database on the NHM web site and a Collections Level Description for the web, by imaging the best specimens and remounting of the iconic birds. The target for 2019 is electronic documentation of at least 1,000 bird specimens, focusing on type, Mesozoic and iconic specimens. The benefits are that the Bird Collection is more research-ready for loans, laser and micro-CT scanning and Photogrammetry, and iconic specimens are more readily available for Public Engagement.

# DINOSAUR LATITUDINAL BIODIVERSITY GRADIENT REVEALS THE PALAEOGEOGRAPHIC SIGNATURE OF SAUROPOD THERMOPHYSIOLOGY

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**Keywords:** *Dinosauria, Sauropoda, diversity, latitude, physiology*

Presentation type: oral communication

The latitudinal biodiversity gradient, characterised by an increase in species richness from the poles to the equator, is the first-order macroecological pattern today. However, evidence from the fossil record suggests that this modern-type pattern has not always been present. Previous work on Mesozoic dinosaurs has suggested a peak in diversity at higher latitudes, with evidence for spatial partitioning between the main subclades (Theropoda, Sauropoda and Ornithischia) in the Late Cretaceous. However, some authors have suggested this might be an artefact. We combined a global occurrence dataset of non-avian dinosaurs for the Late Cretaceous (100.5–66 million years ago) with HadCM3L General Circulation Models that reproduced the climatic conditions of this time interval. We evaluated the effect of physical drivers, such as climate (e.g. temperature, precipitation) and palaeogeography (e.g. range size), on dinosaur distribution. Sampling-standardisation approaches indicate a subtropical distribution for sauropods, in contrast to an antitropical distribution for theropods and ornithischians. Multivariate space quantification of palaeogeographic and palaeoclimatic occupation shows that sauropod hypervolumes are more constrained by temperature extremes than the other two dinosaur clades. Using generalized least-squares regressions to determine the relationships between latitudinal biodiversity patterns and potential explanatory variables (e.g. temperature and sampling proxies), we demonstrate statistical support for sauropod diversity and range sizes being constrained by temperature fluctuations. In contrast, theropod and ornithischian diversity patterns and ranges appear largely independent of climate. These results are supportive of a different thermophysiological strategy for sauropod dinosaurs, with a possible explanation for the gigantothermic physiology experimented by this group.



# TAPHONOMY OF THE DINOSAUR BONE BEDS FROM THE MIDDLE JURASSIC OF KULINDA (SOUTHEASTERN SIBERIA)

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**Keywords:** taphonomy, neornithischian dinosaur, bone beds, palaeo-environment

Presentation type: oral communication

The Kulinda locality, situated in south-eastern Siberia, has yielded differently preserved remains of the neornithischian dinosaur *Kulindadromeus zabaikalicus*. The fossil assemblage includes bones and soft tissues, with integumentary structures interpreted as primitive feathers. Recent combined U-Pb and palynological analyses showed that *Kulindadromeus* is Middle Jurassic – probably Bathonian – in age, pushing back the first palaeontological evidence of feathers within the dinosaur clade. Our current study aims at understanding the taphonomy and paleoecology of the locality.

At Kulinda, the stratigraphic section consists of a succession of immature deposits interpreted as greywackes and arenites, composed of volcanic and plutonic clasts derived from nearby igneous sources. Three major monospecific bone beds are intercalated within these deposits and display distinct modes of preservation, with (1) abundant soft tissues – skin and feathers – in close association with articulated bones, (2) few soft tissues and disarticulated bones, and (3) the lack of soft tissues and epigenized disarticulated bones.

The macrofloral and palynological assemblages are characteristic of a pioneer vegetation, including mosses, liverworts, ferns and horsetails. Gymnosperms, in particular pteridosperms, pinaceae and podocarpaceae, are equally represented. This assemblage suggests a rather humid and temperate environment in the region during the Middle Jurassic. The absence of paleosol and root traces in the deposits suggest that sedimentation rates were too fast for the establishment of stable plant communities and pedogenesis. The locality was characterized by a harsh and unstable environment, which may explain the presence of very few vertebrate taxa.

# LIGHTS AND SHADOWS ON THE VILLAGRANCHIAN PERISSODACTYLS OF ITALY

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**Keywords:** *Perissodactyla*, *Tapiridae*, *Rhinocerotidae*, *Equidae*, *Villafranchian*

Presentation type: poster

A critical revision of the Villafranchian fossil record of perissodactyls in Italy is undertaken herein to provide insights (“lights and shadows”) of occurrences and evolution of this group.

The genus *Tapirus* occurred in Italy during the latest Miocene and it became extinct in Italy at the end of the Pliocene (early Villafranchian), at the transition from the Triversa Faunal Unit (FU) to the Montopoli FU. Accordingly, *Tapirus* represents an important biochronological element that allows us to discriminate between Pliocene and early Pleistocene faunal complexes.

During the Villafranchian, the Rhinocerotidae were represented by two species: *Stephanorhinus jeanvireti* and *S. etruscus*. *S. jeanvireti* was present during the late Pliocene (MN 16), while *S. etruscus* occurred in Italy during the latest Pliocene (MN 16a and 16b), and it was reported through the middle and late Villafranchian. *S. etruscus* persisted in central Italy until the end of the early Pleistocene.

The *Equus* Datum is represented in Italy by the large stenonine horse *Equus* from the Montopoli FU, chronologically dated at 2.58 Ma. *E. stenonis* and *E. stehlini* are the two other species known from Val di Magra basin and the Upper Valdarno deposits, referable to the Olivola FU and the Tasso FU. *Equus sussenbornensis* and *E. altidens* are reported from the Farneta FU and Pirro Nord FU, at the end of the Villafranchian. Nevertheless, recent studies pointed out the presence of small horses before the *E. stehlini* datum (1.6 Ma), from Coste San Giacomo (2.1 Ma) and Montecarlo (2.4 – 2.2 Ma, Upper Valdarno basin). Furthermore, the occurrence of *E. sussenbornensis* and *E. altidens* at the end of the Villafranchian is still uncertain, as reported from previous authors.



# THE LATE TRIASSIC VERTEBRATE LOCALITY WITH ARCHOSAUR AND TURTLE REMAINS IN KOCURY, POLAND

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**Keywords:** *Triassic, Poland, Testudinata, Aetosauria, Dinosauria*

Presentation type: oral communication

Since 1990, several localities with terrestrial vertebrate remains have been discovered in Keuper (upper Middle to Upper Triassic) strata from Southern Poland. In 1932, Friedrich von Huene already published the description of an incomplete bone from rocks of similar age exposed at Kocury (Kotzuren) near Dobrodzień in Upper Silesia. This bone was interpreted as a dinosaur fibula and named *Velocipes guerichi*. Although Kocury has a high scientific potential, this site was forgotten and not mentioned in the literature for over 80 years.

In 2011 we reexamined von Huene's material and confirmed that it belongs to a neotheropod dinosaur. Since 2012, our excavations in the rediscovered Kocury locality has yielded further taxonomically identifiable vertebrate material. In addition to the neotheropod dinosaur, bones and osteoderms of a new typothoracisine aetosaur, carapace fragments of a proterochersid turtle *Proterochersis* cf. *porebensis*, and the tooth plate of a ptychoceratodontid lungfish were collected. This material suggests faunal and environmental similarities with the turtle-dominated Poręba locality, Norian in age.

# VARIABILITY IN SKULL SHAPE OF ARMADILLOS AND GLYPTODONTS (CINGULATA)

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**Keywords:** *geometric morphometrics, skull, armadillos, Xenarthra, disparity*

Presentation type: oral communication

Xenarthra is one of the four major clades of placentals. It is an exclusively American group of mammals, which split from the rest of the mammalian clade very early. Xenarthrans showed a large diversity in the past, represented by two different clades; sloths and anteaters (Pilosa), and armadillos and pampaterids (Cingulata). The armadillos were one of the most diverse groups of xenarthrans, including the bizarre glyptodonts, giant armadillos that can weight up to 2 tons. Despite the low number of extant species (21), they are still the most diverse xenarthrans.

The variability of the lower jaw of xenarthrans has been thoroughly explored, showing a surprisingly large disparity in shape when compared with other clades of mammals, like ungulates or carnivorans. This variability is especially impressive in the clade of armadillos.

Nevertheless, the mandible of xenarthrans is not their most striking feature, with some of the extinct forms showing highly modified skulls. These modifications are diverse between extinct and extant forms, from very long snouts in some armadillo species, to the telescoped skulls of the giant glyptodonts. Changes in the skull are expected to be more constrained than changes in other anatomical parts, as there are different selective pressures imposed by its many different functions, and its complex developmental pathway. However, skull variability has not been analysed in the past. In this work I explored the variability of the skull shape of extant and extinct armadillos, using geometric morphometrics methods to quantify the shape changes. For doing that I analysed 139 skulls representing 18 species.

# 3D LIMB BIOMECHANICS OF THE STEM-ARCHOSAUR *EUPARKERIA* *CAPENSIS*

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**Keywords:** *biomechanics, modelling, range of motion, Archosauria*

Presentation type: oral communication

Archosaurs are an extremely diverse group of reptiles, originating shortly before the Triassic period and radiating rapidly after the Permo-Triassic mass extinction. In the Triassic they explored diverse morphologies in the ankle and pelvis, which lead to the different locomotor types and body plans we see throughout their evolutionary history. The diverse skeletal morphologies in Triassic archosauriforms had an undeniable influence on their locomotion, however the implications for specific functions are still poorly understood. Early archosaurs and sister taxa to Archosauria are essential to understand the evolution of the different locomotor adaptations; however, quantitative locomotor biomechanics studies of extinct archosaurs have so far focused almost exclusively on non-avian dinosaurs. We present the first detailed, quantitative and 3D investigation into the locomotory abilities of the stem-archosaur *Euparkeria*.  $\mu$ CT scans of multiple specimens from South Africa enabled the reconstruction of its limbs in unprecedented detail and the characterization of previously unknown morphological features. To test previous qualitative hypotheses regarding posture, gait and stance of *Euparkeria*, the mobility of the complete hindlimb was assessed and the maximal joint ranges of motion quantified in 3D. Two sensitivity analyses were performed to account for the unknown amount of epiphyseal cartilage and the restricting influence of soft-tissue. Due to the medially expanded femoral head and the distinct supra-acetabular rim, *Euparkeria* seems to have been capable of adopting a crocodile-like “semi-erect” posture. This is consistent with other evidence suggesting that the common ancestor of archosaurs had a similar ability to adduct the hindlimbs into less sprawling poses.



# THE PELVIC, CAUDAL AND HIND LIMB MUSCULATURE OF *PLATEOSAURUS*

## ENGELHARDT

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**Keywords:** 3D-modelling, musculature, reconstruction, Sauropodomorpha

Presentation type: poster

Sauropodomorpha includes the Sauropoda, the largest land animals of all times. Understanding the locomotion of early sauropodomorphs is therefore crucial for understanding the evolution of quadrupedalism and gigantism in derived taxa. Basal taxa with modest body size are of key importance; however, previous research on dinosaur hindlimb myology has mainly focused on the theropod line to extant birds. Here, we present the first detailed three-dimensional reconstruction of locomotor musculature of a non-theropod dinosaur, using a novel volumetric reconstruction method, which greatly improves muscle modelling and biomechanical analyses, on the example of the basal sauropodomorph *Plateosaurus*.

Our reconstruction is based on an EPB approach, opting for crocodilian myology whenever there was conflicting evidence, as our model is rooted in the assumption that osteological similarity indicates myological similarity. The volumes of the individual muscles were determined by scaling cross sections of *Alligator mississippiensis* limbs to match the cross sectional area of the corresponding bones in *Plateosaurus*, and tracing the muscle outlines. This approach is validated as the shape of the muscles approaches the origins of the individual muscles identified via the EPB despite the differently proportioned pelvic bones in *Plateosaurus*.

This new method improves on a solely the EBP-based approach, as all muscle shapes inform on their neighbours. Incorrectly placed, shaped or missing muscles result in illogical shapes or gaps, and thus can be detected and corrected easily. This method can advance both kinematic and dynamic modelling approaches, providing more exact input parameters for muscle mass, mass distribution and lines of action.

# THE TAIL OF THE LATE JURASSIC SAUROPOD *GIRAFFATITAN BRANCAI*: ANATOMY AND BIOLOGICAL ROLE

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**Keywords:** *Sauropoda*, *Tendaguru*, *Giraffatitan*, volumetric musculoskeletal modelling, tail

Presentation type: poster

Sauropod dinosaurs were the dominant mega-herbivores from the Early Jurassic, until their extinction at the end of the Cretaceous period, and by far the largest animals to ever roam the earth. They are universally recognizable by their large size and extremely elongated necks and tails. While the biomechanics of their necks have been investigated in the past, their tail musculature, in contrast to theropods, has not received much attention. As it bears the main musculature for propulsion, it is crucial for the understanding of the locomotion. Here, we present the first detailed three-dimensional computational reconstruction of the caudal epaxial and hypaxial musculature of the Late Jurassic sauropod *Giraffatitan brancai*, and highlight the importance and necessity of 3D-modelling in musculoskeletal reconstructions.

The tail of this basal macronarian is relatively short compared to diplodocines. However, our reconstruction suggests that the tail musculature in *Giraffatitan* was well developed and robustly built to compensate for the shorter length of the *M. caudodorsalis longus*, the main hindlimb retractor muscle. Even though the centre of mass lies well in front of the hindlimbs, the main component of propulsion is still provided by the hindlimbs, while the forelimbs help to support the animal's body weight.

## A SPRING APOCALYPSE AT THE K-PG BOUNDARY

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**Keywords:** *K-Pg boundary, seasonality, acipenseriformes, impact, extinction*

Presentation type: oral communication

The Chicxulub impact on the Yucatán Peninsula (~66 Ma) obliterated ~75% of all species. Particularly, the Cretaceous-Paleogene (K-Pg) mass extinction was among the most selective extinction events in the history of life on Earth. The impact was geologically recorded by impact spherules, shocked quartz, and a global iridium anomaly. Until now, impact timing was constrained on a millennial timescale, yet the season of impact remained unclear. However, survival of the latest-Cretaceous biota was likely influenced by the timing of impact relative to their seasonal cycles.

Here, we demonstrate that the bolide responsible for the K-Pg mass extinction struck during boreal spring. Seiche deposits preserving mass-death assemblages of fishes with impact spherules lodged in their gill rakers was recently discovered (Tanis, North Dakota, USA). Using synchrotron microtomographic osteohistology (BM05, ESRF) and stable isotope analysis (VU), we obtained high-resolution growth records from dermal bone of sturgeons and paddlefishes.

These data continuously resolved annual cyclicity during the final years of the Mesozoic. The periosteal surfaces preserve an unfinished growth zone with a  $\delta^{13}\text{C}$  value of -2.5 ‰. This is intermediate between winter minimum values of -3.3‰ and summer maximum values of -1.3‰.

Our high-resolution records thereby demonstrate that the fish perished in spring. Annual life cycles, including timing and duration of reproduction, ingestion, and metabolic activity, strongly varies across biota. Seasonal sensitivity to the effects of ejecta reentry, wildfires, and reduced insulation and acid-rain precipitation induced by sulfuric aerosols will have substantially influenced relative biotic survival rates across the K-Pg boundary.

# THE TAPHOCOENOSIS OF THE FISCHSCHIEFER (RUPELIAN/OLIGOCENE) AT RAUENBERG (BADEN-WÜRTTEMBERG/GERMANY) – TAXONOMY, TAPHONOMY AND PALAEOECOLOGY

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**Keywords:** *Fischschiefer, Palaeoecology, Rupelian, Taphonomy, Taxonomy*

Presentation type: oral communication

Excavations of the Rupelian Fischschiefer (Fish Shale) at the Unterfeld clay pit (Rauenberg) exposed a diverse tapho- and tanatocoenosis featuring a wide array of plant (Embryophyta) and bony fish (Teleostei) species. The rare occurrence of cartilaginous fish (Chondrichthyes) and marine tetrapods (Testudinata, Sirena) suggests a hostile, at least in phases, anoxic deposition environment. However, the existence of terrestrial tetrapods (Aves, Microchiroptera, Creodonta) indicates a coastal deposition area. Taphonomical analysis revealed an allochthonous origin for most of the fossils confirming that multiple interlaced ecosystems provided material to this taphocoenosis.

The Rauenberg Clay Pit Unterfeld deposits are interpreted with respect to sedimentology, stratigraphy, taxonomy, diversity, taphonomy and palaeoecology. Layers of grey-black clay alternate with silt deposits, suggesting periodic variations in water-level in the Rupelian Bay. Sedimentological section analyses established that sapropels were deposited both above and below the storm-wave base, confirming recurrent fluctuation of sea-level during early Oligocene.

Conclusions drawn from frequency of plant and animal fossils allows to establish a depositional model for the Fischschiefer at Rauenberg, suggesting that this formation coalesced in a coastal undersea basin at a water depth below 50 m with shifting influence from land-based, marshland and open-sea ecosystems dependent on prevailing sea levels, storm surge and wind direction. The taxonomical and taphonomical analyses revealed sparse evidence of species occupying seafloor habitats, indicating a predominantly anoxic deposition environment conducive to fossil preservation. The selective diversity of taxa found in the Rauenberg Fischschiefer fossil assemblage suggests that the bay must have provided a thriving, life-sustaining environment.



# NEW SACRAL MATERIAL OF *MORELLADON BELTRANI* FROM THE UPPER BARREMIAN MORELLA FORMATION IN MORELLA (SPAIN)

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**Keywords:** *Styracosterna*, *Morelladon*, *Lower Cretaceous*, *Morella*, *Spain*

Presentation type: poster

The most representative dinosaur group of the late Barremian Arcillas de Morella Formation are styracosternan ornithopods, which are also very abundant throughout the Iberian Lower Cretaceous. Among the more than 20 vertebrate fossil sites documented in this formation the Mas de la Parreta quarry (CMP), located at the southwest of the locality of Morella (Castellón province, Spain) is particularly noteworthy. Currently, three styracosternan species have been recognized in this quarry: *Iguanodon bernissartensis*, *Mantellisaurus atherfieldensis* and *Morelladon beltrani*. Up to the present, *Morelladon* was just represented by the holotype specimen located in CMP-MS-03 site. Here, new postcranial bones of *Morelladon beltrani* from three different sites (CMP-3c, CMP-MS-03 and CMP-MS-05) within the Mas de la Parreta quarry are examined for the first time. These bones correspond to nearly complete and partial sacra of three new individuals. These sacra can be confidently referred to *Morelladon beltrani* based on the autapomorphic midline ventral keel of the centrum in sacra 2 and 3 of CMP-3c and CMP-MS-05 specimens and in sacral 4 of CMP-MS-03 and CMP-MS-05 specimens. These new occurrences confirm that remains of this species were more common than previously thought in the Arcillas de Morella Formation.

# TAPHONOMY OF ANURANS FROM THE EOCENE GEISELTAL KONSERVAT-LAGERSTÄTTE (GERMANY)

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**Keywords:** *mineralization, organic preservation, amphibians, soft tissue, lignites*

Presentation type: poster

The Eocene Geiseltal Konservat-Lagerstätte (~47.5–42.5 million years) is hosted in lignites recovered from open mine pits located ca. 20 km SW of Halle (Saale), Saxony-Anhalt, Germany. Excavations began in the 1920's and were terminated by the flooding of the pits in the 2000's. Today, circa 50,000 specimens are curated in the Geiseltal Collection, most of which are vertebrates. Despite early studies on the fossil soft tissues, the specimens have not been studied using modern techniques and thus the taphonomy and controls on the preservation of the fossils are incompletely resolved.

The Geiseltal anurans represent at least three families (including Pelobatidae, Palaeobatrachidae, Ranidae), each represented by a single taxon. All specimens were prepared via paraffin- or lacquer transfer at the time of collection.

Most collected specimens are fully or well articulated and nearly complete. Soft tissues are evident as thin, discontinuous layers of mineralized and/or carbonaceous residues that exhibit various textures reported from fossil frogs from other localities, e.g. Libros (Miocene, Spain). These textures include polygonal fracturing characteristic of fossil melanosome films, dimpling characteristic of mineralized skin (as in other fossil frogs), granular pale material in the cranium and nerve cord characteristic of otoliths and/or mineralized nerve tissue. Ongoing analysis of these features using SEM, EDS, FTIR and Raman spectroscopy reveal the composition of the soft tissues of the frogs and are the basis of the first modern taphonomic model for soft tissue preservation in the Geiseltal biota.

# THE EVOLUTION OF THE EARLY EOCENE GENUS *AGERINIA* (PRIMATES, ADAPIFORMES) UNDER THE LIGHT OF THE RECENT DISCOVERIES

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**Keywords:** *Paleogene, early primates, Notharctidae, Pyrenees, Iberian Peninsula.*

Presentation type: poster

The diversity of the European early Eocene Primates is relatively high, although the available material from the Iberian Peninsula is still scarce. During this decade, our research team has revised meticulously the historical collections of the Institut Català de Paleontologia Miquel Crusafont, and has prospected several early Eocene Spanish basins, discovering new fossil localities. These works have led to the description of new material of the species *Agerinia roselli* and the erection of two new species: *Agerinia smithorum* and *Agerinia marandati*. Here we present the still unpublished material of *Agerinia* sp. from the new localities Font del Torricó-1 and 3, and *Agerinia smithorum* from Casa Retjo-3 and Cabana del Llúcio-1. Despite the scarcity of material from these sites, the new findings confirm that the genus *Agerinia* was more common than previously thought. Furthermore, the analysis of the material of the three species of *Agerinia* has depicted morphological trends from *A. smithorum* to *A. marandati*, and finally to *A. roselli*. Some of them are the reduction of the anterior lower premolars, the progressive molarization of the P<sub>4</sub>, the loss of the paraconid in the lower molars and the occurrence of enamel wrinkling in the upper molars. All these tendencies support the hypothesis of an anagenetic lineage integrated by these three species.

This work was supported by the Spanish Government (CGL2017-82654-P, BES-2012-052951), Generalitat de Catalunya (Programmes CERCA and Beatriu de Pinós, 2017-BP-00003) and Universidad de Granada.

# TRADITIONAL MORTAR FOR THE RESTORATION OF DINOSAUR FOOTPRINT SITES

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**Keywords:** *paleontology, conservation, restoration, mortar, dinosaur footprints*

Presentation type: poster

La Rioja (Spain) has one of the best paleoichnological fossil records of the world. One of the best-known sites is “La Virgen del Campo”, found in the Enciso locality. In this work, we show the preservation and restoration works made in the summer of 2018.

We analyzed the pathologies that could be causing harm to footprints. The site is exposed to temperature and humidity variations, rainfall erosion and other factors that could be damaging for the preservation of the footprints. We tried materials that are usually used in conservation and restoration of stone monument heritage and not the ones that are traditionally used in fossil footprint restoration. Before the restoration work in the site, we performed laboratory tests on samples from the same geological layers of the site to verify the proper functioning of the material.

As we know the properties of traditional lime mortars, we studied different kinds of mortars made of hydraulic lime and different types of aggregates, such as sand, silica and calcium carbonate. After all the laboratory tests, we performed the same analysis near the site but in the same stone. We applied different mortars depending on the needs. That is why we developed injecting and sealing mortars. For the correct application of the mortars by the work team, we designed a diagram with instructions for every possibility. Now we are monitoring the results of our work, in a way that we can determine the efficiency and durability of this restoration in the future.



# A NEW AVIALAE FROM THE LATE JURASSIC OF SOUTHERN GERMANY

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**Keywords:** Late Jurassic, Solnhofen Archipelago, bird origins, flight evolution, Paraves

Presentation type: oral communication

The Late Jurassic lithographic limestones of the Solnhofen Archipelago are famous for their exceptionally preserved fossils, including the urvogel *Archaeopteryx* von Meyer, 1861, which has played a pivotal role in the discussion of the origin of birds. Here, we describe remains of a new avialan from the Lower Tithonian Mörnsheim Formation, represented by a partly articulated, almost complete right forelimb. The new specimen is about 10 percent larger than the Solnhofen specimen, the largest specimen assigned to the genus *Archaeopteryx*, and shows a number of characters that distinguished it from the latter, but can be found in more derived Avialae like *Jeholornis* Zhou & Zhang, 2002, *Sapeornis* or *Confuciusornis*. These characters include a strongly curved humerus, an enlarged deltopectoral crest with a pronounced facet for the attachment for the pectoralis muscle, a large, crest-like *tuberculum bicipitale radii*, a robust second manual digit, and relatively small unguals. A phylogenetic analysis found the new specimen crownwards to *Archaeopteryx*, representing the most derived avialan known from the Jurassic. Thus, although the specimen is highly fragmentary, it can be classified as a new taxon, increasing the previously known avialan diversity of the Solnhofen Archipelago. Furthermore, the modifications found in the deltopectoral crest and the proximal end of the radius represents increased muscle attachment areas that are relevant for the downstroke of the wing, indicating a rapid adaptation of the forelimb for active flapping flight in the early evolution of birds.

# PRE-FORMATIVE HUMAN REMAINS FROM BOLIVIA: UNEXPECTED DIVERSITY AND MANY OPEN QUESTIONS

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**Keywords:** *Homo sapiens, Bolivia, pre-formative, diversity, pathology, megafauna*

Presentation type: oral communication

The Formative Period in America ranges from about 6,000 to 1,500 years BP and represents an early stage of agriculture and craftsmanship. While human remains of early hunters and gatherers (12,000 – 5,000 BP) have been reported from North America, Mexico and Brazil, the discoveries made in Bolivia remained basically unknown to the scientific community, mainly because they were only published in local journals. The recent re-investigation of five human remains of the pre-formative period in Bolivia has yielded an unexpected osteological variability. All specimens are unequivocally *Homo sapiens* (*sensu lato*). The Hombre de la Ciénega (Swamp Man) was found in the vicinity of Cochabamba and is characterized by a lowly vaulted skull roof and a body height of at least 1.8 meters. The skeleton was preserved in a flexed lateral position and shows massive pathologic deformations in the intervertebral joints. Apparently, the interment is a burial although it lacks clear grave structures. Another specimen from the area is exhibited in the Archaeology Museum in Cochabamba. The skeleton of the Hombre de Jayhuayco (Jayhuayco Man) suggests a body height of about 1.65 meters. The bones are encrusted by sediment. A third specimen from Cochabamba, the Hombre de Sacaba (Sacaba Man) is only represented by an undiagnostic calvarium. The two specimens from Tarija (Hombres de San Luis and Ñuapua; San Luis and Ñuapua Man) both had a height of about 1.67 meters. The Hombre de San Luis was found in a flexed position while the Hombre de Ñuapua lacks any collection data. Their skull roofs posterior to the supraciliary arch is more vaulted than that of the Swamp Man. The curvature of the occiput in both Tarija specimens is similar, but the mandibles differ significantly with respect to the ratio between the dental and the muscular part and the angle between the articular and coronoid processes. The Ñuapua, San Luis and Ciénega Men share a wide and flat nasion. All skeletons were found isolated and with the exception of the Hombre de la Ciénega no

further description of the archaeological context is available. Dubious  $^{14}\text{C}$  datings and the possible presence of megafauna associated with the skeletons suggest that either some Bolivian megafauna survived into the Holocene, or that the humans are older than expected.

# A NEW STYRACOSTERNAN ORNITHOPOD-BEARING FOSSIL SITE FROM THE UPPER BARREMIAN MORELLA FORMATION IN MORELLA (SPAIN)

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**Keywords:** *Styracosterna*, *Mas de la Parreta*, *Lower Cretaceous*, *Morella*, *Spain*

Presentation type: poster

Mas de la Parreta quarry (CMP), located at the southwest of the locality of Morella (Castellón province, Spain), is a richly fossiliferous area of the Arcillas de Morella Formation that commonly yields vertebrate fossils. Seventeen vertebrate fossil sites have been documented so far. Nowadays, the identified vertebrate fauna includes sharks, bony fishes, plesiosaurs, turtles, crocodiles and dinosaurs. Among this diverse fauna highlights the discovery of more than 2.000 styracosternan ornithopod dinosaur remains, including some partial skeletons of distinct medium to large individuals. We provide information on CMP-MS-05 site, located at Mas de Sabaté area in the Mas de la Parreta quarry. The vertebrate fauna identified in CMP-MS-05 site includes semionotiform fishes, turtles, non-eusuchian neosuchian crocodiles, pterosaurs and dinosaurs. The fossil accumulation includes teeth of spinosaurid and allosauroid theropods, and remains of, at least, three styracosternan individuals. Two of these partial skeletons, including skull material, belong to a large-sized and robust styracosternan ornithopod that shares many similarities with *Iguanodon bernissartensis*. The third partial skeleton represents a medium, lightly built styracosternan dinosaur, similar in body proportions to *Morelladon beltrani*.



# SATELLITE IMAGERIES FOR FOSSIL DETECTION: MATERIALS AND METHODS

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**Keywords:** *fossil recovery, field works, multispectral analysis, Remote Sensing*

Presentation type: oral communication

Field surveys are affected by a high degree of uncertainty despite continued efforts to maximize the potential results. During field surveys, important fossils can be missed simply because of time or budget constraints. Moreover, temperature excursion and wind erosion drive to the destruction of fossils once they are exposed on the surface. Specimens may indeed be fragmented or even displaced into a different stratigraphic context, so it is essential to collect fossils soon after their initial exposure. These factors represent one of the main challenges for palaeontologists to evaluate the results of field surveys in a particular region.

We present a new standard protocol to analyse the regions of interest in advance, as a first step of fossil detection. Using satellite imageries, we applied the method on remote areas with no vegetation and high frequency of large fossils. The selected localities, i.e. the Pisco Basin (Peru), the Petrified Forest (Arizona, US), Wadi el Hitan (near Cairo, Egypt), and Gadoufaua (near Agadez, Niger), show a wide range of different vertebrate remains and wood trunks exposed on the surface and are well known for the size and quality of their fossils.

We applied multispectral analyses and pixel-to-pixel comparisons developed in the Remote Sensing sciences for mineral exploitation to spectral signatures obtained by fossils.

Our results represent the first step in a new branch of paleontology, and we demonstrate the possibility of detecting different signals from both fossils and matrix, allowing researchers to improve the effectiveness of their field work, and fossils to be recovered before their complete destruction.

# A NEW SPHENISCIFORM FOSSIL HELPS TO UNCOVER THE BODY PLAN OF EXTINCT GIANT PENGUINS

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**Keywords:** allometry, morphometrics, Oligocene, penguin, New Zealand

Presentation type: poster

Penguins (Order Sphenisciformes) have the richest and most continuous fossil record of any extant order of bird. This wealth of available fossils has provided rich insight into the evolutionary history of Sphenisciformes, particularly with respect to body plan. Stem penguins notably diversified in body size during the Paleogene producing a size guild of 'giant penguins' that were substantially larger than modern taxa. Moreover, the ancient 'giant' penguins are strongly differentiated from crown penguins with respect to hindlimb proportions and other regional allometry, presenting a possible difference in ecological role exploited by extinct taxa. Here we analyse a previously undescribed 'giant' penguin from the North Island of New Zealand, discovered in Oligocene-aged Whaingaroa Formation. This fossil represents one of the most complete stem-penguin specimens ever reported and is also the most complete pre-Pleistocene vertebrate fossil reported from the North Island of New Zealand. Phylogenetic analyses recover this new specimen forming a clade with *Kairuku*, a taxon endemic to New Zealand. The forelimb elements of the new specimen are almost identical with those of named *Kairuku* specimens

(including size) but the pelvic girdle elements are significantly more elongated in the new specimen. This mix of characters increases the body plan variation within this clade of closely related taxa, providing a potential transitional form toward the extremely derived condition found in *Kairuku*. We discuss how the peculiar bauplan of this clade of 'giant penguins' along with the new specimen may reflect differences in ecology compared with crown taxa.

# THE DROWNING SWAMP OF GRAČANICA – A NEW MIDDLE MIOCENE VERTEBRATE LOCALITY IN BOSNIA-HERZEGOVINA

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**Keywords:** early middle Miocene, MN5-MN6, vertebrate fauna, fossil mammals, Bosnia-Herzegovina

Presentation type: oral communication

The new middle Miocene vertebrate fossil locality Gračanica (near Bugojno in central Bosnia-Herzegovina) is of biogeographical and biostratigraphical interest. After the formation of the *Gomphotherium*-landbridge in the early Miocene, the Balkan Peninsula acted as a migration corridor for land mammals between the Near East and Central Europe. Therefore, this new vertebrate locality adds new information on the fauna in this crucial area and is a welcome addition to the relatively poor middle Miocene fossil record of the Balkan Peninsula.

The locality Gračanica is an active opencast coalmine. The lacustrine sediments yielded a rich fossil vertebrate fauna. Additionally, an invertebrate fauna (arthropods, insects, mollusks) and flora is present.

The lower half (~20 m) of the geological section showing alternations of lignite and marl beds is interpreted as deriving from a swampy environment. The fossil fauna consists of proboscideans (*Prodeinotherium*, *Gomphotherium*, *Protanancus*), rhinos (*Brachypotherium*, *Lartetotherium*, *Plesiaceratherium*, *Hispanotherium*), equids (*Anchitherium*), chalicotheres (*Anisodon*) ruminants (*Dorcatherium*, *Palaeomeriidae* indet., *Giraffokeryx*, *Eotragus*, and ?*Tethytragus*), suoids (*Bunolistriodon*, *Conohyus*, *Choeromorus*), carnivores (*Amphicyon*, *Hemicyon*, *Ursavus*, *Percrocuta*, *Mustelidae* indet., and *Feliformes* indet.), rodents (*Steneofiber*, *Democricetodon*, *Soricidae* indet.), and *Eulipotyphla* indet.

The overlying half (~20 m) of the succession in the mine is made of partly laminated light-colored marls, clay- and siltstones. These deposits represent an open lake environment and yielded an aquatic or semiaquatic vertebrate fauna like fishes (*Barbus* and killifishes), salamanders (*Chelotriton*), frogs (*Latonia*), alligators (?*Diplocynodon*), and *Anguinae* indet.

Ongoing bio-magnetostratigraphic analyses indicate correlation with the MN5 or earliest MN6 zone and an age range between 15.2 and 14.0 Ma.

# CETIOSAUR DIVERSITY IN THE MIDDLE JURASSIC OF THE UK

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**Keywords:** *Sauropoda, Eusauropoda, Middle Jurassic, diversity*

Presentation type: poster

The Middle Jurassic *Cetiosaurus* of the UK is historically the oldest sauropod described, and numerous phylogenetic and osteological analyses build on its information. However, *Cetiosaurus* is a classic ‘wastebasket-taxon’, with many specimens traditionally assigned to it without having been examined in over almost a century. Next to the holotype and associated material of *Cetiosaurus oxoniensis* from the Forest Marble Formation of Oxfordshire, currently housed at the Oxford University Museum of Natural History, several specimens are housed in museums in Leicester, Gloucester, Stroud, and Skye. The ‘Rutland *Cetiosaurus*’ from Leicester is already thought to consist of a different taxon and is currently being revised. The Gloucester material comprises ischia, coracoids and caudal vertebral material. Stroud has several axial elements, including cervical and dorsal vertebrae, a femur, and an ilium. The Skye material consists of dorsal and caudal vertebral centra, as well as appendicular elements. As the Gloucester and Stroud material originate from the Lower Oolite, underlying the Forest Marble, it is possible these represent different taxa. Indeed, when compared to the holotype material of *Cetiosaurus oxoniensis*, they present significant osteological differences in vertebrae and pelvic elements. A preliminary phylogenetic analysis retrieves the Gloucester specimen as nested within *Cetiosaurus*, and as sister-taxon to *Lapparentosaurus* from Madagascar. The Stroud specimen is retrieved outside and more basal to this node, and the Skye material shows potential to be more derived than the latter two. These results suggest a high diversity in both cetiosaurid and eusauropod taxa in the Middle Jurassic of the UK.



# DOWNSIZING IN THE LATE PLEISTOCENE: *SUS SCROFA* (SUIDAE, MAMMALIA) IN THE APULIAN PENINSULA (SOUTHERN ITALY)

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**Keywords:** *Aurelian, mammals, biochronology, body mass, wild boar*

presentation type: oral communication

The extant wild boar *Sus scrofa* has one of the largest geographical ranges of all mammals, and from its appearance in the late Early Pleistocene (Epivillafranchian) it is also widely represented in the European fossil record. There is a general consensus in recognizing that early wild boars are larger than Late Pleistocene specimens, but no agreement exists neither on the chronology of this transition, nor if only one occurred.

From the end of 1800s, the Apulian peninsula (Southern Italy) represented a key region to study Mediterranean Quaternary paleoenvironmental dynamics. This territory is rich in mammal remains, often associated to lithic tools and human remains. Consequently, this region has a remarkable research tradition, which constitutes a solid background to test *S. scrofa* size variability through time. Here, the wild boar craniodental material from several late Middle and Late Pleistocene sites (Aurelian assemblages) of Apulia is presented for the first time. The studied sample includes specimens from different localities with well-documented palaeobiological, biochronological, and geo-archaeological data (e.g., Grotta Romanelli, Melpignano, and Avetrana).

The results support that *S. scrofa* populations underwent a size reduction during the early Late Pleistocene. The biochronological and paleoenvironmental implications of this bioevent are discussed in the broad scenario of Aurelian faunal impoverishment, when other long-lasting species such as the straight-tusked elephant and the hippo disappeared from the region.

# **A NEW ICHTHYOSAUR (REPTILIA, ICHTHYOPTERYGIA) FROM THE LATE JURASSIC KIMMERIDGE CLAY FORMATION OF DORSET, UK**

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**Keywords:** *ichthyosaur, Late Jurassic, Kimmeridgian, United Kingdom*

Presentation type: oral communication

A new ichthyosaur specimen (K1885) from the Late Jurassic (Kimmeridgian) Kimmeridge Clay Formation of Dorset, United Kingdom is described. The specimen, expertly prepared on a slab of laminated coccolith limestone, comprises a near complete skull, in articulation with the anterior vertebral column and associated thoracic ribs, complete pectoral girdle, fully exposed left forelimb, and some elements of the right side.

Aspects of the dentition, skull roof bones and the forelimb configuration distinguish the new specimen from previously described Late Jurassic ichthyosaurs, and consequently it is referred to a new genus and species. Unusually, an enlarge process on the supratemporal bones may have given the animal a 'horned' appearance in life.

Aspects of the humerus and skull show the new taxon lies as a sister family to Ophthalmosauridae, and this is supported by a cladistics analysis.

The new specimen adds to the diversity of the Ichthyopterygia of the Kimmeridge Clay Formation, and also emphasis the important contribution of amateur collectors in Palaeontology.

# CASES OF PATHOLOGICAL BONE GROWTH IN *ISANOSAURUS* AND *SPINOPHOROSAURUS* (SAUROPODA): PERIOSTEAL REACTION AND TUMOR-LIKE CONDITIONS IN DINOSAURS

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**Keywords:** Radial Fibrolamellar bone, *Isanosaurus*, *Spinophorosaurus*, bone histology, bone growth

Presentation type: oral communication

The long bone histology of sauropod dinosaurs appears uniform and conservative along the Sauropoda evolutionary tree. Fibrolamellar Complex (FLC), a scaffold of poorly and highly organized bone tissues, is the main 3D architecture building up the cortex of these bones. However, we report some Radial Fibrolamellar bone (RFB) in the outer cortex of the humeri of a young adult *Isanosaurus* (Nam Phong Formation, Upper Triassic of Thailand) and an adult *Spinophorosaurus* ('Argiles de l'Irhazer', Lower/Middle Jurassic of Niger). RFB is regarded as a fast-growing bone tissue and has been documented only in a few dinosaurian taxa including one titanosaur, but never among basal sauropods. Its outermost position within the cortex raises questions because such a rapidly apposed bone tissue would rather be expected in the inner cortex (corresponding to an early juvenile ontogenetic stage). Bone pathologies have been reviewed in order to determine whether these RFB occurrences are linked to a pathological condition. The RFB observed here is typical of periosteal reactions. Its 'hair-on-end' or sunburst appearance is probably related to sarcomas or metastasis around the coring sites than fracture/callus or bone infection, both of these last pathologies being completely absent from the sections and the sampled bone. Comparisons with human medicine studies and other periosteal reactions in dinosaurs are consistent with this interpretation. Intriguingly, the RFB of *Spinophorosaurus* is buried in the outer cortex, followed by a recovery of a 'normal' FLC. *Spinophorosaurus* thus survived its pathology and represents the first survival case of periosteal reaction-related event within Sauropoda.

# BIOMAGNETOSTRATIGRAPHY OF THE EARLY MIOCENE MAMMAL RECORD OF THE VALLÈS-PENEDÈS BASIN (CATALONIA)

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**Keywords:** *magnetostratigraphy, biostratigraphy, Ramblian, Aragonian, Western Europe*

Presentation type: oral communication

The Vallès-Penedès (Catalonia, Spain) is a classical area for the study of the Miocene terrestrial faunas of Western Europe. Recently, the early Miocene outcrops have been systematically surveyed, resulting in the discovery of new fossil sites and the recovery of large micro- and macrovertebrate samples. Moreover, high-resolution litho- and magnetostratigraphic studies of the main sections have been undertaken. Preliminary results show that the rodent succession in the Vallès-Penedès Basin is close to that from the Aragonian stage type area in the Calatayud-Montalbán Basin (Aragon, Spain), so that the same local zonation might be extended to the Catalan basin. The different Vallès-Penedès sites are correlated to zones A (MN3, Ramblian) or C (MN4, early Aragonian), the short-lasting zone B being missing. Zone B is defined by the first common occurrence of modern cricetids, being exclusively represented by *Democricetodon hispanicus*. In the Vallès-Penedès the genera *Democricetodon*, *Megacricetodon* and *Eumyarion* are first recorded simultaneously at zone C. Nevertheless, there are some differences between the two records, such as the occurrence of Central European taxa or the significantly later extinction of certain rodent species in the Vallès-Penedès. Contrary to the Aragonian type area, most of the Vallès-Penedès sites have also yielded large mammals. Our refined bio- and magnetostratigraphy allow a more accurate calibration of major dispersal events in Western Europe, such as the immigration of gomphotheres from Africa (recorded at Sant Andreu de la Barca, 19-17 Ma) or the equid *Anchitherium* from North America (recorded at the Costablanca site, 18-17.7 Ma).

**Acknowledgments:** Work supported by 2019 FI\_B2 00192 pre-doctoral grant to SJV (AGAUR), CGL2016-76431-P and CGL2017-82654-P (AEI/FEDER, EU), CGL2014-55900-P, RYC-2013-12470 to ICV and CGL2014-55900-P to MG, CERCA Programme (Generalitat de Catalunya), project 2014/100584 (Departament de Cultura, Generalitat de Catalunya), and grant 9640-15 (National Geographic Society). Some authors belong to consolidated research group NQVP (2017 SGR 116) and Geodynamycs and Basin analysis (GGAC, 2017 SGR 596) of the Generalitat de Catalunya.



# TAPHONOMY OF A UNIQUE MULTIGENERATIONAL *TRICERATOPS* BONEBED FROM EASTERN WYOMING (USA): NEW INSIGHTS FROM A MULTI-PROXY PERSPECTIVE

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**Keywords:** *Triceratops*, taphonomy, bonebeds, Cretaceous, Wyoming

Presentation type: oral communication

Bonebeds of chasmosaurine ceratopsian dinosaurs are surprisingly rare compared to the high relative abundance of isolated material of this group in the fossil record. Here, we describe a large bonebed of *Triceratops horridus* with at least five individuals, abundant postcranial material preserved (>30%) and skeletons displaying features of subadult and adult ontogenetic stages. Hence, this fossil locality can shed new light on the osteology, ontogeny and possible gregarious behaviour of this iconic horned dinosaur. Since 2013, Naturalis Biodiversity Center has been excavating this bonebed, which is situated in eastern Wyoming (USA) and comprises fluvial sediments from the lower part of the Upper Maastrichtian Lance Formation. Five field campaigns and a 3D survey including drone photogrammetry resulted in a high-resolution 3D model of the excavation site, incorporating the spatial position of >1100 bone elements and >500 sediment samples.

Integrating this 3D framework with a multi-proxy study of osteohistology and sedimentological and geochemical analysis allows for a detailed taphonomic reconstruction. The bone layer is c. 0,5 m thick and stretches over an area of c. 200 m<sup>2</sup>, displaying disarticulated but associated skeletal remains with little evidence of scavenging. Grain-size, loss-on-ignition, XRF and palaeobotanical data suggests a paludal environment that experienced two separate flooding events. We propose that the *Triceratops* individuals in this bonebed were mired, possibly as a group, and post-mortem rapidly buried by two crevasse splays of coarse silt to very fine sand. This explains both the lateral bone distribution and the rare preservation of small postcranial elements such as unguals.

## TITHONIAN VERTEBRATES FROM THE PAYS DE BRAY (NORTHERN FRANCE)

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**Keywords:** *Hybodontiformes*, *Ginglymodi*, *Pycnodontiformes*, *Ichthyosauria*, *Crocodylomorpha*

Presentation type: poster

In the Pays de Bray, on the edge of Normandy and Picardy, a large buttonhole-shaped anticline punctures the Upper Cretaceous chalky plateaus of northern France and allows bedrocks formed during the Late Jurassic and Early Cretaceous (Kimmeridgian to Albian) to be investigated without subsurface exploration. The Upper Jurassic largely outcrops on the margins of the Paris Basin, but beds of this age in the Pays de Bray may document different palaeoenvironments. In particular, compared with the coeval rock units in the Boulonnais, lesser terrestrial influences are expected due to a greater distance from landmasses. Combining a comprehensive review of the literature, examination of specimens stored in public collections and renewed field prospecting, we aim to achieve a better understanding of the Late Jurassic vertebrate fauna of the Pays de Bray. Although strata ranging in age from the Late Kimmeridgian to the Late Tithonian are present in the Pays de Bray, only the Middle Portlandian *sensu gallico* (Early Tithonian) appears to have yielded vertebrate remains. Our preliminary results suggest the presence of two indeterminate species of hybodontiform sharks, at least one large-sized ginglymodian fish (probably *Scheenstia maximus*), a pycnodontiform fish (*Macromesodon* sp.), an indeterminate ichthyosaur, a possible turtle and an indeterminate teleosaurid crocodile.

# THE EARLY PLEISTOCENE ICHTYOFAUNA FROM COPĂCENI (DACIAN BASIN, SOUTHERN ROMANIA)

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**Keywords:** *diversity, fish, paleoecology, Pleistocene*

Presentation type: oral communication

A remnant of the western Paratethys, the Dacian Basin gradually switched from a marine to a freshwater depositional environment during the Pliocene, and remained so during the subsequent Pleistocene, when fluvio-lacustrine units accumulated, containing large mammal assemblages, albeit of low taxonomic diversity. The search for biostratigraphically-important mammal remains in the new fossil locality of Copăceni (Ilfov County, southern Romania) yielded the first Pleistocene ectothermic vertebrates reported from the entire Dacian Basin. Following screen-washing of the silty sediment, the assemblage from Copăceni, dated at around 1 Ma on the basis of the large and small mammals, was also found to include snakes, lizards, amphibians and fishes, reaching the highest vertebrate diversity known so far for a Pleistocene assemblage of the Dacian Basin.

The freshwater fish assemblage is particularly diverse, including 17 taxa mostly belonging to the families Cyprinidae, but also including some representatives of Percidae, Esocidae, and Salmonidae. The genera diversity suggests that the fluvial system from Copăceni was complex. Indeed, there are 1) fishes (*Chondrostoma*, ?*Salmo*) found usually in rapids with well-aerated water fast-flowing over sandy or pebbly riverbeds, 2) fishes (*Leuciscus*, *Rutilus*, *Scardinius*, *Carassius*, *Tinca*, *Esox*, *Perca*) related to areas with slowly flowing water, muddy or sandy bottom, and thickets of underwater vegetation, as well as 3) fishes (*Silurus*) found usually in backwaters.

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CNCS – UEFISCDI, project number PN-III-P1-1.1-PD-2016-0848, within PNCDI III (to Ș.V.).

# JAW MORPHOLOGICAL AND BIOMECHANICAL DISPARITY OF ARCHOSAURS DURING MIDDLE TRIASSIC TO MIDDLE JURASSIC

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**Keywords:** *Geometric morphometric analysis, biomechanical analysis, disparity analysis, archosaurs*  
Presentation type: poster

Mass extinctions not only dramatically change faunas but also play an important role in evolution. In the Triassic, archosaurs evolved into two large clades: avemetatarsalians (the dinosaur-bird lineage) and pseudosuchians (the crocodile lineage). In the Late Triassic, pseudosuchians were more disparate, diverse, and abundant than avemetatarsalians, but this situation changed after Triassic-Jurassic mass extinction. There are two main hypotheses for explaining early dinosaur diversification: the 'competitive adaptive radiation' hypothesis states that dinosaurs were superior to other pseudosuchians because of physiology or novel locomotion; the 'opportunistic non-competitive' hypothesis holds that the mass extinction cleared ecological space that dinosaurs were able to exploit. Debate continues regarding these hypotheses. We here assess jaw morphology changes in Middle Triassic-Middle Jurassic archosaurs by using geometric morphometrics and biomechanical analysis. We find that (1) avemetatarsalians (both dinosaurs and pterosaurs) occupied a different area in morphospace and biomechanical morphospace than pseudosuchians. (2) It is not until the Early Jurassic (Pliensbachian-Toarcian) that dinosaurs occupied different morphospace than pseudosuchians. However, in biomechanical morphospace, dinosaurs were in a different area than pseudosuchians during the entire Late Triassic (late Norian-Rhaetian) to Middle Jurassic, except for the Early Jurassic (Pliensbachian-Toarcian). (3) In morphological disparity, substantial turnover between the two crown groups happened three times during the Late Triassic (late Norian-Rhaetian) to Early Jurassic (Hettangian-Sinemurian). Furthermore, substantial turnover between dinosaurs and pseudosuchians happened three times during the Late Triassic (late Norian-Rhaetian) to Middle Jurassic. Nevertheless, in biomechanical disparity, substantial turnover only occurred between the Early Jurassic (Pliensbachian-Toarcian) to Middle Jurassic between avemetatarsalians and pseudosuchians.

# WHAT DO OSSIFICATION SEQUENCES TELL US ABOUT THE ORIGIN OF EXTANT AMPHIBIANS?

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**Keywords:** *evo-devo, ossification sequence, Lissamphibia, Tetrapoda, phylogeny*

Presentation type: oral communication

The controversial origin of extant amphibians has been studied using several sources of data and methods, including phylogenetic analyses of morphological data, molecular dating, stratigraphic data, and comparisons of ossification sequences. A consensus has failed to emerge, perhaps because the diversity of methods used hampers comparisons. We have compiled two datasets of ossification sequences of 101 extant and extinct terminal taxa and seven cranial bones, or 102 terminal taxa and six cranial bones. (The possibility of analyzing a third dataset with postcranial bones and a wider variety of extinct taxa is currently being explored.) These data allow us to assess the relative support for six competing hypotheses about the origin(s) of the most inclusive uncontroversial extant amphibian clades: a monophyletic origin among temnospondyls, a monophyletic origin among lepospondyls, a diphyletic origin among both temnospondyls and lepospondyls, a diphyletic origin among temnospondyls alone, and two variants of a triphyletic origin, in which anurans and urodeles come from different temnospondyl taxa while caecilians come from lepospondyls and are either closer to anurans and urodeles or to amniotes. The data are analyzed through maximum likelihood, and the AICc (corrected Akaike Information Criterion) weights of the six hypotheses allow us to assess their relative support. By an unexpectedly large margin, our analyses of both datasets support a monophyletic origin among lepospondyls; a monophyletic origin among temnospondyls, the current near-consensus, is a distant second. All other hypotheses are exceedingly unlikely according to our data.



# THE BEAST OF MÜHLHEIM: FIRST EVIDENCE OF A SOLNHOFEN MEGAPLANKTIVORE

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**Keywords:** *diversity hotspot, Megaplanktivory, Pachycormiformes, Solnhofen ecosystem, suspension-feeder*

Presentation type: poster

As the first animals to successfully occupy the large (> 1 m Standard Length, SL) vertebrate suspension-feeding niche, pachycormid osteichthyans were the Mesozoic ecological forerunners of today's cetacean (mysticetes) and chondrichthyan (*Rhincodon* and *Cetorhinus*) planktivores. At their acme in the Callovian (Middle Jurassic), suspension-feeding pachycormids were growing to sizes in excess of today's whale sharks (*Leedsichthys*, estimated SL 16 metres), achieving a scale of growth unequalled by subsequent osteichthyans. Until recently, the largest suspension-feeding pachycormid in the Upper Jurassic Plattenkalk fauna was the 1.9-2.3 metres long *Asthenocormus*, although occasional discoveries had suggested that there might be something larger. Anomalous pectoral fins in the BSPG, Munich, since 1951 were >3x any recorded specimen of *Asthenocormus* (0.5x *Leedsichthys*), with a highly non-asthenocormid shape. In 2009, a tail ray specimen was found in the Mühlheim quarry (Upper Jurassic, Mörsheim Fm), exhibiting the classic pachycormid characteristic of bifurcating without segmentation, to a length of around 90cm, 3x longest recorded for *Asthenocormus* (0.5x *Leedsichthys*). In 2015, the pit also yielded highly elaborate gill rakers more than twice the length of those commonly seen in *Leedsichthys*, and substantially more robust.

Although virtually meaningless to estimate the size of such an animal from these small components of its gill basket, it is the first evidence that the Upper Jurassic in Southern Germany may have had a significantly larger suspension-feeding pachycormid than the Middle Jurassic *Leedsichthys*, indicating that the Plattenkalk deposits preserve even more of a diversity hotspot than previously suspected, with the apex of Mesozoic suspension-feeding represented in this ecosystem.

# NOT JUST THE FOOD MARKED FOR VEGETARIANS: GILL RAKERS AS AN UNEXPECTEDLY UBIQUITOUS AND POWERFUL MORPHOLOGICAL TOOL TO EXPLORE PHYLOGENY ACROSS A GROUP OF DIVERSE DIETS

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**Keywords:** *cranial overweighting, gill raker morphology, Pachycormiformes, phylogenetic power, reduced ossification*

Presentation type: oral communication

Many pachycormid problems result from their trend towards poor ossification with the increasing adult size of a given taxon. This entails that with increasing adult size, genera have increasingly poorly ossified sections of their post-cranial material (leading to a reduction in post-cranial material to code), and more poorly fused and fragile cranial material (leading to a lack of accessible skull characters to code). Both of these tendencies have the effect of reducing the quantity of comparable characters common across most of the taxa, and increasing the fog surrounding phylogenies, in particular the latter trend, when the standard matrix used to decipher interrelationships for pachycormids is a dataset of over 120 characters where 77% of them are cranial.

In 2007, it was argued that the use of gill raker characters for pachycormids was flawed, as they were only really known in the largest representatives from the group (specifically *Leedsichthys*, and more questionably at the time from *Asthenocormus*) and might simply be acting simply to overweight the suspension-feeding signal. However, ten years on, the discovery of rare examples previously unknown for some taxa, coupled with recent advances in CT-scanning making it possible to determine the structure of gill rakers deep within unprepared skulls, have meant that gill raker morphology may once again be used credibly as a source of characters with which to examine pachycormid interrelationships. Indeed, they stand as the single most powerful potential source of characters within the group, due to their unique ubiquity across a breadth of pachycormid taxa.

# PRESENCE OF *BYZANTINIA* (RODENTIA, CRICETODONTINAE) IN THE LATE MIOCENE OF LEBANON

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**Keywords:** Cricetodontinae, *Byzantinia*, Miocene, Lebanon, dispersal

Presentation type: poster

*Byzantinia* is a Cricetodontinae of which nine species are known to date. *Byzantinia* originated in Anatolia in late Middle Miocene time and became extinct at the end of the Miocene. Until now, it was known only from Anatolia and Greece. However, various isolated molars of *Byzantinia* have been collected at a new locality, situated immediately northwest of the town of Zahleh (Bekaa Valley, central Lebanon). These fossils are indeed the first remains of *Byzantinia* from the whole Arabian area. They provide thereby the first physical evidence of the dispersal of these rodents into Afro-Arabia. The molars of the Lebanese taxon are slightly hypsodont. The second upper molars are characterized by showing a “funnel” structure on the occlusal surface, which allows to differentiate the taxon to which they belong from all the known species of the genus but *B. eskihissarensis*, *B. sofcaensis*, *B. nikosi* and *B. ozansoyi*. The Zahliote *Byzantinia* is noticeably smaller than all the known species of the genus except for *B. nikosi* and *B. ozansoyi*. The marked reduction of the posterior part of the third upper molar shows that it probably belongs to neither of these two small species of *Byzantinia*. Therefore, we are inclined to regard the specimens from Zahleh as a new, relatively small species of *Byzantinia*, which represents an evolutionary stage very close to *Byzantinia ozansoyi*, from the Late Miocene site of Bayraktepe I (MN7+8). Accordingly, we infer that the lacustrine sediments from which these new specimens have been recovered are early Tortonian in age.

# A REVIEW OF THE FOSSIL RECORD OF TURTLES OF AFRICAN PAN-TESTUDINOIDEA

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**Keywords:** fossil Testudinoidea, Testudinidae, *Emys orbicularis*, *Gigantochersina*

Presentation type: poster

The superfamily Pan-Testudinoidea is defined as a well-supported clade containing the three extant families Emydidae, Geoemydidae and Testudinidae, with the possible addition of the monogeneric family Platysternidae. As far as African pan-testudinoids are concerned, there are no comprehensive studies focused on the phylogenetic relationship among extant and extinct taxa. The first dispersal of Testudinoidea in Africa is considered coincident with the appearance in the fossil record of *Gigantochersina ammon*, from the early Oligocene of Oman and Fayum (Egypt), which shows affinities with the relatively primitive Eurasiatic '*Hadrianus*' type. After a gap, tortoises reappeared in the early Miocene fossil record with different species widespread in three main biogeographic zones: the Namibian zone (early-middle Miocene), the Kenya-Uganda zone (early Miocene) and the North Africa-Arabian Peninsula zone (early-middle Miocene). The extinction of at least some of the taxa of this superfamily has previously been connected to the appearance of *Homo* in Africa starting from the Early Pleistocene, but particularly since hominins started to use early Oldowan stone tools for butchering. The Neogene and Quaternary diversity trend of Testudinoidea is regressive, with a progressive faunal reduction caused by the climatic change. The alternation of dry and cool periods intercalated by humid periods caused the disappearance of the large tortoises from Maghreb, leaving only the extant Palearctic *Testudo* and *Mauremys*. The dispersal from Europe to North Africa of *Emys orbicularis* is a relatively recent event as testified by both the fossil record and molecular evidence. A taxonomic review of the 24 named African fossil taxa finds 19 nomina valida, and five nomina dubia.

# TAPIR FORELIMB MORPHOLOGY: ANATOMY, FUNCTION AND IMPLICATIONS FOR LOCOMOTOR EVOLUTION OF THE PERISSODACTYLA (MAMMALIA)

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**Keywords:** *geometric morphometrics, locomotion, musculoskeletal, Tapirus*

Presentation type: poster

Perissodactyls have developed a variety of forelimb morphologies throughout their rich evolutionary history. Examples of functional forelimb changes include a reduction in digit number from the ancestral tetradactyl (four-toed) state, tendonisation of autopodial muscles etc. To provide insights into these presumably adaptive locomotor transitions, I investigated the forelimb functional morphology of the outwardly plesiomorphic extant perissodactyl family – the Tapiridae (tapirs). By quantifying the anatomy of tapir forelimb bones and muscles, I aimed to establish the variability of forelimb functional anatomy of extant tetradactyl perissodactyls, so as to better understand the changes in forelimb condition undergone by the ancestors of other modern perissodactyls (e.g. rhinoceroses, equids). Throughout this study I adopted a geometric morphometric approach, using landmarks on three-dimensional surface scans to quantify osteological variation in both modern and extinct tapir species, supplemented by a quantitative dissection of a tapir forelimb. Key results from my osteological and myological investigations have demonstrated that 1) tapir forelimb shape variation is greater than previously supposed, and poorly correlated with variation in body size; 2) relatively few muscles from the proximal and distal forelimb of tetradactyl perissodactyls exhibit comprehensive architectural differences to those of monodactyl species (i.e. equids); and 3) rapid changes in carpal morphology between tetradactyl to tridactyl equids limited their ability to adduct/abduct their lateral digits, reducing locomotor efficiency on compliant substrates, although likely benefiting them on firmer soils in drier ecosystems. Overall, this study demonstrates the utility of investigating tapir limbs to better understand evolutionary shifts in perissodactyl locomotor anatomy.

# A NEW *T. REX* 3D SKELETON USED FOR HIGH-FIDELITY 3D MUSCLE MODELLING

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**Keywords:** 3D digitizing, tyrannosaur, muscle modelling, onemore

Presentation type: oral communication

An exceptionally complete and largely well-preserved specimen of *Tyrannosaurus rex* was digitized in high resolution. The individual bones were captured in 3D using photogrammetry. We articulated the virtual skeleton in a CAD program, replacing missing and taphonomically deformed bones with generalized shapes. Based on the articulated skeleton, we are now in the process of reconstructing the organs and the entire musculature (tail, hind limbs completed, rest ongoing) in high fidelity in 3D, using osteological marks (insertions, intermuscular lines and ridges) and an EPB approach. This approach allows a more confident reconstruction than a purely EBP-inference driven workflow, as each muscle shape can be checked for internal consistency: oddly shaped muscle bellies, unexplained holes between muscles or other anatomical impossibilities indicate missing, overinflated, misplaced or otherwise incorrectly reconstructed muscles. For example, we can more confidently reconstruct the M. flexor tibialis internus 1 (FTI1), the origin of which in *Tyrannosaurus* is a II' inference based on osteological correlates alone. Additionally, we gain a more exact and detailed assessment of mass and mass distribution. Overall, our work affords us a more thorough and detailed understanding of the myology of *T. rex*, of the biomechanics of its locomotion, and thus finally of its ecology. As our existing models are easily scalable and adjustable, we also apply them with much less effort to morphologically similar taxa, allowing detailed insight into phylogenetic developments.



# DWARFS AMONG GIANTS: RESOLVING THE SYSTEMATICS OF THE TITANOSAURIAN SAUROPOD DINOSAURS FROM THE LATEST CRETACEOUS OF ROMANIA

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**Keywords:** *Hațeg, Laurasia, Phylogeny, Sauropoda, Titanosauria*

Presentation type: oral communication

Although famous for their gigantic size, titanosaurs also comprise some of the smallest sauropods, including *Magyarosaurus*. The latter comes from the latest Cretaceous of Romania, which has yielded a rich sauropod record. However, skeletal associations are rare. The type species, *Magyarosaurus dacus*, is currently restricted to a caudal vertebra, whilst '*Magyarosaurus*' *hungaricus* is known only from a tibia and fibula. Detailed study of historical and undescribed remains enables us to build composite OTUs from a number of overlapping, partial skeletons. We are able to refer multiple axial and appendicular remains to *Magyarosaurus dacus*. These include a tibia and fibula, which differ notably from the morphology that characterizes '*M.*' *hungaricus*. Referrals of additional appendicular remains to the latter taxon enable us to further differentiate it from *M. dacus*. A poorly preserved partial skeleton with a distinct morphology demonstrates the presence of a large-bodied titanosaur. A fourth taxon, *Paludititan naltzensis*, can be differentiated from *Magyarosaurus dacus*, but does not overlap with '*M.*' *hungaricus*. Unfortunately, many elements cannot currently be referred to any taxon because of a lack of anatomical overlap. These include a well-preserved braincase. Its external and internal morphology reveal numerous differences with contemporaneous European titanosaurs. Preliminary phylogenetic analysis, based on a data matrix comprising 160 taxa scored for >600 characters, indicates that *M. dacus*, '*M.*' *hungaricus*, and *Paludititan* are not closely related to one another. Our results support the presence of high sauropod diversity in the latest Cretaceous of Romania, and indicate a potentially complex biogeographic assembly of this fauna.

# OLD IGUANODON REMAINS SHED NEW LIGHT ON THE EVOLUTION OF ORNITHOPOD INTEGUMENT

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**Keywords:** *Ornithischia, Cretaceous, Bernissart, scales, tubercles*

Presentation type: poster

*Iguanodon* is one of the most famous dinosaur genera, being one of the first dinosaurs ever discovered. Thanks to the high number of individuals found in 1878 in Bernissart (Belgium) we have a good understanding of the anatomy and the biology of the species. However, the skin found in association with the skeletons has never been discussed in detail. Here, we report an extensive description of tubercle morphology and body distribution of *Iguanodon* skin. Some patches show small tubercles (between 1 and 3 mm in diameter, with slight variation in shape) on the left side of the proximal region of the tail, with irregularly positioned flower-like feature-scales. The same patterns are also represented by isolated, fragmentary skin material. Whilst small and nearly homogeneous tubercles are shared with hadrosaurids and other iguanodontian taxa (*Mantellisaurus*, *Tenontosaurus*), the flower-like feature-scales are less common, found only in *Lambeosaurus*. A shared feature between non-hadrosaurid ankylopollexians as *Iguanodon* and hadrosaurids comprises the proportions between body size and tubercles, with small scales in a large body. We hypothesize that the smaller tubercles allowed more flexibility in the body of these ornithopods. Small tubercles are also present in non-ornithopod ornithischians, such as in *Psittacosaurus*. Nonetheless, tubercles increase in size with body volume along ceratopsian evolution, in contrast with the skin homogeneity in the large, derived ornithopods. Based on these data, we have prepared a new life reconstruction of *Iguanodon* modelled on the photogrammetry of the original skeleton.

# THE CONSERVATION RESTORATION OF DINOSAURS EGGS CLUTCHES FROM THE UPPER CRETACEOUS OF GUADALAJARA, SPAIN

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**Keywords:** *conservation, restoration, preparation, eggs, dinosaurs*

Presentation type: poster

Dinosaur eggshells and complete eggs sometimes grouped in clutches, have been recently discovered in deposits belonging to the Upper Cretaceous section of the Villalba de la Sierra Formation in the area of Buendía (Sacedón, Guadalajara, Central Spain).

The eggs appear filled and surrounded by a clay saturated with water, because the location of the deposit are on the banks of a reservoir. The preparation process is complex due to problems generated by the drying of the clays because the eggs are entirely fragmented. During the extraction every egg is protected individually. In the case of clutches, the relative position of the eggs is maintained by extracting them in blocks.

The plaster jacket made for the extraction, which has the information about the exact location of the eggs in the clutches, has been adapted to include the new support of the blocks. Polyvinyl acetate was applied as a water repellent to the surface, and an Aerolam© strip was placed to reinforce the base. The support was finished by applying a layer of Exaduro plaster to give it consistency for possible transfers and an appropriate appearance for exhibition.

Once the jacket was protected, the restoration of each egg began. The cleaning was done taking into account the weakness of the surface, avoiding the use of metallic elements and cutting. Once this action was completed, the eggs were stabilized by consolidation with Paraloid B72 and a structural reintegration of the fissures and cavities using an epoxy resin.

# REINVESTIGATION OF *GLIRULUS* AFF. *LISSIENSIS*, A GLIDING RODENT FROM THE LATE MIOCENE OF SAINT-BAUZILE (ARDECHE, FRANCE)

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**Keywords:** *Rodentia*, *dormouse*, *flying rodent*, *post-cranial adaptations*

Presentation type: oral communication

Among extant mammals, except bats which have achieved an evolution toward active flight, the vast majority of species remain terrestrial. The only exceptions are a few gliding species of Diprotodontia (Metatheria), Dermoptera (Eutheria), and Rodentia, the so-called “flying squirrels” (Eutheria). Today, only two families of rodents include gliding species: Anomaluridae and Sciuridae. However, in the fossil record, two other families are known to have evolved similar adaptations: Eomyidae (extinct family) and Gliridae (extant dormice). This last one is known thanks to a beautifully preserved specimen of *Glirulus* aff. *lissiensis* from Saint-Bauzile (late Miocene, France), including soft tissue remains indicating the existence of a possible patagium between the anterior and posterior limbs. This discovery is especially surprising because none of the extant species of Gliridae can glide. The study of this fossil specimen was published in 1991. At the time, the only anatomic comparisons made were with *Glirudinus japonicus*, considered to be the closest extant relative. The present reinvestigation includes now a 3D model of the fossil skeleton based on X-ray tomography allowing to see the whole anatomy (one side of the bones being otherwise concealed in the sediment). Additionally, further anatomic comparisons are now possible with other extant glirids (including now also a CT-scan of *G. japonicus* for more detailed comparisons) and other gliding rodents. The aims are (1) to confirm that the anatomic differences between *G. aff. lissiensis* and *G. japonicus* are indeed due to gliding adaptation and (2) to morphofunctionally characterize these adaptations in comparison to other gliding rodents.

# 3D GEOMETRIC MORPHOMETRICS AND THE LOCOMOTOR REPERTOIRE OF *ADAPIS* GROUP PRIMATES: INSIGHTS FROM THE DISTAL HUMERUS

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**Keywords:** functional morphology, primates, Eocene, 3D GM, locomotion

Presentation type: oral communication

The locomotor repertoire of the adapiform *Adapis parisiensis* has been traditionally analogized with that of lorisids because of certain features of its postcranial skeleton. However, recent analyses of twenty humeri from Quercy (France) attributed to this primate presented several features of the distal articulation that previous descriptions assured were not present in this species. After analyzing the variance of several linear measurements of the distal articulation, which exceeded that of living primates of similar size, and after analyzing distal humeral proportions of these measurements, which do not overlap with lorisids, we questioned again if what is usually called *A. parisiensis* is really a single species, and if the locomotor repertoire traditionally assigned to it is correct. In this context, 3D geometric morphometrics were used on a broad dataset of primates including fossil adapiforms and omomyids, all extant families of strepsirrhines and platyrrhines, and *Tarsius*. Our results show that the only fossils overlapping with the *Adapis* group morphospace are two specimens of *Protoadapis*. Most *Adapis* group specimens do not overlap with any extant primates, suggesting that there may not be living analogues for them. Two specimens overlap with lorisids, although they also overlap with galagids, cheirogaleids and lepilemurids. Many other adapiforms and omomyiforms fall close to certain *Adapis* group specimens, suggesting that humeral remains of early strepsirrhines (adapiforms) and haplorhines (omomyids) are not easy to discern.

This work was supported by the Spanish Government (MINECO/FEDER, UE, CGL2017-82654-P), Generalitat de Catalunya (Programes CERCA, 2017 SGR 86 GRC, and Beatriu de Pinós, 2017-BP-00003).

# THE FIRST RECORD OF *SIVATHERIUM* (MAMMALIA, GIRAFFIDAE) FROM THE EARLY PLEISTOCENE OF ANATOLIA

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**Keywords:** *Ruminantia, Sivatheriinae, Turkey, Villafranchian*

Presentation type: poster

*Sivatherium* constitutes one of the most iconic extinct giraffids, mostly known from the Indian subcontinent and Africa. As the most prominent representative of the Sivatheriinae, the taxon, together with samotherines, symbolizes an important clade of crown giraffids, exhibiting various early morphological evolutionary patterns. With only a few recognized species, *Sivatherium* has been reported from African, Southern and Central Asian, as well as Balkan Miocene and Plio-Pleistocene deposits. Here we present the first record of this genus from the early-Late Villafranchian of Asağı Çobanisa, Western Turkey. The giraffids are represented by an upper part of a left metacarpal and co-occur with various large (Proboscidea, Rhinocerotidae, Equidae, Cervidae and Bovidae) and small-sized mammalian remains. Based on the characteristic morphological features and size measurements, we assign this giraffid specimen to *Sivatherium* sp. This occurrence suggests that African sivatherine taxa migrated through Anatolia on their way to Europe and Central/Southern Asia.



# THE PARDEL LYNX (*LYNX PARDINUS*) FROM THE LATE PLEISTOCENE OF INGARANO (FOGGIA, APULIA, ITALY): REDEFINING ITS PALAEOBIOGEOGRAPHY AND PALAEOECOLOGY

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**Keywords:** *Euro-Mediterranean, carnivorans, Aurelian, taxonomy, mammal*

Presentation type: poster

Here, we report on morphological and biometric analyses of the craniodental remains of lynx from Ingarano (Foggia, Southern Italy) and discuss about the morphological variability and palaeobiogeographical distribution of Late Pleistocene Pardel lynx. The lynx sample recovered from the Ingarano site with 418 specimens represents the largest and best-preserved sample of Late Pleistocene lynxes from the European fossil record. It has been attributed for a long time to *Lynx lynx* mainly on the basis of the large body size. The debate on the taxonomy and palaeobiogeographic distribution of Late Pleistocene lynxes in Europe is in progress. Nowadays, the cranium from Avenc Marcel (NE Iberian Peninsula), dated at 1.6-1.7 Ma, is the earliest fossil evidence of *Lynx pardinus*. Several authors suggest considering *Lynx spelaeus* (= *L. pardinus spelaeus*) as a junior synonym of *L. pardinus*, since no valid diagnostic features have been identified to distinguish the two taxa.

The morphological analysis of the fossils from Ingarano allows to ascribe them to *L. pardinus*, extending therefore the palaeobiogeographical distribution of this carnivore in the Late Pleistocene of Southern Europe. This provides data for a more accurate taxonomical determination of the Middle-Late Pleistocene lynxes from the Mediterranean region. The evolutionary trend of the fossil Pardel lynxes depicted by L. Werdelin is therefore still valid in its general scheme. Nevertheless, the first occurrence of *L. pardinus* has to be considered much older than previously thought. In addition, the chronology of the diffusion of *L. lynx* in Europe needs to be reconsidered in detail.

# RE-EVALUATING THE VALIDITY OF *PARTANOSAURUS ZITTELI* (SAUROPTERYGIA), FROM THE MIDDLE TRIASSIC OF AUSTRIA

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**Keywords:** *Simosauridae*, *Simosaurus gaillardoti*, *Paludidraco multidentatus*, Austrian Alps

Presentation type: poster

For more than two decades, *Simosaurus gaillardoti*, from the Ladinian (Middle Triassic) of France and Germany, was considered the only valid taxon within the sauropterygian clade Simosauridae. Thus, *Partanosaurus zitteli*, a problematic sauropterygian taxon whose remains were found in the 19th century in the Ladinian of the Austrian Alps, has been considered a junior synonym of *Simosaurus gaillardoti*. However, the discovery of new simosaurian remains, including the recently described *Paludidraco multidentatus*, from the Upper Triassic of Central Spain, as well as other fragmentary remains from the Middle and Upper Triassic of Europe and the Middle East, allows us to re-evaluate the validity of *Partanosaurus zitteli*. An exclusive combination of characters not present in *Simosaurus gaillardoti* or *Paludidraco multidentatus* supports the hypothesis that *Partanosaurus zitteli* is a valid taxon within the sauropterygian clade Simosauridae. The diversity of the clade Simosauridae is recognized as higher than previously expected.

**IDENTIFICATION OF *ADCROCUTA EXIMIA* (MAMMALIA, CARNIVORA, HYAENIDAE) HEMIMANDIBLE AND CF. *PARAMACHAERODUS* (MAMMALIA, CARNIVORA, FELIDAE) DENTITION FROM THE CHU FORMATION AT ORTOK, KYRGYZSTAN**

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**Keywords:** *Adcrocuta eximia*, *Paramachaerodus*, *Miocene*, *Kyrgyzstan*, *Ortok*

Presentation type: poster

A partial hemimandible and partial maxillary dentition from a large-bodied hyaenid, and partial dentition from a medium-bodied saber-toothed felid are described from the Chu Formation of Kyrgyzstan. Identified as *Adcrocuta eximia* and cf. *Paramachaerodus*, this represents the first described example of these taxa from this region. These specimens were recovered from the Ortok site at the Northwestern end of the Kochkor Basin, the youngest of the thus far discovered bone bed localities in the Chu Formation. Using bio- and magnetostratigraphy, the Chu Formation is attributed to the late Miocene to Pliocene, deposited approximately at 8 to 4 Ma. The Kyrgyz fauna, particularly of the Miocene, is argued to be consistent with *Hipparion* fauna, found across Asia. The *Adcrocuta* specimen consists of a partial dentary with condyle and angular processes: one upper and five lower cheek teeth, and the partial root and alveoli of a fifth mandibular tooth. The *Paramachaerodus* specimen includes a partial M1, P4 and C1, exhibiting the features of “scimitar-toothed” machairodontines rather than the more-derived “dirk-tooth”. Due to these features, we hypothesize vicariance in Kyrgyzstan from earlier genera, or the possibility of a Lazarus *Paramachaerodus* taxon in Ortok. Both these fossils bring new evidence of the ecology and biodiversity of Chu fauna during the Late-Miocene/Early-Pliocene in Kyrgyzstan and extend the currently published biogeographic ranges of these taxa in Asia. Thus, the Chu fauna amend the geographic range of sabertooth and large-bodied hyaenid taxa in Asia.

# ENIGMATIC TETRAPOD TRACKS FROM THE EARLY JURASSIC ZAGAJE FORMATION OF POLAND

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**Keywords:** *Braided River System, Early Jurassic, Poland, tetrapod tracks, Zagaje Formation*

Presentation type: oral communication

We report on a series of enigmatic traces from the Early Jurassic of Poland that co-occur with tridactyl dinosaur tracks on the same surface. Apart from theropods, ornithischian as well as tracks of sauropods are known from coeval deposits. Swim traces of theropods and an isolated footprint of a mammal have also been reported.

The specimen was donated to the senior author by a fossil dealer in 2018 and comes from the Zagaje Formation (Lower Jurassic, Early Hettangian); although a specific locality was not indicated, the provenance is most likely the Soltyków outcrop. The Zagaje Formation has been interpreted as a braided river system (Early Jurassic; Hettangian).

The specimen consists of a cream colored sandstone slab (27 x 30 cm) that shows asymmetric ripple marks on the upper surface; the lower surface reveals several positive hypichnia. One tridactyl track, although only partially imprinted, can be attributed to the ichnogenus „*Moyenisauropus*“, interpreted as the footprints of an early ornithischian dinosaur. In addition to that the sandstone slab yields several deep bowl shaped hypichnia of different sizes (L: 2.5 – 9cm). The most conspicuous features are five clearly visible parallel, slightly curved scratch marks, arranged in a broad arch-like pattern and an extensive sole surface, similar to turtle tracks. The depth, the shape and the number of digits rules out swim tracks of theropods. Although mammals have a size close to 2.5 cm, this would not account for the larger scratch marks. We suggest that these enigmatic traces were made by turtles.

## NEW PRIMATE MATERIAL FROM THE LOCALITY OF PONTILS (MIDDLE EOCENE, NE SPAIN)

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**Keywords:** *Ebro Basin, Iberian Peninsula, Robiacian, early primates, microchoerines*

Presentation type: poster

Discovered in the 1980 decade, the locality of Pontils (Middle Eocene, Ebro Basin, NE Spain) is situated in a section consisting of alternating limestones, marls and lignite, which represents a transitional continental-to-marine sequence. Field campaigns carried out in 2012 and 2016 by the team of the Institut Català de Paleontologia Miquel Crusafont have led to the recovery of abundant, still undescribed, fossil material belonging to a diverse vertebrate assemblage. The lowest levels of the section have yielded continental vertebrate remains, including squamates, crocodilians, rodents, artiodactyls, perissodactyls, marsupials and primates. The upper levels, recording the change from continental to marine conditions, contain abundant chondrichthyan and actinopterygian teeth and marine invertebrate remains, together with scarce terrestrial mammals. Among this assemblage, primates deserve particular attention due to their abundance and diversity. Although they are in a very preliminary phase of study, four different forms can be recognized. A relatively large-sized anchomomyin and a microchoerin showing enamel wrinkling are represented by extremely scarce remains. Dental elements assignable to the genus *Pseudoloris* are somewhat more abundant. But the best represented primate in this locality corresponds to a very small form, never recorded before elsewhere, which surely will allow the description of a new taxon. An exhaustive study of this material will undoubtedly improve the information about the primate evolution during a particularly poorly known mammal age such as the Robiacian.

This work was supported by the Spanish Government (CGL2017-82654-P), Generalitat de Catalunya (Programmes CERCA and Beatriu de Pinós, 2017-BP-00003) and Universidad de Granada.

# PRELIMINARY SYSTEMATIC OVERVIEW ON A NEW TITANOSAURIAN SPECIMEN FROM THE UPPER CRETACEOUS OF LO HUECO (CUENCA, SPAIN)

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**Keywords:** *Ibero-armorican island, Sauropoda, Titanosauria, Cretaceous, phylogeny*

Presentation type: poster

The titanosaurian fossil record from the Upper Cretaceous of Europe is becoming relevant with several important sites recently discovered in the Ibero-Armorican domain. Lo Hueco (Cuenca, Spain) represents a Campanian-Maastrichtian multitaxic bonebed, with several partial titanosaurian skeletons, mostly articulated or with low dispersion, which will be key for the phylogenetic study of the European and North African titanosaurs. A small and partially articulated titanosaurian specimen (HUE-EC-02) from Lo Hueco has been recently prepared and is currently under study. This specimen preserves an almost complete axial series from anterior-middle cervical to middle-posterior caudal vertebrae, including cervical and dorsal ribs, chevrons and a few appendicular elements. A preliminary systematic approach is herein proposed. HUE-EC-02 shared several features with *Lithostrotia* such as the presence of strong procoelous middle caudal vertebrae and deltopectoral crest extending medially across the anterior face of the humerus. HUE-EC-02 and the type specimen of *Lohuecotitan pandafilandi* present a similar overall morphology including some peculiar characteristics (e.g., double articulation in the chevrons; loss of a pronounced convex anterior articulation through the dorsal series). Despite these similarities, they differ in the orientation of dorsal transverse processes and caudal neural spines. A first phylogenetic analyses recovered HUE-EC-02, and other European titanosaurs (*Paludititan*, *Lirainosaurus*, *Ampelosaurus* and *Lohuecotitan*), as a basal member of a clade including Saltasauridae and some giant titanosaurs (*Argentinosaurus*, *Epachthosaurus* and *Dreadnoughtus*). This specimen is also characterized by the presence of several putative pneumatic features through the surface of the centra and neural arches similar to those of *Paludititan* and *Lohuecotitan*.



# REDESCRIPTION AND REASSESSMENT OF THE PHYLOGENETIC AFFINITIES OF *PALUDITITAN NALATZENSIS*, FROM THE UPPER CRETACEOUS OF ROMANIA

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**Keywords:** *Dinosauria*, *Titanosauria*, *phylogeny*, *Maastrichtian*, *Hațeg Basin*

Presentation type: poster

The evolutionary history of the European titanosaurs is still poorly understood. The description of several new and old specimens will be important for the improvement of the current phylogenetic approaches. The uppermost Cretaceous of Romania has provided an important titanosaurian fossil record since the end of the nineteenth century, allowing the establishment of two taxa: *Magyarosaurus dacus* (known by its relatively incomplete type specimen plus several referred specimens); and *Paludititan nalatzensis*, which corresponds to a single individual and the most complete titanosaurian specimen from Romania. The present work provides a detailed description on the available axial (dorsal and caudal vertebrae, dorsal ribs and chevrons) and appendicular (ilium, pubis, ischia, femur and two ungual phalanges) elements of this last form, from the Maastrichtian of Nălaț-Vad (Hațeg Basin). It is recovered as a member of Lithostrotia, due to the presence of a strongly posterodorsally projected mid-dorsal neural spine and the absence of a posterior expansion in the distal blade of the middle and posterior chevrons. *Paludititan nalatzensis* shares a few characters with Iberoarmorian titanosaurs, especially with *Lohuecotitan pandafilandi* (late Campanian-early Maastrichtian, Spain). *Paludititan nalatzensis* shares with *L. pandafilandi* chevrons with double proximal heads, and anterior-middle dorsal vertebrae with a smooth postspinal lamina in the dorsal half of the neural spine, which were previously considered as autapomorphies of the Spanish taxon. *Paludititan nalatzensis* is also characterized here by two relatively uncommon features: two modified anterior chevrons (interpreted as the two first ones), and dorsal centra with an extremely pneumatized surface.

# ON THE SYSTEMATIC POSITION OF THE EUSUCHIAN *DUEROSUCHUS* *PISCATOR* (MIDDLE EOCENE, SPAIN)

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**Keywords:** Europe, Iberian peninsula, Eocene, Crocodylia

Presentation type: poster

*Duerosuchus piscator* is a middle Eocene eusuchian crocodile only known by several remains from Corrales del Vino (Zamora, Spain). The species was defined based on an incomplete skull, the partial lower jaws, several osteoderms and some vertebrae. A detailed study of these remains allows us to question the attribution of all these remains to the same form. Only the cranial remains are considered as indisputably attributable to it, the validity of this species being supported. The phylogenetic relationships of *Duerosuchus piscator* within Crocodylia have not been analyzed until now. The present study provides a detailed description and an amended diagnosis for *Duerosuchus piscator*, which is included for the first time in a phylogenetic analysis in order to establish its systematic position. As a result of this study, the Eocene crocodyliform paleobiodiversity in the Duero Basin is recognized as composed by a notosuchian (*Iberosuchus macrodon*), as well as three forms of Crocodylia, belonging to three different clades: the alligatoroid *Diplocynodon tormis*, the crocodyloid *Asiatosuchus* sp., and *Duerosuchus piscator*, which is here identified as being part of another lineage up to now unrecognized in the Iberian fossil record.

# **STRONG BITES IN A LIGHTWEIGHT HEAD. INNER COLUMNS ON THE ROSTRUM OF *PREJANOPTERUS CURVIROSTRIS* REVEAL SUPPORT CAPACITY AGAINST TENSION**

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**Keywords:** FEA, dentition, durophagous, pterosaur, rostrum, micro-CT Scan

Presentation type: poster

The morphological characteristics of the pterosaur skull and mandible could have limited their bite strength. However, some groups or species may be an exception to this general condition. This is the case of *Prejanopterus curvirostris*, a small pterosaur from La Rioja (Spain). The combination of its rostrum features makes it a possible durophagous pterosaur. There are other pterosaurs that have been commonly interpreted as durophagous, as the case of the Asian, Lower Cretaceous dsungaripterids. This taxon has been identified as a member of the family Pterodactylidae, but some authors have suggested that it could belong to the family Lonchodectidae. We analysed the rostrum of *P. curvirostris*. Micro-CT scanning, reveals its inner structure, showing a collapsed hollow structure, subtriangular in section and a couple of interesting features. 1) a continuous channel in the palatal region, that goes all along the rostrum and 2) thickened trabeculae, dorsoventrally oriented and regularly spaced, situated between the teeth pairs. We present a Finite Element Analysis (FEA) showing the columns and rostrum behavior under bite forces. When those bite forces are applied to the rostrum, columns give structural stiffness to the bone structure, preventing its collapse. The forces are distributed in the same way that in the columns or pillars of a building, preventing higher flexion forces in the structure.

# A RE-EXAMINATION OF THE PHYLOGENETIC RELATIONSHIPS OF ITALIAN AND MALTESE MIOCENE TOMISTOMINE CROCODYLIANS

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**Keywords:** *Crocodylidae, Tomistominae, Miocene, Malta, Italy*

Presentation type: poster

Represented today by just one species (*Tomistoma schlegelii*), Tomistominae once comprised a near-global clade of longirostrine crocodiles, with unambiguous remains extending back to the early Eocene (~55 Ma). Although several tomistomine species are currently recognised from the Miocene (23.03–5.33 Ma) of Europe, a large proportion of these were historically erected from fragmentary remains. Here, we re-describe four of these taxa: *Melitosaurus champsoides*, *Tomistoma calaritanum*, *Tomistoma gaudense*, and *Tomistoma lyciensis* from Malta and Italy, and for the first time place them into a phylogenetic analysis, comprising 68 taxa scored for 245 characters. A number of these characters are novel or revised. Based on a unique combination of features, *Melitosaurus champsoides* is regarded as a valid taxon, and *Tomistoma calaritanum* is tentatively considered to be its junior synonym. *Tomistoma gaudense* is also deemed to be a distinct species, but we refrain from providing a new genus name given its fragmentary (and possibly juvenile) nature. The highly fragmentary nature of the type specimen of *Tomistoma lyciensis* means that it is regarded as Tomistominae indet. Several characters, including a thin posterior wall of the supratemporal fenestrae, and a narrow interfenestral bar, suggest a close relationship between *Melitosaurus champsoides*, *Tomistoma gaudense* and derived, approximately contemporaneous tomistomines, such as *Tomistoma lusitanica* and *Gavialosuchus eggenburgensis*. These revised phylogenetic relationships will ultimately help to improve our understanding of European tomistomine diversity, and will allow us to advance on previous biogeographical studies relating to the dispersal of tomistomines throughout Europe.

# STABLE ISOTOPES SHOW ECOLOGICAL NICHE PARTITIONING AMONG INSULAR MEGA-HERBIVORE DINOSAURS

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**Keywords:** *Dinosauria, isotopes, paleoecology, Cretaceous, Europe*

Presentation type: poster

Dinosaurs from the Late Cretaceous of Europe are known to be scaled-down versions of their continental relatives, due to their evolution under insular conditions. Despite the small geographic area of the islands where they lived, insular dinosaur communities were remarkably diverse. Titanosaurian sauropods and hadrosaurids stand out as the most abundant and diverse groups of dinosaurs that once inhabited the Ibero-Armorican Island (present-day Iberian Peninsula and France). In the southern Pyrenees, titanosaurs and hadrosaurids rarely co-occur in the same locality, which may indicate different environmental preferences. Here we tested this hypothesis using stable isotopic data ( $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ ) from dinosaur tooth enamel, as well as co-occurring carbonate pedogenetic nodules. After testing for the chemically unaltered nature of the fossil samples, the results indicated a bimodal distribution of the isotopic signatures of both  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ , even though some overlap was also observed. Data suggest that titanosaurs would have shown preference for feeding on C3 plant canopies growing in floodplains. By contrast, hadrosaurids would have preferred fluvial environments for roaming and feeding on C3 plants that grew in water-stressed conditions. In light of these results, we hypothesize niche partitioning between Ibero-Armorican titanosaurs and hadrosaurids, which may also represent the first evidence of ecological adaptations aimed at avoiding competition among dinosaur groups in an insular environment.

# ON THE FOSSIL TURTLES FROM HOWENEGG (LATE MIOCENE, SOUTH GERMANY): PRELIMINARY RESULTS

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**Keywords:** *palaeontology, Miocene, turtle fauna, Höwenegg, Germany*

Presentation type: poster

The purpose of this study is to contribute to the knowledge of taxonomy, diversity, evolution, taphonomy, and palaeoecology of the Neogene biota from the western Palearctic, focused on the study of the rich and diverse fossilized record of turtles from the Höwenegg region, Germany.

Höwenegg is situated 2.5 Km from Immendingen and is part of the Hegau, a volcano area in Southern Germany. Höwenegg locality is noteworthy for its rich and diverse Late Miocene fauna (MN9), comprising well-preserved fossils and almost complete skeletons of vertebrates. Tortoises and freshwater turtles from several families have also been excavated in the past from this location, but have received limited attention up to now.

The primary objective of the study is the complete analysis of the turtle material, starting with the preparation and cataloging of the specimens. A detailed taxonomic analysis will follow, aided by additional taphonomic, palaeoecologic, and phylogenetic information.

The preliminary study of the Höwenegg's turtle fauna reveals the presence of several cryptodiran clades of turtles. Most of them appear to be represented by a single taxon (Pan-Trionychidae, Pan-Chelydridae, Emydidae, Geoemydidae), whereas tortoises (Testudinidae) are apparently represented by a small and a medium-to-large taxon. Our preliminary assessment, therefore, identifies up to six different turtle species surviving in Höwenegg during the Late Miocene. These clades were quite diverse in Central Europe during the Neogene, and Höwenegg appears to be one of the most diverse localities of that period.



# MORPHOLOGICAL DISPARITY AND NICHE EXPLOITATION IN TWO TITANOSAUR FORMS FROM THE CAMPANIAN-MAASTRICHTIAN OF LO HUECO (CUENCA, SPAIN)

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**Keywords:** *Titanosauria, Ibero-Armorican island, morphological disparity, morphometrics, niche partitioning*

Presentation type: poster

The Campanian-Maastrichtian Konzentrat-Lagerstätte of Lo Hueco has yielded at least two titanosaur morphotypes, based on the analysis of cranial, axial and appendicular skeleton remains. One of this titanosaur forms can be related to the exclusive titanosaur *Lohuecotitan pandafilandi*. Morphological differences have been analyzed with 3D geometric morphometrics toolkit and morphological features with dissimilarity metrics via Gower's distances and principal coordinate analysis. The analyses of shape variables show slightly different results compared to the morphospaces from dissimilarity analyses between morphological characters. Both types of analyses support the presence of two distinct titanosaur morphotypes with significant differences in all bone elements types from the forelimb and hindlimb.

Previous works on titanosaur cranial material from Lo Hueco also highlighted differences in ecological niche exploitation, similarly to other sauropod communities. Niche partitioning has been proposed for other Upper Jurassic and Lower Cretaceous sauropod communities, e.g. at Tendaguru (Tanzania). A statistical model was used to test the hypothesis of different feeding niche exploitation. The correlation of some of the morphological variation observed in the appendicular skeleton among the sample of Lo Hueco titanosaurs was assessed with differences in feeding capabilities and morphofunctional constraints of the sauropod appendicular skeleton. The morphological variables were compared in a sample of Lo Hueco forelimb and hindlimb elements, and other sauropods with proposed high browser feeding capabilities and low browser feeding capabilities. Preliminary results of the analyses are congruent with presence of morphological specialization and feeding niche partitioning between the two main morphotypes from Lo Hueco.

# PALAEOPATHOLOGICAL SURVEY OF ICHTHYOSAURS FROM THE MIDDLE TRIASSIC BESANO FORMATION (NORTHERN ITALY AND SOUTHERN SWITZERLAND)

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**Keywords:** *palaeopathology, ichthyosaurs, Triassic, marine reptiles, palaeoecology*

Presentation type: oral communication

A key assumption of palaeontology is that ecological processes in the past operated as in the present. However, during the Mesozoic, a profound shift occurred in marine ecosystems, leading to increasing predation pressure and competition in marine environments. We examined whether this shift is associated with the incidence of skeletal pathologies in Triassic ichthyosaurs relative to Jurassic genera. We surveyed 199 ichthyosaurs from the Middle Triassic Besano Formation, referred to three taxa (*Mixosaurus*, *Cymbospondylus*, and *Shastasauridae*), and compared the incidence and distribution of pathologies to that in the Early Jurassic ichthyosaurs. Our results show similar pathologies in both *Mixosaurus* and the larger Triassic taxa. Small and large individuals of *Mixosaurus* have similar incidence of pathologies (7% vs. 6%), indicating that age-related skeletal diseases were relatively infrequent in this genus. No traumatic injuries to the ribs were detected in any of the ichthyosaurs from the Besano Formation, in contrast to Early Jurassic taxa in which these injuries are common, indicating either a difference in the type of aggressive behaviour of ichthyosaurs during the Middle Triassic or reduced survivorship after attacks. We found no significant difference in the total frequency of pathologies between the most common Triassic and the most common Early Jurassic genera (*Mixosaurus* and *Stenopterygius*). Our results suggest that the Mesozoic Marine Revolution did not result in a substantial deterioration in skeletal health in marine reptiles between the early and mid-Mesozoic, but the parts of the skeleton most affected varied between the two samples, indicating potential palaeobiological differences.

# LIMB MORPHOLOGICAL INTEGRATION IN THE PALEOZOIC TEMNOSPONDYL *APATEON PEDESTRIS*

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**Keywords:** *Temnospondyli, morphological integration, limbs*

Presentation type: poster

Intraspecific morphological integration refers to the covariation or correlation among morphological traits within a single species and it has been proposed to channel morphological evolution by modulating variability. In spite of the potential evolutionary relevance of intraspecific morphological integration, studies on the subject in fossils are scant. Herein, we quantified the patterns of limb morphological integration in *Apateon pedestris*, a branchiosaurid temnospondyl amphibian from the Paleozoic, as the first step of a broader comparative study within Temnospondyli. Linear measurements of the length and width of the autopodial and zeugopodial bones were taken on 21 individuals of a time-averaged population from Odernheim, Germany. The patterns of integration among the limb variables were calculated by partial correlations, which were classified as strong or weak using edge exclusion deviance. The total integration of fore and hindlimbs was quantified as the relative standard deviation of eigenvalues of the correlation matrices and compared by bootstrapping. Integration patterns calculated alternatively from width and length variables are similar. Within limbs, the zeugopodial bones are strongly integrated; the relationships between the stylopodium and the zeugopodial elements differ in the fore- and hindlimb: the humerus is strongly integrated with the ulna (postaxial element), whereas the femur, with the tibia (preaxial element). Between limbs, strong relationships were recovered for the serial homologous humerus/femur and ulna/fibula, with forelimb showing the highest total integration. Further analyses in other well represented temnospondyl species will allow us to test whether the limb integration patterns recovered here are conserved or vary within the lineage.

# IMPLICATIONS ON THE UPPERMOST CRETACEOUS DIVERSITY OF PLEURODIRA IN SOUTHWEST NIGER BASED ON THE FINDING OF THE FIRST ALMOST COMPLETE SHELL

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**Keywords:** *Testudines, Bothremydidae, Taphrosphyini, Maastrichtian, Africa*

Presentation type: poster

The Maastrichtian (uppermost Cretaceous) beds of the south-western region of Niger have provided several remains of pleurodiran turtles. The large *Nigeremys gigantea*, represented by a skull, comes from those beds. It corresponds to a member of Bothremydidae, belonging to the abundant and diverse clade Taphrosphyini. A second representative of Bothremydidae has recently been recognized in these beds, corresponding to a new form of Taphrosphyini, currently under study. The analysis of unpublished material allow us to recognize the diversity of turtles from the Maastrichtian levels of that region as greater than that described so far. In this sense, the first almost complete shell identified in this area is presented here. It can also be attributed to a member of Pleurodira. However, its availability of characters is not compatible with that of the members of Taphrosphyini. The detailed anatomical description of this specimen allows us to discuss its systematic position. Its attribution to a new form cannot be ruled out.

# IDENTIFICATION OF A SECOND MEMBER OF PLEURODIRA AT THE MIDDLE EOCENE LEVELS OF THE SPANISH AINSA BASIN

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**Keywords:** *Testudines, Podocnemididae, diversity, Sobrarbe Formation, Lutetian*

Presentation type: poster

The record of pleurodiran turtles is relatively abundant and diverse in the Eocene levels of Western Europe. Most of these findings correspond to members of Podocnemididae. Among them, the diverse *Neochelys* is the best represented. In addition to the finding of several forms of terrestrial and freshwater cryptodires, the presence of *Neochelys* had been recognized in the Spanish Lutetian (middle Eocene) Sobrarbe Formation of the Ainsa Basin (southern Pyrenees, Huesca). This freshwater turtle has been identified in several sites of that Basin. The first complete shell of a turtle from this Formation is presented here. It can be attributed to a podocnemidid pleurodiran turtle. However, it does not correspond to a member of *Neochelys*. This finding has been performed in the Castejón de Sobrarbe-41 fossil site which corresponds to an intertidal floodplain, where several littoral fossils have been recognized, including sirenian marine mammals. The systematic position of this turtle is discussed, especially taking into account the available information about the poorly known European littoral form *Eocenocheilus*, whose type species (i.e. *Eocenocheilus eremberti*), from the Franco-Belgian Basin, also comes from Lutetian levels.

# FIRST DATA ABOUT THE SOLEMYDIDAE TURTLES FROM THE LOWER CRETACEOUS OF ARIÑO (TERUEL, SPAIN)

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**Keywords:** *Testudinata, shell, Albian, Santa María Quarry*

Presentation type: poster

The lower Albian (Lower Cretaceous) Spanish vertebrate locality of Santa María Quarry, in Ariño (Teruel Province, Aragón), provided abundant remains of several individuals that were attributed to a new freshwater turtle, *Toremys cassiopeia*. This taxon corresponds to the youngest representative of Paracryptodira Pleurosternidae so far identified. Although this turtle is the only one from the Santa María Quarry studied so far, it does not correspond to the only representative identified in the site. Thus, a clade of terrestrial primitive turtles (i.e. stem Testudines) is also well represented. It is Solemydidae. As in the case of the pleurosternids, the solemydids are known both in North America and in Europe. The solemydids are scarce at the Upper Jurassic levels, but relatively abundant in the European Cretaceous record, its greatest diversity being recorded during the Lower Cretaceous. The Iberian record of Solemydidae hitherto known is composed of fragmentary remains, those from the Lower Cretaceous being scarce. The findings of Solemydidae performed in Ariño are an exception. Thus, sets of disjointed or partially articulated elements, including partial skeletons and relatively complete shells, are recognized. A shell of Solemydidae from Ariño is here presented for the first time. It shows an ornamental pattern composed of tubercles. The arrangement of these tubercles, as well as other anatomical characters, especially those related to the morphology and disposition of some of its plates and scutes, allow us to make a first approximation on the systematic position of this Spanish form, taking into account the European Lower Cretaceous record.



# ON THE ANATOMY AND SYSTEMATICS OF THE ONLY EMYDID TURTLE RECOGNIZED IN THE FOSSIL RECORD OF EL SALVADOR

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**Keywords:** *Cryptodira, Emydidae, variability, late Pliocene-early Pleistocene, Río Tomayate*

Presentation type: poster

The late Pliocene-early Pleistocene fossiliferous area of Río Tomayate (Apopa Municipality, El Salvador) represents the richest vertebrate locality in Central America. A diverse fauna was recorded, especially considering the record of reptiles and mammals. The greatest diversity of reptiles corresponds to the turtles. A terrestrial form, belonging to a large-sized testudinid, and two freshwater taxa, identified as a kinosternid and an emydid, were reported. The available information on these taxa was very limited, due to the scarce material attributed to each taxon in the study in which the Río Tomayate fauna was presented, and to the absence of subsequent publications. In the case of the emydid, only an almost complete nuchal (the only figured plate), a partial one, and an epiplastron were recognized. However, the potential belonging of many other unspecified elements to it was suggested. Abundant remains of the emydid from Río Tomayate are recognized here. In this sense, even the single plate (attributed here to a hypoplastron instead of a hyoplastron) previously assigned to a kinosternid (the only report of *Kinosternon* in a Central American fossil site), is reassigned to the emydid. The almost complete plastral morphology of this emydid is reconstructed, and many elements of the carapace are identified. Based on this new information, which also allows the documentation of intraspecific variability, we perform an accurate approach to the systematic position of the emydid from Río Tomayate, being the only one recognized in the fossil record of El Salvador. Thus, its potential attribution to Deirochelyinae is discussed.

# FIRST RECORD OF A GIANT BIRD FROM THE LATE MAASTRICHTIAN OF THE TREMP BASIN (SOUTHERN PYRENEES, SPAIN)

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**Keywords:** Aves, cervical vertebra, Upper Cretaceous, Tremp Formation, Southern Pyrenees

Presentation type: poster

The bird fossil record from the Upper Cretaceous of Europe is scarce and fragmentary. Nonetheless, some enantiornithine remains (e.g. *Martinavis cruzensis*) have been found, and most remarkably, the remains of the giant bird *Gargantuavis philoinos* from the lower Maastrichtian of France, which has an uncertain position among Aves. To this day, however, no bird remains from the upper Maastrichtian have been recovered on the Ibero-Armorican Island. Here we present a cervical vertebra (MPZ 2019/264) belonging to a large-sized bird recovered from the fossil locality 'Dolor 3' (Tremp Formation: Maastrichtian-Danian) near the village of Serraduy (Huesca Province, NE Spain). The Tremp Formation deposits from this area are dated to within Chron C29r, therefore MPZ 2019/264 is the youngest Mesozoic avian fossil occurrence for the Ibero-Armorican Island, and the first report of this animal clade from the Tremp Basin. MPZ 2019/264 is a moderately well-preserved elongated vertebra with some weathered and eroded parts, lacking the caudal articular face. Nevertheless, the morphology of the cranial articular face (concave transversely-convex dorsoventrally) confirms an advanced heterocoelous condition. The vertebra is strongly pneumatized, bearing two lateral pneumatic foramina in the neural arch and another one in the centrum. This feature along with a low and anteroposteriorly elongated neural spine and the arrow-shaped section of the centrum, differentiate MPZ 2019/264 from the cervical vertebra from Montpelo-Nord (France), referred to *Gargantuavis*. This implies the presence of a second taxon of giant bird on the Ibero-Armorican Island on the last few hundred thousand years before the K/Pg extinction.

# A NEW RAPTORIAL SPERM WHALE (CETACEA, PHYSETEROIDEA) FROM THE LATE MIOCENE OF SOUTH ITALY

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**Keywords:** *Odontoceti, macroraptorial sperm whales, palaeoecology, taphonomy, Pietra leccese*

Presentation type: poster

We report on the finding of a new physeteroid specimen from the Pietra leccese, a Miocene calcareous formation exposed in South Italy and widely known for its abundance of fossil marine vertebrates. This specimen, kept at Museo di Storia Naturale dell'Università di Pisa (MSNUP) with accession number MSNUP I-17076, was found in Tortonian strata exposed at the Cisterna quarry, not far from the holotype of *Zygophyseter varolai*, another fossil sperm whale. MSNUP I-17076 consists of an incomplete skeleton, including a partial cranium, part of both mandibles, twenty teeth, and several fragmentary postcrania. The teeth exhibit both apical and anterior/posterior wear facets, the latter being due to occlusion; in a few teeth, the crown is even completely missing. These observations, coupled with the position of the gingival collar, which indicates that a great fraction of the dental root was not covered by the gum, suggest that MSNUP I-17076 might have used some kind of raptorial feeding strategy for preying upon food items such as large-sized bony fish or diminutive marine mammals. The bones are mostly disarticulated and broken, and some of them display traces that indicate scavenging by other organisms. Furthermore, the skull is pervasively encrusted by oysters, suggesting that it rested on the seafloor for a long time before being buried. This find provides new clues about the composition of the early late Miocene vertebrate assemblage of the Pietra leccese and suggests that more than one species of macroraptorial sperm whale inhabited the central Mediterranean Basin in Tortonian times.

# INTRASPECIFIC VARIABILITY AMONG A LARGE POPULATION OF ORNITHOMIMOSAURS - AN INSIGHT FROM THE LOWER CRETACEOUS OF THE SOUTHWEST OF FRANCE

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**Keywords:** *intraspecific variability, ornithomimosaurs, limb long bones, ontogeny, sexual dimorphism.*

Presentation type: poster

Intraspecific variations such as ontogenetic changes and sexual dimorphism can lead to important morphological fluctuations within a species. Studying these variations among extinct vertebrates is highly challenging because only a few skeletal elements from a limited number of individuals of a given species are usually available. Consequently, the inability to recognize these intraspecific variations could lead to different taxonomic attributions of various morphotypes from the same species. Such cases were already reported among non-avian dinosaurs, showing that intraspecific variability within this group is still poorly documented. Here we propose to study the intraspecific variability within a large population of at least 44 individuals from a single new species of an early ornithomimosaur discovered at the Berriasian bonebed of Angeac Charente (France). The shape variation between 140 hindlimb bones – 85 tibiae and 55 femora – is quantitatively analysed using 3D geometric morphometrics and multivariate statistical analyses. Ontogenetic series of both tibiae and femora are available and will be used to understand growth patterns and allometric changes. In addition, this population could also represent a noteworthy open window on sexual dimorphism among extinct vertebrates. In fact, hindlimb bones of some modern and recently extinct archosaurs were previously reported displaying reversed size sexual dimorphism (RSD) with females being larger than males. RSD is usually inferred by phylogenetic bracketing to non-avian theropods. If the occurrence of sexual dimorphism is supported by our results, the presence of medullary bone among one cluster will be investigated by paleohistological analyses in order to identify the female morph.

# FEEDING ECOLOGY OF PLIO-PLEISTOCENE PALEARCTIC CERCOPITHECIDS

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**Keywords:** *cercopithecids, Plio-Pleistocene, Europe, feeding ecology, microwear, enamel thickness*

Presentation type: oral communication

Cercopithecidae or Old-World monkeys, is one of the most taxonomically diverse group of primates, originated in Africa during the Miocene and then expanded through the Palaearctic. During Pliocene (ca. 5.3-2.5 Ma) cercopithecids explosively radiated leading to a new *Mesopithecus* species along with newcomers such as *Dolichopithecus*, *Macaca*, *Paradolichopithecus* and *Procynocephalus*, all inhabited and in cases coexisted temporally in the Palaearctic realm. This increase in the taxonomic diversity of Palearctic cercopithecids is considered to be an outcome of global and regional climatic events and interspecific competition. To investigate that, here we attempt to characterize the feeding ecology of the Plio-Pleistocene Palearctic cercopithecids based on evidence found on dental tissues. Our basic aim is to better understand the adaptive mechanisms that were used to withstand the environmental pressures, and if their rapid phylogenetic radiation is interconnected with their ecological diversity.

The dental microwear textural analysis is used to explore feeding behavior prior to death and enamel thickness using dental topography through  $\mu$ CT scans as a proxy to assess the dental capabilities and dietary adaptations. Representative samples of all recorded fossil taxa accross Eurasia are involved in the analyses along with a large comparative set of extant Old World monkeys.

Preliminary results of microwear analysis for *Paradolichopithecus* from Greece and France, show similarities with modern *Papio* but also with macaques. The analogies and the distribution of the enamel indicate that *Paradolichopithecus* was capable of processing and consuming hard and brittle food objects, suggesting a durophagous tendency in its diet.

# DISTRIBUTION OF THE SPECIES *MAMMUTHUS MERIDIONALIS* ON THE TERRITORY OF OLTENIA (SW OF ROMANIA)

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**Keywords:** *Mammuthus meridionalis*, Pleistocene, Oltenia, Romania

Presentation type: poster

This research documents the distribution of the Pleistocene mammoth *Mammuthus meridionalis* on the territory of Oltenia, Romania. My intention is to shed light on all the occurrences of *M. meridionalis* on the territory of Oltenia and to update the map of the distribution of this species. The region of Oltenia occupies the south-west of Romania and is framed by the river Olt (on the Eastern side), by the river Dunarea in the South and by the Meridional Carpathian arch in the North and West. The fossils belonging to *M. meridionalis* have been discovered in rock formations from the Pleistocene age. The material under scrutiny comes from personal discoveries (Leu, Boureni, Palilula, etc.), from the collection of the Museum of Oltenia Craiova, as well as from collections belonging to other museums located in the region of Oltenia. I have also taken into account material present in the scientific literature. On the territory of Oltenia, *M. meridionalis* occurs both isolated, and, most of the times, associated with other species of mammals. Beside the molars, there have been discovered many parts of the postcranial skeleton, in connexion or isolated.



# COEVAL RHABDODONTID AND HADROSAURID DINOSAURS FROM MAASTRICHTIAN STRATA OF THE EASTERN TREMP SYNCLINE, NORTHEASTERN SPAIN

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**Keywords:** *Dinosauria, phylogenetics, systematics, anatomy, Europe*

Presentation type: poster

During the Late Cretaceous, a diverse assemblage of dinosaurian clades roamed the European Archipelago. The fossiliferous Upper Cretaceous strata of the eastern Tremp Syncline, in the Pyrenean mountains of northeastern Spain, preserve one of the best-documented records of these and other European terrestrial vertebrates from the last million years of the Mesozoic.

We introduce two new coeval iguanodontian monospecific genera from lower Maastrichtian strata of the Conques Formation in Lleida Province, NE Spain. One of them is the basal iguanodontian *Pareisactus evrostos*, a relatively large rhabdodontid characterized by apomorphies of the scapula. The proximal region of this bone is mediolaterally wider than the proximal scapular constriction is deep. The deltoid fossa is extremely deep and bounded dorsally by a well-demarcated deltoid ridge. The other taxon is the lambeosaurine *Adynomosaurus arcanus*, an outgroup to Parasaurolophini + Lambeosaurini. Known from two fragmentary skeletons, *A. arcanus* is nearly four million years older than the type locality of the tsintaosaurin *Pararhabdodon isonensis*. *A. arcanus* is diagnosed on the basis of a scapula with a nearly unexpanded blade. With a femoral length of 938 mm, *A. arcanus* includes the largest hadrosaurid specimen known in Europe. The unexpanded nature of the scapular blade suggests a decrease in the abduction, adduction and retraction strength of the humerus of *A. arcanus* relative to that of other hadrosaurids.

The discovery of these new forms reveals a relatively high iguanodontian diversity during the Maastrichtian of the Ibero-Armorican domain. Notably, it documents the sympatric co-existence of basal iguanodontians with derived hadrosaurid ornithopods.

# A REAPPRAISAL OF THE EARLY CRETACEOUS THEROPOD DINOSAUR *CAMARILLASAURUS* FROM SPAIN

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**Keywords:** *Theropoda, Early Cretaceous, Iberia, Megalosauroida*

Presentation type: poster

Although isolated remains and teeth indicate a diverse theropod fauna in the Early Cretaceous of the Iberian Peninsula, diagnostic theropod remains from this area are rare. Apart from the carcharodontosaur *Concavenator* and the ornithomimosaur *Pelecanimimus* from the Barremian Konservat-Lagerstätte of Las Hoyas, the only other taxon named from the Early Cretaceous of Spain is *Camarillasaurus cirugedae*, based on a fragmentary postcranial skeleton from the Barremian Camarillas Formation of Teruel Province. *Camarillasaurus* was originally interpreted as one of the most basal representatives of the Ceratosauria, thus implying the existence of a basal clade of ceratosaurs with a ghost lineage of some 40 Ma. A reappraisal of the material of *Camarillasaurus* revealed numerous misidentified elements in the original description. A supposed cervical vertebra is a posterior dorsal vertebra, several supposed dorsal vertebrae are caudal vertebrae, and the 'sternal plates' are parts of the scapulae. Furthermore, the supposedly diagnostic characters of the species are here interpreted as preservational artifacts. Further excavation at the type locality yielded some additional elements, presumably of the type individual, including an anterior caudal vertebra, a complete femur, and a pedal ungual. Together with a re-evaluation of the original type material, the new remains indicate that *Camarillasaurus* is a megalosauroid tetanuran, and probably a spinosaurid, rather than a ceratosaur. The validity of the species is supported by the unusual morphology of posterior caudal vertebrae of the original type material, but more information on caudal morphology in spinosaurids is needed to decide if this structure is truly diagnostic.

# ***HOMO ERECTUS* (S.L.) LIVED IN EUROPE DURING THE EARLY PLEISTOCENE AS PART OF THE MIDDLE / LATE VILLAFRANCHIAN ECOSYSTEM**

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**Keywords:** *Paleoanthropology, Early Homo, artefacts, Villafranchian, Dmanisi, Tegelen, Liessel, Mill-Langenboom*

Presentation type: oral communication

The discovery of lithic artefacts in two Late Villafranchian mammal localities in the Netherlands raises the question who made these stone tools. Similar associations are known from France: Chilhac being the best known. Villafranchian mammal faunas are found over much of Europe and Western Asia, and consist of a recognizable set of taxa. The central locality in our arguments is Dmanisi (Georgia), where a combination of a Villafranchian mammal fauna, human remains, abundant stone artefacts and absolute dates are found. Here, through comparison with the discoveries in Georgia and by using abductive reasoning, we argue for a new interpretation of the associations of lithic artefacts from the Netherlands and France with Villafranchian mammals. It is hypothetically proposed that *Homo erectus* sensu lato was present in Western Europe, including the Netherlands, around 1.8-1.7 million years ago. We suggest that early hominids were an integral part of the Villafranchian ecosystem.

# THE ANATOMY AND PHYLOGENETIC RELATIONSHIPS OF THE BASAL ALLIGATOROID *DIPLOCYNODON HANTONIENSIS* FROM THE LATE EOCENE OF THE UNITED KINGDOM

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**Keywords:** *Diplocynodon*, *Crocodylia*, *Alligatoroidea*, *Eocene*, *postcrania*

Presentation type: poster

*Diplocynodon* is a genus of basal alligatoroid crocodylian that was ubiquitous in European freshwater ecosystems during the Cenozoic. Nine species, spanning the late Paleocene to middle Miocene are considered valid. Despite recent revisions of most *Diplocynodon* species, one of the earliest named and most complete, *Diplocynodon hantoniensis*, has not been re-described for over 150 years. This species is known from the remains of numerous individuals from the Priabonian (late Eocene) Headon Hill Formation, which crops out in southern England, UK. Here we re-describe and diagnose *Diplocynodon hantoniensis*, and for the first time present a detailed description of its axial and appendicular skeleton. *Diplocynodon hantoniensis* is diagnosed by three local autapomorphies: retention of ectopterygoid-pterygoid flexure throughout ontogeny, prominent laminae lateral to the choanae, and low preorbital ridges on the lacrimals. We incorporate *Diplocynodon hantoniensis* into a phylogenetic analysis including all putative *Diplocynodon* species (103 taxa scored for 187 characters). Analyses were repeated under four character weighting schemes: equal weights, implied weighting (k value of 8) and extending implied weighting (k=4 and k=8). We recover a monophyletic *Diplocynodon* in three of the four analyses. However, the analysis with the strongest downweighting of homoplastic characters recovers the Paleocene *Diplocynodon remensis* outside *Diplocynodon*. We provide one of the most comprehensive descriptions of a basal alligatoroid, facilitating comparisons within *Diplocynodon* and other basal alligatoroids. Furthermore, our extensive postcranial description,

frequently neglected in studies of crocodylomorph anatomy, provides a rich source of new character data, and a basis for comparing postcranial anatomy in other fossil crocodylians.

# NEW ORNITHOPOD DINOSAUR REMAINS FROM THE LATE JURASSIC LOURINHÃ FORMATION

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**Keywords:** *Iguanodontia, Ornithopoda, systematics, taxonomy, Portugal*

Presentation type: oral communication

The Upper Jurassic Lourinhã Formation, Portugal, is one of the richest lithostratigraphic units yielding vertebrate fauna in Europe, which shows paleobiogeographic affinities with the coeval Morrison Formation and to a certain degree with the slightly younger Tendaguru Formation. Its dinosaurian fauna has yielded a diverse assemblage of sauropods, theropods and thyreophorans. By contrast, neornithischian and more specifically ornithopod taxa are scarce. Two endemic species of iguanodontians have been so far recognized, the dryosaurid *Eousdryosaurus nanohallucis* and the camptosaurid *Draconyx loureiroi*. Here we report undescribed ornithopod material housed at Museu da Lourinhã (ML). Most notably, two associated partial dorsal vertebrae (ML 452), an isolated dorsal neural arch (ML 864) and a large isolated scapula (ML 2042) indicate the presence of an unreported large sized ornithopod. The vertebrae present stout centra, tall and anteroposteriorly wide neural spine encased by two lateral depressions. The transverse processes are proportionately short, and the prezygoapophyses inclined of 45° respect to one another. The scapula is dorsoventrally bowed, with convergent dorsal and ventral margin towards the distal part of the scapular blade. The proximal extremity flares gently, being concave on the lateral surface. The acromion process is rounded and the underlying coracoid suture suddenly deflects into glenoid. The general morphology and size of ML 452, ML 864 and ML 2042 is not consistent with possible dryosaurid or camptosaurid affinities, while closely resembles larger and more derived species present in Early Cretaceous ecosystems. This new finding suggests that the diversity of Late Jurassic iguanodontians may be underestimated.



## HADROSAURS FROM CAÑADA ANCHA (CERRO DEL PUEBLO FORMATION; UPPER CAMPANIAN), COAHUILA, MEXICO

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**Keywords:** *Hadrosaur taxonomy, Campanian, Cerro del Pueblo Formation, Coahuila, Mexico*

Presentation type: oral communication

At Cañada Ancha, about 15 km northwest of Saltillo, northeastern Mexico, sediments of the Upper Campanian Cerro del Pueblo Formation exhibit disarticulated hadrosaur bone clusters, which are embedded in a breccia including long bones orientated in NW-SE direction. Diagnostic elements comprise two maxillae, of which one is assigned to *?Velafrons coahuilensis* and the second to a distinct, yet undetermined lambeosaurine. One caudal vertebra and a humerus are assigned to Lambeosaurinae. Accumulation and orientation of the bones likely were caused by a catastrophic viscose flash flood event that transported diagenetically altered and disarticulated bones together with sediment and clasts. High-energy currents broke and orientated the bones, but the lack of bone abrasion suggests a short distance transportation. The site resembles that of Las Águilas, about 50 km west of Cañada Ancha, where hadrosaurid bones accumulated, too, but as a result of at least 10 flooding events. One single flash flood event and absence of oysters and characeans suggests a more continental deposition regime than Las Águilas, likely with seasonal water supply. Future research in Coahuila and Chihuahua, northern Mexico will concentrate on a paleogeographic W-E transect ranging from Campanian into Maastrichtian deposits in order to reconstruct the eastbound progression of the coast line, as well as the turnover of vegetation and herbivorous dinosaur species with a focus on hadrosaurids, but also ceratopsians that share a similar type of dentition. The investigation may also include titanosaurid sauropods that appear during the Maastrichtian in northern Mexico and had a distinct type of dentition.

# SPINOSAURIDAE VS CROCODYLOMORPHA. THE CHALLENGE OF DISCRIMINATING HIGHLY CONVERGENT ISOLATED TEETH

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**Keywords:** *Early Cretaceous, Eusuchia, Goniopholididae, Las Hoyas, Theropoda*

Presentation type: oral communication

Two isolated conical crowns (conodont tooth) from Las Hoyas fossil site (Barremian, La Huérguina Formation, Cuenca), currently under study, are tentatively attributed to a spinosaurid theropod and to a neosuchian crocodylomorph. These teeth show similar traits: conodonty, unserrated carinae and fluted surfaces, and the quantitative characters usually measured for identification of isolated theropod teeth were unable to discriminate with enough certainty between spinosaurine and crocodylomorph teeth. However, subtle differences in the flute disposal and enamel texture lead us to consider they might correspond to distinct taxa. Additionally, the use of non-destructive techniques such as CT-Scan allowed us to identify interesting internal features that might be potentially diagnostic. These characters concern the internal structure of the teeth, such as the relative thickness of the enamel and dentine layers, and the relative size of the pulp cavity. A more comprehensive comparative including the ontogenetical changes of crocodylomorph teeth might shed light on the validity of these internal characters. Thus, such internal differences are expected to be unambiguous synapomorphies in spinosaurids, and different from the construction of neosuchian teeth. Since these lineages have coexisted during the Early Cretaceous, probably including the Las Hoyas locality, there is a necessity to find clearly discriminating characters to tell them apart.

# FOSSIL MAN OF BELGIUM: A REVIEW OF QUATERNARY COLLECTIONS OF ULIEGE

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**Keywords:** *H. neanderthalensis*, *H. sapiens*, *hominini*, *Schmerling*, *Fraipont*, *Lohest*

Presentation type: poster

Palaeoanthropology emerged as a science in the 19<sup>th</sup> century Belgium. Philippe-Charles Schmerling is notably considered as the first palaeoanthropologist by his peers. He was the first to survey bone deposits in caves around Liège where he discovered in 1830 what he interpreted as the remains of a fossil man different from *Homo sapiens*. Unfortunately, his fellow scientists were not ready to accept this revolutionary idea and Schmerling's discoveries were forgotten for over a century. In the 1880s, Prof. Julien Fraipont re-discovered Schmerling's collection of Quaternary megafauna and subsequently followed the same path when he started to study the cave remains with his colleague Maximin Lohest. Together they described another Belgian celebrity: the 'Spy Man' – in fact two incomplete skeletons, identified as a Neanderthalian in 1887. For the first time a fossil man was uncovered from the same horizon than extinct megafauna and Mousterian artefacts. Charles Fraipont, Julien's son and successor at the Chair of Palaeontology, studied Schmerling's fossils and identified officially the 'Engis Child' as the first ever described Neanderthalian. Charles Fraipont created the School of Palaeoanthropology in the 1910s and developed his discipline worldwide. He gathered copies of all fossil human remains known at the time, together with a large amount of anthropological objects. Nowadays, all archaeological and anthropological objects have been split between several institutions but the bulk of the Quaternary megafaunal collection, gathered by these four scientists, is housed in Liège, most of it remains unstudied under modern aspects.

# FIRST RECORD OF ARTICULATED ICHTHYOSAUR VERTEBRAE FROM THE CRETACEOUS OF THE NORTHERN APENNINES

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**Keywords:** *Cretaceous, ichthyosaur, articulated centra, taphonomy, Northern Italy.*

Presentation type: poster

In 2018 a set of ichthyosaur vertebrae were found near Pavullo nel Frignano, Modena province (Northern Apennines, Italy). The fossils include six isolated partial centra, a row of six articulated centra and many bone fragments for which identification is problematic. Due to the typical discoidal biconcave shape of the centra and to the preserved bone structure the specimen can be attributed to an ichthyosaur.

In the northern Apennines area fossils of Cretaceous ichthyosaurs have been found since the XIX century. These are platypterygine rostrum fragments, a partial humerus, and a few isolated vertebrae, but the new finding represents the first articulated partial skeleton from the entire area. The new fossil was found in the Argille Varicolori Formation (late Cenomanian - early?-late Campanian). Seemingly all articulated centra preserve only a layer of compact bone in the outer margin of the amphicoelous body while the core of the centra is completely lacking and replaced by the arenaceous matrix. The isolated vertebral fragments show the same taphonomic condition, resulting sometimes in a singular bi-convex structure due to the preservation of a cast of the intervertebral space coated by a thin layer of lamellar bone from two contiguous centra.

Since the isolated centra are definitely larger than the articulated ones, we infer they could be from the posterior dorsal-anterior caudal region ('sacral' region). They are similar to those of large Cretaceous ichthyosaurs such as *Pervushovisaurus* but, due to the absence of diagnostic features and poor preservation, for the time being we prefer to avoid any taxonomic attribution.

# EVOLUTION OF THE INNER SKULL CAVITIES IN EUSUCHIA

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**Keywords:** *neuroanatomy, cognitive and sensory abilities, Eusuchia*

Presentation type: oral communication

Eusuchia is the only extant lineage of Crocodylomorpha, spanning 129 million years from its origin in the Early Cretaceous to present day. Eusuchian remains are common in numerous Mesozoic and Cenozoic fossil sites across the world. However, the structure of their inner skull cavities remains poorly known.

The basal eusuchians from Lo Hueco (Late Cretaceous, Cuenca, Spain) are noteworthy because of their abundance and exquisite state of preservation. The skull of several specimens from this site and of various extant crocodylians representing major lineages were CT-scanned and their brain and pneumatic cavities were 3D reconstructed and analysed in order to assess sensory and cognitive capabilities.

The results show that the inner skull cavities of eusuchians are conservative structures. Those of extant taxa are very similar to those of basal members of the group. However, there are a few characters that appear to have varied during the course of evolution, such as the shape of the caudodorsal surface of the cerebrum, the relative size of the intertympanic diverticula and the relative length of the median pharyngeal sinus. Our results also suggest that the neurosensory and cognitive capabilities of extant crocodylians, including good olfactory and visual abilities, and a specialization for low-frequency hearing, were already present in early members of Eusuchia.

# THE TAPHONOMY OF PTEROSAURS FROM THE CRETACEOUS KEM KEM BEDS OF S.E. MOROCCO

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**Keywords:** *Cretaceous, taphonomy, pterosaur, Kem Kem, Morocco*

Presentation type: poster

The mid Cretaceous (Albian? - Cenomanian) Kem Kem beds of Morocco represent a dominantly fluvial depositional environment. Its vertebrate assemblage is highly diverse and includes a wide variety of elasmobranchs, osteichthyans, turtles, crocodilians, dinosaurs and pterosaurs. The rarity of pterosaur remains in Africa makes the Kem Kem beds of significance for understanding these enigmatic animals in this part of Gondwana. Surprisingly pterosaur remains occur frequently in the Kem Kem beds but are usually fragmented and always isolated. The material indicates a high diversity of pterosaurs with representatives of Azhdarchidae and Ornithocheiridae, and possibly Pteranodontidae and Tapejaridae. The first remains were reported in 1996 by Kellner and Mader, and since then many, more specimens have been described, representing at least four species *Siroccopteryx moroccanus*, *Alanqa saharica*, *Xericeps curvirostris* and *Coloborhynchus fluviferus*. Interestingly, azhdarchid jaw tip fragments constitute approximately 50% of the pterosaur material from the Kem Kem, indicating either a taphonomic or a collecting bias, or both. Quantitative analysis of pterosaur elements from comparative deposits, including the Cambridge Greensand of the UK and Bissekty Formation of Uzbekistan, suggest a taphonomic fingerprint with enhanced abundances of cervical vertebrae, humeri and scapulocoracoids. This pattern is not seen in the Kem Kem beds suggesting additional biases may be acting upon the material. No clear causative agent has yet been identified to explain this preservational bias. Human collecting bias is ruled out due to observations of the miners collecting every fragment of bone.

# CT ANALYSIS REVEALS NEW INFORMATION ON THE DIVERSITY OF SMALL THEROPODS OF THE KEM KEM BEDS, SOUTHEASTERN MOROCCO

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**Keywords:** *dinosaur, theropod, Noosauridae, Cretaceous, Morocco*

Presentation type: poster

The Kem Kem beds of Morocco have yielded abundant material of giant theropod dinosaurs, but remains of small theropod taxa are rare. Here we describe external and internal morphology of a theropod cervical vertebra (RS-KK-2019-06) revealed by  $\mu$ CT-scanning. These provide much needed information on the diversity of small-bodied theropods in Gondwana during the 'mid' Cretaceous. An anterior cervical vertebra (RS-KK-2019-06) assigned to Abelisauroidae based on deeply excavated spinoprezygopophyseal and spinopostzygopophyseal fossae and a neural arch bearing lateral cavities opening into the neural canal. Noosauridae based on extremely well developed centroprezygapophyseal fossae and an anteriorly positioned neural spine. The internal structure shows regular branching pattern of septae, wide chambers with at least 3 main camerae, and pneumatic pedicles connecting wide, deep fossae of the neural arch. These are indicative of a polycamerate centrum and a procamerate neural arch typical of Ceratosauria. This vertebra may represent juvenile *Deltadromeus*, a taxon regularly recovered as noosaurid in phylogenetic analyses. However, this specimen may represent a new addition to the Kem Kem theropod assemblage. Noosaurid material is extremely rare, and the described vertebra adds to the few records of this clade from the African 'mid' Cretaceous.



# CRITICAL ANALYSIS OF THE CARNIVORAN MAMMAL SUCCESS IN EUROPE DURING THE PALEOGENE

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**Keywords:** *ecology, taxonomic diversity, diet, body mass, competition*

Presentation type: oral communication

Why are we surrounded by only one group of placental carnivorous mammals (Carnivora: the present-day lions, dogs, bears, and seals among others) today, while at least three other groups of placental mammals (Hyaenodonta, Mesonychia, Oxyaenidae) were in competition with carnivorans 50 million years ago? Since the 1990s, palaeontologists have investigated the success of carnivoraform mammals (including Carnivora) and their crucial adaptations in detail. Analysis of the taxonomic and morphological diversification of these groups in the North American fossil record clearly demonstrated that carnivoraforms outcompeted hyaenodonts and oxyaenids during the Eocene, specifically from around 50 Ma onwards.

We document the evolutionary history of the taxonomic diversity as well as the evolution of the body mass of carnivorous mammals that lived in Europe during the Paleogene (66–23 Ma). The results suggest that this competition was diametrically opposed in North America and Europe. Carnivoraforms actually did not become diversified in Europe during the Eocene and thus were not as taxonomically successful in Europe as in North America during that period. Moreover, during the Eocene, European hyaenodonts varied more in body mass than carnivoraforms. The situation dramatically changed during the 'Grande Coupure' (around Eocene–Oligocene boundary; ca. 33.9 Ma). This transition corresponds to a major faunal turnover in Europe: during the earliest Oligocene global cooling event (Oi-1), the Eocene endemic carnivorous fauna was replaced by immigrant taxa (hyaenodonts and carnivorans), mainly from Asia.

This abstract is a contribution to the Belspo Brain Pioneer project BR/175/PI/CARNAGES funded by the Belgian Science Policy Office.

# IMPROVING THE USE OF MORPHOLOGICAL DATA IN INFERRING PHYLOGENY

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Presentation type: oral communication

DNA-based phylogenies appear in most cases to be more accurate than those based on morphology, due to reasons including greater objectivity of scoring and homologization, more robust analytical techniques, and lower proneness to convergence. This is problematic because DNA is not available for fossils, and fossil phylogenies may contain major errors. In order to address this problem, the homoplasy of different groups of characters is examined in extant crocodylians. Cranial characters are significantly less homoplastic, and meristic characters more homoplastic – the former is probably specific to crocodylians, but meristic characters may generally be best avoided. Characters passing three tests – (1) observability; (2) complete scoring accuracy; and (3) clear and plausible state delimitation – were significantly less homoplastic than others, and a phylogeny inferred from these placed the controversial taxon *Gavialis* (gharial) as using DNA, within Crocodylinae. Rescoring characters to pass the tests resulted in a phylogeny similar in several respects to DNA using Bayesian methods, but less so using parsimony. Use of extant (*Varanus*, *Struthio*) rather than fossil (*Bernissartia*; metriorhynchidae indet.) outgroups also improved concordance with DNA. Longirostrine convergence is likely to be responsible for the basal placement of *Gavialis* using morphology. Trees inferred from cranial shape data reflected longi/brevirostry and thus pera/paedomorphic processes. Further routes to inference of phylogeny from cranial shape are available and should be explored.

# ECTOTHERMIC VERTEBRATES FROM PIETRAFITTA (ITALY, EARLY PLEISTOCENE) AND THE LAST OCCURRENCE OF *LATONIA* IN EUROPE

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**Keywords:** *Pleistocene, Italy, herpetofauna, ichthyofauna, Latonia*

Presentation type: oral communication

The Early Pleistocene site of Pietrafitta (central Italy) yielded a rich vertebrate assemblage, which has been chronologically referred to the Farneta Faunal Unit (Late Villafranchian). Geological and palynological data show that during the Early Pleistocene, the Pietrafitta area was characterized by a lacustrine-palustrine environment, in which lignite and clay were deposited. The collection consists of at least 40 vertebrate taxa including fishes, amphibians, reptiles, birds, and mammals. The approximately 100 fish remains from Pietrafitta can be referred to the cyprinid genera *Barbus*, aff. *Leuciscus*, *Scardinius*, and *Tinca*. The 185 herpetological specimens belong to two anuran and five reptile species. The anuran collection includes 80 bones from several individuals of the large-sized frog *Latonia* sp. (Alytidae) and about 50 belonging to the green frog *Pelophylax*. Snakes are represented by three precloacal vertebrae, the largest and most complete of which is referred to the genus *Vipera* (cf. gr. “Oriental vipers”). More than 50 chelonian remains are attributed to the European pond turtle (*Emys orbicularis*) and one to the Hermann’s tortoise (*Testudo hermanni*). The *Latonia* remains from Pietrafitta represent the last European occurrence of this genus, which was previously thought to disappear from the continent at the end of the Miocene. The presence of an “Oriental viper” in the Italian Peninsula is one of the last occurrences of this group in continental Europe. These remains confirm the hypothesis that during the Early Pleistocene, the Italian Peninsula acted as a refuge for a number of thermophilous vertebrates, which survived the Plio-Pleistocene climatic cooling trend.

## REVISION OF *TANYSTROPHEUS* TAXONOMY

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**Keywords:** *Tanystropheus*, *taxonomy*, *cervical vertebrae*, *Archosauromorpha*

Presentation type: oral communication

*Tanystropheus* is among the most iconic reptiles from the Triassic. It has an extremely long neck consisting of easily recognizable extremely elongated cervical vertebrae with a reduced neural spine. The genus was erected on the basis of a number of isolated vertebrae from the Upper Muschelkalk of Germany more than 150 years ago. Previously six species of *Tanystropheus* were recognized. Apart from *Tanystropheus longobardicus* from Switzerland, Italy, and likely also China, all these species were based either on a single specimen (*Tanystropheus meridensis* and *Tanystropheus fossai*) or isolated material of which only the cervical vertebrae were diagnostic (*Tanystropheus conspicuus*, *Tanystropheus antiquus*, *Tanystropheus haasi*). The validity of a number of these taxa has previously been questioned but none were formally revised. Here we provide such a taxonomic revision based on first-hand observations of material of four of the six species. We find that *T. conspicuus*, *T. longobardicus*, and *T. meridensis* are morphologically indistinguishable. Therefore the iconic species *T. longobardicus* becomes a junior synonym of *T. conspicuus*. Furthermore we maintain that *T. haasi* is possibly also indistinguishable from *T. conspicuus* but this material requires revision. *T. antiquus* is tentatively maintained and the recently rediscovered original material of this species from Gogolin, Poland, needs to be revised in order to assess the assignment of other material from the Lower Muschelkalk to this species. *T. fossai* is also maintained. In conclusion we consider *Tanystropheus* to encompass four species and the geographic range of the best represented species *T. conspicuus* is distinctly increased.

# A NEW PLEISTOCENE MAMMAL LOCALITY FROM PENINSULAR THAILAND: IMPLICATIONS FOR THE SAVANNA CORRIDOR HYPOTHESIS DURING GLACIALS

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**Keywords:** *hyenid assemblage, stable carbon isotope, bioapatite, Krabi Province, Sundaland*

Presentation type: poster

Although the hypothesis of a “savanna corridor” (a band of open vegetation) stretching from mainland Southeast Asia to Java at several periods of lowering sea level during glacial has long been proposed to explain the facilitated migration route for early humans and associated large mammals, the existence of savanna grasslands in Peninsular Thailand during the Pleistocene has never been demonstrated due to the scarcity of available proxies. The new Pleistocene fossil site of Yai Ruak (Krabi Province, Thailand) has been excavated in 2017. Cave-filling sediments have yielded numerous teeth and bones identified as belonging to 4 mammal taxa: *Hystrix* cf. *brachyura*, *Crocota crocuta ultima*, *Rhinoceros sondaicus*, and *Rusa unicolor*. The biochronological age for the fauna is preliminarily regarded to be comprised between late Middle and Late Pleistocene based on the presence of *C. c. ultima*. We reconstructed the Pleistocene vegetation and environments of the region, using a stable carbon isotope analysis of the mammalian tooth enamel recovered from this cave. The stable carbon isotope results reveal that an open vegetation/forest-grassland mosaic was dominant in this region during that time, unlike today, thus supporting the existence of the savanna corridor in Peninsular Thailand. However, the connection of similar open vegetation types between Peninsula Thailand and other Indonesian islands is still not demonstrated. Further investigations into the Pleistocene mammal faunas in Thai-Malay Peninsula are thus helpful to better identify such a corridor in relation to the early human migration route and to the paleobiogeography of Southeast Asian large mammal species in the future.

# NEW DATA ON STRATIGRAPHY AND FAUNA OF THE LATE MIOCENE LOCALITY ON RIVER FORTEPJANKA (NORTH-WEST CISCAUCASIA, ADYGEA)

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**Keywords:** late Miocene, Upper Sarmatian, Cetotheriidae, ruminants, terrestrial fauna

Presentation type: poster

Several late Miocene localities were found in 2003 along the river Fortepyanka, in the Republic Adygea (Russia, Red October's forest management, Wolf ravine), containing a marine and terrestrial vertebrate fauna. The local section includes the largest part of the upper Blinovo Formation. These localities on the river Fortepyanka present special interest for the possibility to correlate terrestrial and marine faunas. During fieldwork of the Crimean-Caucasian Expeditions PIN RAS in 2018, new material from Northern Cis-Caucasus has been collected. The finds of ruminants (*Euprox* and *Protragocerus*); small otter-like predators; small monachine seals (including *Monachopsis* sp. 2); and *Cetotheriidae* (*Kurdalagonus maikopicus* and *Kurdalagonus* sp.) and the faunal analysis clarified the age of the terrestrial fauna of the river Fortepyanka consolidated section. It is shown that the fauna corresponds to the Early Vallesian, mammal zone MN9 of Europe, and belongs to the first half of the Tortonian, Upper Sarmatian (Khersonian regional stage, early late Miocene) of the Eastern Paratethys. In addition, *Cetotherium*-like whales are recorded along the section until the top. Three forms of *Kurdalagonus* are known here. Upward, at the base of the section Gaverdovsky Formation around the village Gaverdovsky, whales are no longer encountered. This study was partially supported by the Russian Foundation for Basic Research, project no.18-35-00206 (for field studies, collecting fossil whale material, and stratigraphic descriptions), with partial support from the RNF18-74-10081 "Evolution of Vertebrate Communities in the Late Cenozoic of Eastern Europe" (morphological descriptions and late Miocene faunal analyses).

# ALL THE PASSING LIVES AND DEATHS: THE DIVERSIFICATION DYNAMICS OF NEOGENE AND QUATERNARY MARINE VERTEBRATE PREDATORS FROM THE NORTH AMERICAN WEST COAST

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**Keywords:** *diversification, marine, predators, Neogene, Quaternary*

Presentation type: oral communication

“I felt the full breadth and depth of the ocean... back billions of years to the beginning of life, across all the passing lives and deaths, the endless waves of swimming joy and quiet losses of exquisite creatures... There is nothing the ocean has not seen.” -Sally Andrew

As modern ocean temperatures, sea level, and ecosystem composition are changing rapidly, understanding how they contribute to extinction rates is vital for mitigating the ongoing biodiversity crisis. Yet how these factors influence evolutionary patterns is poorly understood, particularly in the marine realm. Despite the focus of conservationists on modern biological studies, neobiological data alone lacks adequate temporal range for understanding the complex reaction of taxa to abiotic and biotic changes. As many modern marine vertebrate predators face a disproportionately high extinction risk, investigating their diversification dynamics in the fossil record is paramount.

Sedimentary units along the western coast of North America have yielded a rich fossil record of Neogene and Quaternary predatory marine vertebrates. This record preserves the rise of modern faunal assemblages, including the rise of pinnipeds and diversification of seabirds. Moreover, sea surface temperature and sea level varied dramatically over this time. However, no studies have yet applied rigorous hypothesis testing to examining the influence of these factors on the diversification dynamics on these taxa. Therefore, this project will use the program PyRate to test the strength and directionality of influences from environmental and ecological variables on the speciation and extinction rates of odontocetes, pinnipeds, chondrichthyans, and seabirds.



# REVISION OF *RONZOTHERIUM*, ONE OF THE EARLIEST TRUE RHINOCEROTIDAE

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**Keywords:** *Rhinocerotidae*, *evolution*, *Grande Coupure*, *Oligocene*, *Ronzotherium*

Presentation type: oral communication

*Ronzotherium* is one of the first Rhinocerotidae to appear after the Grande Coupure event in Europe. It was notably designated by Michel Brunet as one of the “chefs de file” [leaders] of the earliest Oligocene immigration in Europe. This genus is a key taxon for the comprehension of the migration event, and for the systematics and phylogeny of Rhinocerotidae, since it possesses both derived and ancestral character states.

However, it is also a very poorly understood genus, which may include up to seven species. Up to now only two authors have proposed a systematic study of this genus and their results are contradicting. This is problematic for the understanding of the rhinocerotid evolution, and a revision of this genus is thus needed.

We completely revised the genus *Ronzotherium* based on direct observations of all the European type materials (from five localities in France and Romania) and of referred material from more than ten major localities, including undescribed specimens. By using phylogenetic analyses, we tested the validity of species, and propose numerous new attributions to key specimens, besides the type materials. Our results differ from previous studies and show that the evolution of this genus was more complex than previously thought. This extensive revision allows us to propose new interpretations of the history of *Ronzotherium*, and new systematic implications. This revision should also lead to a future revision of all the Oligocene European rhinocerotids, with the goal of better understanding the early diversification of this family.

## MORPHOLOGICAL DISPARITY IN THE FOSSIL RECORD – APPROACHES AND CHALLENGES

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**Keywords:** disparity, morphology, morphospace, macroevolution

Presentation type: poster

Analyses of diversity or species richness through time have long been a staple of macroevolutionary studies. Since the early 1990s, analyses of morphological diversity or morphological disparity have increasingly been made in parallel with studies of diversity. Disparity studies variously attempt to compare the diversity of morphology for two or more clades, or for successive time-slices from the same clade, with reference to a typically large number of shape or discrete character variables. Counterintuitively, diversity and disparity are largely decoupled, but with a tendency for clades to show low diversity but comparatively high disparity early in their evolution. Data reduction and ordination techniques are often used to visualise the distributions of taxa within some form of morphospace, although such morphospaces are not necessary in order to index disparity. The majority of disparity studies utilise empirical data rather than a theoretical framework to prescribe the ways in which morphology can vary. Similarly, most morphospaces are empirical rather than theoretical, and the latter are typically ontogenetic in the sense that form is described in terms of the developmental processes that generate it. Moreover, for most large and anatomically highly diverse clades, it becomes necessary to use discrete rather than continuous variables, and describe the presence/absence or states of characters rather than shape per se. There is no single agreed index of disparity, and each analysis provides its own framework within which indices can only be relative. There are no metrics comparable across analyses, and the most appropriate data and analytical approaches depend upon the purpose for which they are implemented and the evolutionary question they are intended to address.

# COMPARISON OF WEIGHTING STRATEGIES FOR SPECIMEN-LEVEL PHYLOGENY BASED ON SKELETAL MATERIAL OF LIZARDS (SQUAMATA)

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**Keywords:** *maximum parsimony, k-value, Lacerta, osteology, implied weighting*

Presentation type: oral communication

Weighting strategies in phylogenetic analysis have been a controversial topic throughout the last few decades. Tests have been performed using both simulations and real datasets, comparing parsimony to model-based approaches with discrete morphological characters. Here, we provide a first test case of a number of weighting strategies that use a real dataset composed of morphological characters and specimen-level operational taxonomic units represented by skeletons of lacertilians, with the genus *Lacerta* as the ingroup. We compare the results from analyses under equal weighting, implied weighting with different k-values, and extended implied weighting with the same k-values as used with traditional implied weighting. Tree accuracy was tested based on the number of specimens of a known biological species that actually formed a monophyletic clade and relative length increase to constrained trees. Our results show that the analyses run under both extended and traditional implied weighting recovered better-resolved trees than the analysis under equal weighting. Also, tree accuracy was generally higher when the characters were weighted, especially when using higher k-values (between 10 and 50), representing a weaker downweighting of homoplastic characters. Our data highlight the advantages of implied weighting over equal weights for the specimen-level phylogeny in terms of tree resolution and recognition of species clades. Considering that many fossil vertebrate species are represented by single specimens, extended or traditional implied weighting (with a high k-value) appear to be the best strategies to find the more accurate trees when using parsimony.

# IDENTIFYING PTEROSAUR INTEGUMENTARY STRUCTURES – A CRITICAL ANALYSIS

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**Keywords:** *pterosaur, integument, pycnofibre, wing-fibre, feather*

Presentation type: oral communication

Understanding the nature of the pterosaur integument has been critical to the development of ideas about pterosaur biology and has gained broader significance with the recent identification of feather-like structures. Several different filament-like integumentary structures have been described: pycnofibres, including monofilament (hair) and branched (feather-like) forms; wing-fibres (aktinofibrillae); muscles fibres; and structural fibres in cranial crests. This study reports on a critical reassessment of the identity and distribution of the various filament types and the several lines of evidence used to identify them. Fossil evidence for the integument was reviewed for 100+ individuals distributed among 24 pterosaur species representing 11 (out of 20) principal clades that, collectively, span much of the Mesozoic. Approaches to identification including the morphology, size, location, arrangement and chemistry of filaments and the presence/absence of melanosomes suffer from various limitations. However, these approaches are effective when used in combination and when they consider filament modification by processes of decay and fossilization. Monofilamentous pycnofibres occur on the head and neck, but cannot be confidently identified on the torso or wing membranes. Aktinofibrillae are universally present throughout the wing membranes. They appear monofilamentous in the distal region of the wing, but their composite nature is revealed by partially unraveled aktinofibrillae in regions of the wing membranes adjacent to the body in several specimens. The latter appear to have been mistakenly identified as feather-like structures. We were unable to confirm the presence of feather-like structures in any pterosaur thus a deep origin for feathers within Ornithodira seems unlikely.

# NEW PALAEOPHIIDAE FROM THE EARLY PALEOGENE OF MOROCCO DOCUMENT A MARINE RADIATION

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**Keywords:** *Palaeophiidae, Phylogenetics, Radiation, Paleocene*

Presentation type: oral communication

The Palaeophiidae is a family of aquatic snakes that originated in the Early Cenozoic and became widespread in low and middle latitudes. The clade was diverse and widespread in the Paleogene, but is known almost exclusively from isolated remains, and their origin and evolution is poorly understood. Here, we describe an associated skeleton of a new palaeophiid from the Ypresian (lower Eocene) phosphates of the Ouled Abdoun Basin in Morocco and describe a new record of *Palaeophis* cf. *toliapticus*. The new taxon differs from the contemporary *Palaeophis maghrebianus* and *P. cf. toliapicus* from the same locality in exhibiting highly derived aquatic adaptations, including hypertrophied neural spines and tall pterapophyses. We analysed patterns of diversity to indicate a rapid appearance of the genus *Palaeophis* in the late Paleocene and fossil occurrences remaining constant throughout the Eocene. Time calibrated phylogenetic and morphological disparity analyses suggest that Palaeophiidae underwent an adaptive radiation in the late Paleocene and early Eocene, likely in response to new aquatic niches appearing due to Paleocene-Eocene global warming. The pattern of reversed Bergman's rule in extant snakes is also shown in palaeophiids. Lineage through time analyses suggest a rapid increase over the latest Paleocene indicating a morphologically disparate and diverse family coinciding with the Paleocene-Eocene thermal maximum.

# 3D GEOMETRIC MORPHOMETRIC ANALYSES OF MIDDLE PLEISTOCENE CAVE BEAR (*URSUS DENINGERI*) SKULLS AND MANDIBLES: IMPLICATIONS FOR DIET AND EVOLUTION

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**Keywords:** *geometric morphometrics, masticatory system, skull, mandible*

Presentation type: oral communication

Middle Pleistocene cave bears (*Ursus deningeri*) have been studied less frequently than Late Pleistocene cave bears (*Ursus spelaeus*). Our objective is to present, for the first time, an analysis of the cranial and mandibular shape of *U. deningeri* regarding diet and evolution.

Bear crania and mandibles of *U. deningeri* (n=18), *U. spelaeus* (n=13) and 100 individuals of the eight extant bear species (n=100) were digitised with a Microscribe or CT-scanned and the surface models subsequently landmarked. The landmarks were chosen based on a compromise between functional morphology and sample size. Then, geometric morphometric analyses of shape and size variation in relation to dietary adaptations were performed, including principal component analysis and regression. Results show that *U. deningeri* and *U. spelaeus* mandibles display very similar morphologies and allometric trajectories to each other and to the herbivorous panda (*Ailuropoda melanoleuca*). It is inferred that masticatory adaptations to a herbivorous diet were already present in the Middle

Pleistocene. *U. deningeri* displays a cranial morphology that is different from both brown and Late Pleistocene cave bears, but more like the latter, although the masticatory signal is less strong in the skull.

We observe intraspecific differences between different populations of *U. deningeri*, which could parallel the genetic diversity found in *U. spelaeus*. The intraspecific differences found within *U. deningeri* may be temporal and/or geographical in nature and could be related to the evolution of the Late Pleistocene cave bear, but this hypothesis remains to be tested.



# THE EARLY PLEISTOCENE HERPETOFAUNAL ASSEMBLAGE FROM TETOIU (DACIAN BASIN, SOUTHERN ROMANIA)

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**Keywords:** *Pleistocene, Colubrinae, Natricinae, Pelobatidae, palaeoecology*

Presentation type: poster

The alluvial Lower Pleistocene deposits of the Tetoiu Formation, cropping out in the western part of the Dacian Basin (southern Romania), yielded numerous vertebrate fossil remains belonging to a rich and diverse mammalian fauna. Three fossiliferous horizons were described, yet no ectothermic vertebrate fauna was reported from this formation. A recent survey of the vertebrate collection from Tetoiu (housed at the “Emil Racoviță” Institute of Speleology, in Bucharest), led to the discovery of about 300 snake vertebrae, and a single anuran frontoparietal fragment.

The morphological and morphodimensional analyses of the snake material led to the identification of a fairly diverse ophidian assemblage, including the colubrines *Hierophis gemonensis*, *H. paralongissimus*, *H. viridiflavus*, *Dolichophis jugularis*, and *Zamenis* sp., as well as the natricines *Natrix natrix*, and *N. tessellata*, whereas the anuran frontoparietal fragment is morphologically similar to the extant *Pelobates syriacus*.

The herpetofaunal assemblage described above is only the second of this kind to be reported from the early Pleistocene of the Dacian Basin. It documents the most diverse snake assemblage, including the first occurrence of *Dolichophis jugularis* from the Romanian Pleistocene, and supports the presence of a warm and dry sub-Mediterranean climate.

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CNCS – UEFISCDI, project number PN-III-P1-1.1-PD-2016-0848, within PNCDI III (to Ș.V.).

# SEX IN THE CAVE - EVIDENCE FOR MATING BEHAVIOR IN THE FOSSIL RECORD OF CAVE BEARS

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**Keywords:** *sexual maturity, baculum, Ursus spelaeus, growth, bone histology*

Presentation type: poster

Cave bears (*Ursus spelaeus*) are abundant in the fossil record and are known from many localities all over Eurasia. As for other ursids, bacula or penis bones of cave bears are commonly found. Using histological and morphometric evidence from femora and bacula of cave bears, I investigated aspects of their mating behavior. Thin sections of cave bear femora of different ontological stages were used to reconstruct individual age and body mass of an animal. The resulting growth curves were then used to reconstruct sexual maturity based on inflexion points. Additionally, the length of the bacula of all extant bear species were compared with their body mass to investigate possible scenarios for intromission time and other mating behaviors in accordance to evidence from literature. Based on histological evidence, cave bears reached sexual maturity around the age of 4 years. This result fits well within the known range of extant bear species, which varies between 3 and 6 years of age. The bacula of cave bears were longer than would be expected when phylogeny is taken into consideration. This result would suggest a higher relative testis mass for cave bears because of a positive covariation between these two variables (sperm competition). Additionally, a prolonged intromission time and higher post-copulatory fertilization success can be inferred.

# EUSAUPOD SACRA: THE CORNERSTONE OF THEIR BODY PLAN AND, AN EVOLUTIONARY INNOVATION?

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**Keywords:** sauropoda, skeletal mounts, virtual paleontology, body plan, evolutionary innovation

Presentation type: oral communication

In the last decade, there has been an intense debate concerning the necks of sauropod dinosaurs: their "neutral" position, range of motion and function. While evidence stemming from extant tetrapods predicts necks dorsiflexed in their posterior region and ventrified in their anterior region as habitual posture, osteology revealed sauropod necks articulate nearly straight. This eventually spread to interpreting many sauropods with horizontal or even ventrally deflected necks, and a low or ground level browsing inferred for them. By assembling a virtual skeleton of *Spinophorosaurus nigerensis* we found that while presacral vertebrae articulate nearly straight, the strongly wedged sacrum makes the caudal and presacral series deflect 20° from each other. Since most known eusauropod sacra are wedged, it would appear that a significant dorsal deflection of the presacral series would be widespread in all eusauropods. However, assembling 17 additional virtual skeletons of 15 different species of sauropods representing most Eusauropoda clades revealed a more complex scenario. Eusauropods with longer forelimbs had extremely wedged sacra and straight or slightly dorsally sloping presacral series, whereas eusauropods with shorter forelimbs had keystone or wedged dorsal vertebrae to counter-act the sacral wedging, bringing the presacral series closer to the ground. Since the sacrum was not wedged in non-eusauropod sauropods, we find the wedged sacra to be a potential synapomorphy of Eusauropoda, which greatly impacted on their body plan. This evolutionary innovation eventually became a constraint in clades which evolved toward low or ground level browsing.

# A NEW GECKO FROM THE EOCENE OF GEISELTAL (GERMANY)

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**Keywords:** *Gekkota*, *Squamata*, *Sphaerodactylidae*, *Europe*

Presentation type: oral communication

The middle Eocene site of Geiseltal, in eastern Germany, is renowned for its highly diverse association of fossil vertebrates, including representatives of at least four different lizard clades: iguanids, eolacertids, anguids, and palaeovaranids. We here report about the only specimen clearly representing a gekkotan from Geiseltal. A fragmentary skull represents a new taxon and to explore its evolutionary relationships we integrated the European gekkotan fossil record into a phylogenetic analysis of the group. We scored the Paleogene *Cadurcogekko* spp., *Laonogekko*, *Rhodanogekko*, *Yantarogekko*, the Neogene *Euleptes klembarai*, *Euleptes gallica*, *Gerandogekko* spp., *Palaeogekko*, and all extant European species into a dataset of 840 morphological characters and 30 taxa. The analysis was run with a molecular backbone constraint and placed the Geiseltal taxon among crown Sphaerodactylidae, in a polytomy with extant *Euleptes europaea* and the fossil *E. klembarai* and *Cadurcogekko* spp. These results imply an Eocene divergence for the living *Euleptes europaea* lineage and indicate that sphaerodactylids may have the longest evolutionary history among extant European Gekkota. The Geiseltal taxon is one of the best-preserved Paleogene Gekkota from Europe and given its recovery as one of the oldest crown-geckos, we suggest its inclusion into molecular divergence dating analyses as a fossil calibration. The subtropical habitat of Eocene stem-*Euleptes* highly contrasts with that of the living species and implies remarkable adaptive capabilities within the lineage. Indeed, such archaic elements with a Paleogene origin are rare in the extant European herpetofauna.

# COMPUTER-ASSISTED EDGE DETECTION AND POINT ACQUISITION: THE FUTURE OF LANDMARK ANALYSIS?

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**Keywords:** *landmark, shape, outline, automated detection*

Presentation type: oral communication

To overcome the limitations of linear measurements, landmark based shape analysis had become more widespread in the field of anatomy in the last few decades. Three types of landmarks can be digitized on a shape: 1) anatomical landmarks correspond between organisms in a biologically meaningful way; 2) mathematical landmarks can be defined geometrically; 3) pseudo-landmarks can be registered equidistantly on an outline. Although anatomical landmarks can easily be placed manually, they are sometimes hard to find on each morphologies involved in the same study. Points of the other types, however, can be used for analysing outlines, but they are hard to detect precisely and/or place equidistantly. Inspired by a study published four years ago by Božidar Potočnik, we developed a program in a software environment called R (v. 3.5.2), which allows the automatic detection of outlines in the case of properly prepared, high contrast images. Without the latter, we still can place outline descriptor points manually onto high resolution pictures with ImageJ (v. 1.52a). After one of these steps, the final type 2) and 3) landmark points are automatically detected and distributed along the outline by the developed program. This procedure will allow objective point placement. We demonstrate the wide taxonomic applicability and flexibility of the program by analysing the shapes of extant tree leaves and Pleistocene deer molars. We hope that our methodology will help future researchers to reveal intra- and interspecific variability of shape more objectively, thus contribute to solving several taxonomical issues.

# UNITING FORCES TO RAISE THE BEASTS: CITIZEN SCIENTISTS AND ACADEMIC PALAEOLOGISTS COLLABORATE ON MIDDLE TRIASSIC DUTCH PALAEOBIOTA

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**Keywords:** Middle Triassic, Winterswijk, Dutch palaeontology, citizen science, legislation

Presentation type: poster

The Dutch quarries of the Winterswijkse Steengroeve expose the early Middle Triassic coastal and shallow marine Vossenveld Formation. Its records preserve a rich palaeoassemblage that spans an unusual diversity of invertebrate and vertebrate trace and body fossils. These often exquisitely preserved remains not only attract considerable attention in academic palaeontology but also appeal to private enthusiasts alike.

Domestic palaeontological opportunities are scarce in the Dutch landscape. Although archaeological heritage is protected under the Malta Treaty, Dutch palaeontological patrimony remains unregulated, rendering government-mandated investigation of native fossils non-existent. Private collecting is generally allowed, yet public access to the few Mesozoic outcrops is only granted to exceptionally well-motivated initiatives. One of these is embodied in the enduring efforts of the Working Group Muschelkalk Winterswijk (WMW) within the Dutch Geological Association (NGV).

The WMW proactively cooperates with the benevolent management of Sibelco B.V., who exploits the quarries, to salvage palaeontological treasures before they are lost in the limestone mills. WMW members actively partake in fruitful academic collaborations, educational excavations, and evocative outreach. Their local expertise and unique collections render them respected partners in palaeontological endeavors focusing on the Middle Triassic of the Germanic Basin. This constructive synergy will be celebrated in an upcoming special publication to be issued by the NGV in December 2019.

Citizen scientists contribute valuable experience and materials to the palaeontological discourse, particularly in states implementing an ambiguous palaeontological policy. Private initiatives, such as the WMW, therefore deserve recognition and proactive inclusion in our shared quest for unraveling life's history.

# BONE HISTOLOGY OF PTEROSAURS FROM THE STONESFIELD SLATE SUGGESTS DIFFERENT SIZE CLASSES WITHIN THE ASSEMBLAGE

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**Keywords:** *Pterosaurs, bone histology, Stonesfield Slate*

Presentation type: poster

The pterosaur fauna of the historically well known Bathonian Stonesfield Slate fossil site in England has a long history reaching to the middle 18th century and has yielded many taxonomic uncertainties. Consisting of isolated, fragmentary bones from the forelimbs, the pterosaur remains have often been taxonomically reinterpreted and the pterosaur fauna was considered as monospecific. However, the only species *Rhamphocephalus bucklandi* was treated as a *nomen dubium* and the fauna was recently hypothesized to consist of at least five different species. To complement the problematic morphological studies on the Stonesfield pterosaurs, this study investigates their histology and tests its potential for inferring taxonomic information. Previous histological studies on Stonesfield pterosaurs are very rare and restricted to only two figured thin sections from 1855 and 1907. Therefore, this is the first modern histological analysis of six as Stonesfield pterosaurs labeled specimens from the mid 18th century. The histology of the six isolated bones from the collection of the Goldfuß Museum in Bonn is very diverse and accounts for at least one specimen to be of other origin than of a pterosaur. The remaining samples show typical pterosaurian growth structures, but they reveal different ontogenetic ages. A combination of measured bone lengths with their histologically estimated ontogenetic ages suggests at least two different size classes within the assemblage. Thus, the histological results of this study confirm the finding of a more diverse, non-monospecific pterosaur fauna in the Stonesfield Slate.



# INFERRING ECOLOGICAL TRAITS IN EXTINCT VERTEBRATES WITH DISCRIMINANT ANALYSIS: DEALING WITH MULTIPLE VARIABLES AND INACCURACY OF COMPOSITE DATA

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**Keywords:** *discriminant analysis, morphometrics, randomization, variable selection*

Presentation type: poster

Inferring unknown ecological traits (e.g. diet, locomotor mode) is a crucial step in investigations of extinct organisms. Typically, such inferences are made from statistical analyses of comparative datasets including multiple variables (e.g. skeletal dimensions). A pertinent issue is that it is not always obvious which, and how many, variables are to be used: including more variables often improves apparent model precision, but may increase the risk of model overfitting. Also, for extinct vertebrates, datasets are often composed of measurements from multiple incomplete specimens, in which case potential inaccuracies due to intraspecific variation could arise. Here, frameworks to handle these issues are presented, with a particular focus on linear discriminant analysis (LDA), a simple and robust predictive method. As a criterion for variable selection, modified versions of AIC designed for LDA were adopted from the literature. Although stepwise searches have been widely employed, these are not guaranteed to reach global optima. Instead, it is proposed that exhaustive search for all combinations of variables may present a practical option, especially when the number of variables does not exceed 15–20. In order to handle the inaccuracy of composite data, I propose a randomization procedure, in which composite data are simulated by randomly drawing individual values (cells) within each modern species compared; the discriminant scores of extinct species are subsequently compared to the simulated pseudovalues to draw conservative inferences. As a case study, these frameworks were applied to a dataset of waterfowl (Aves, Anatidae) to infer flight ability in extinct species.

# **EOSEMIONOTUS FROM THE ANISIAN OF WINTERSWIJK, THE NETHERLANDS**

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**Keywords:** *Eosemionotus*, *Winterswijk*, *Anisian*, *Muschelkalk*, *morphology*

Presentation type: poster

In 1986, one complete specimen of *Eosemionotus* cf. *vogeli* was found and described from the Muschelkalk of Winterswijk, the Netherlands. *Eosemionotus* is a genus of small semionotiform fish from the Anisian (Middle Triassic). In the quarry of Winterswijk, *Eosemionotus* specimens have since been found in two different layers (labelled 9 and 43) with an age difference of about 0.8 – 1 million years. The aim of the research is to find out which *Eosemionotus* species are present and whether the fishes from the two layers differ from each other.

We studied eight possible semionotiform fishes from layer 9 and seven fishes from layer 43. Preliminary data suggest that there are morphological differences between the specimens from layers 9 and 43, and that more than one *Eosemionotus* species is present in the Anisian of Winterswijk. The specimens from layer 9 seem morphologically diverse. Of all available fishes from layer 9, two certainly do not belong to the genus *Eosemionotus*. The remaining six specimens, probably all belonging to *Eosemionotus*, have yet to be identified to the species level. One important difference between the specimens from the two layers is that the ones from layer 43 are smaller when compared to those from layer 9. Additionally, the specimens from layer 43 are extremely well preserved. All but one specimen from layer 43 appear to belong to *Eosemionotus*. Based on morphological features, five of these six are identified as *E. vogeli*; the remaining one is *E. minutus*.

# **RADIAL SPOKE-LIKE TRABECULAE PROVIDE STRENGTH IN HYPER- ELONGATE PTEROSAUR VERTEBRAE**

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**Keywords:** *Pterosaur, Azhdarchid, cervical, internal structure*

Presentation type: oral communication

Azhdarchid pterosaurs are noteworthy for their highly elongate necks with seemingly limited scope for manoeuvrability. In some genera, neck length may exceed 2 metres, posing interesting questions for their posture and feeding capability. Lengthening of the neck occurred by hyper-elongation of the cervical vertebrae, especially CV3-7, rather than an increase in vertebral count. Lengthening of the neck was accompanied by elongation of the skull and the forelimb, potentially giving these pterosaurs an imposing, perhaps giraffe-like posture when on the ground. Exceptionally well-preserved (3D) azhdarchid pterosaur vertebrae from the Cretaceous Kem Kem beds of Morocco provide an opportunity to investigate the internal histology of the hyper-elongate neck. Topographic and CT scanning reveals an intricate arrangement of thin, radially arranged trabeculae suspending a bony neural tube in a more or less central position within a near tubular centrum/neural arch complex. The ultra-thin wall of the centrum/neural arch complex suggests a very fragile structure, however, linking of the bony neural canal by multiple spoke-like trabeculae generates a double-tube structure that significantly increases the strength of the vertebra.

# CROCODYLIFORM GASTROLITHS: A NEW APPROACH TO SOLVE THE ENIGMA OF THEIR FUNCTION

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**Keywords:** *gastroliths, Crocodylia, Eocene, Geiseltal, palaeobiology*

Presentation type: oral communication

Stomach stones (geo-gastroliths) are known from a large variety of crocodyliforms from the Jurassic until today. Today especially common in the crocodilians *Crocodylus* and *Alligator*, gastroliths distribution and amounts within individuals of certain taxa are highly variable, which complicates the identification of their possible function(s). Several functions were proposed, but the two most plausible hypotheses are digestive help by trituration of foodstuffs and buoyancy control as ballast in water. However, evidence for both hypotheses is poor. The occurrence of dozens of articulated crocodilians with preserved gastrolith clusters in situ within Eocene fossilagerstätten in Central Europe (e.g., Geiseltal & Messel) provides a different perspective on the topic and allow to compare potential changes in gastrolith characteristics (mass, rock type, surface features, etc.) over the last 50 million years. All gastroliths-bearing specimens from the high-diversity crocodylian assemblage Geiseltal-Fossilagerstätte are currently CT-scanned and the resulting images segmented in order to use digital 3D models to correctly address skeletal features and the number, size, shape and volume of all gastroliths. Especially interesting is a complete skeleton of *Boverisuchus* (GMH Leo X-8001-1938) which shows strong adaptations to a terrestrial lifestyle (i.e., long legs, short tail, ziphodont teeth, “hoof-like” unguals) but still holds a normal-sized cluster of gastroliths, indicating a potential physiological need for stomach stones beyond buoyancy control.

# THE GIRAFFE THAT WENT WEST: THE FIRST RECORD OF *ALCICEPHALUS NEUMAYRI* (MAMMALIA, RUMINANTIA) FROM THE LATE MIOCENE OF ANATOLIA

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**Keywords:** Giraffidae, Samotheriinae, Turkey, Turolian, MN11

Presentation type: poster

*Alcicephalus neumayri* is a large-sized giraffid, which is mostly known from its type locality, Maragheh, Iran. The taxon has also been reported from North China and it is in fact the most abundant giraffid known from the eastern outskirts of the Pikermian biome. Reassessment of previously studied material from the fossiliferous site at Kavakdere revealed the presence of *A. neumayri*, alongside four other giraffid taxa (*Helladotherium duvernoyi*, *Bramatherium perimense*, *Palaeotragus rouenii* and *Samotherium boissieri*). Kavakdere constitutes one of many important late Miocene fossil mammal-bearing localities in Anatolia. Previous taxonomic studies on its fauna have revealed a plethora of taxa. However, the fossil Giraffidae from this early Turolian locality were until now poorly documented. The occurrence of *A. neumayri* at Kavakdere constitutes the first fossil record of this taxon from a western locality, suggesting a more dominant presence of *Alcicephalus* in the Pikermian biome.

**INSIGHTS INTO THE LAND-TO-SEA TRANSITION: MARINE  
CROCODYLOMORPH (CROCODYLOMORPHA: THALATTOSUCHIA)  
VASCULATURE AND SINUS SYSTEM ADAPTATIONS**

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**Keywords:** *Metriorhynchidae, neuroanatomy, pneumaticity, Thalattosuchia*

Presentation type: oral communication

While the osteological adaptations of secondarily aquatic vertebrates are well understood, the soft tissue ones are not. Here we use the Mesozoic crocodylomorph clade Thalattosuchia as an exemplar of the land-to-sea transition. During the Jurassic, thalattosuchians transitioned from shallow marine to open ocean habitats, with the subclade Metriorhynchidae convergently evolving osteological adaptations seen in other Mesozoic marine reptile groups (e.g. paddle-like forelimbs, hypocercal tail). However, the soft tissue adaptations underpinning the success of Thalattosuchia remain obscure.

Our team CT scanned and digitally segmented the cranial endocasts of 15 extinct and extant crocodylomorphs. The thalattosuchians shared a unique array of intracranial vasculature and pneumaticity anatomies; with hypertrophy of the carotid-orbital vessels, temporo-orbital vessels, transverse sinuses and possibly the cavernous sinus. Based on the blood flow patterns of extant species, thalattosuchians would have had far greater blood flow entering and exiting the orbital and nasal regions. This increase corresponds with their proportionally large eyes, and suggests that the salt glands of Metriorhynchidae evolved at the base of Thalattosuchia.

All thalattosuchians had a less extensive paratympanic sinus system when compared with sphenosuchians, protosuchians and extant species. The recessus epitubaricum, otoccipital diverticula,

and vestigial infundibular diverticula were confluent with the tympanic cavity (rather than discrete diverticula). While the intertympanic and quadrate diverticula were absent.

Our results suggest that at least some of the major soft tissue adaptations that underpinned the metriorhynchid radiation into the pelagic realm occurred much earlier in thalattosuchian evolution, and occurred prior to their osteological and locomotory adaptations.



# **A GIANT EARLY PLEISTOCENE BIRD FROM EASTERN EUROPE: UNEXPECTED COMPONENT OF TERRESTRIAL FAUNAS AT THE TIME OF EARLY HUMAN ARRIVAL**

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**Keywords:** *Pleistocene, Eastern Europe, giant ostrich, body mass*

Presentation type: oral communication

Giant birds, comparable in size with elephantbirds and moas, have never been reported from Europe. Here we describe a femur from the Early Pleistocene of the northern Black Sea area (Crimea) that is referred to a giant bird with an estimated body mass of about 450 kg (in accordance with formulae widely used for large terrestrial avians). This value makes this extinct bird one of the largest ever known avians (comparable with *Aepyornis maximus*) and the only bird of such giant size in Europe and the Northern Hemisphere in general. In contrast to very large insular birds, this bird was a better runner, which may be explained by its co-existence with large carnivorous mammals. This giant bird and associated assemblage of fossil mammals are shared with the Dmanisi locality in Georgia (~1.8–1.7 Ma), and thus this giant bird was likely a typical component of eastern European faunas at the time of early hominin arrival. We suggest that these large birds, together with early *Homo* and a variety of mammals, reached the northern Black Sea region via Southern Caucasus and Anatolia, because the older (Pliocene) finds of this fauna are known from Georgia and Turkey.

# FISHING FOR AN ICHTHYOSAUR: REASSESSMENT OF THE “INACCESSIBLE” HOLOTYPE OF LATE JURASSIC *NANNOPTERYGIUS ENTHEKIODON* HELPS TO RESOLVE A LONG-STANDING TAXONOMIC TANGLE

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**Keywords:** *Ichthyosaurs, Nannopterygius, Late Jurassic, Ophthalmosauridae*

Presentation type: oral communication

The ichthyosaur genus *Nannopterygius* from the Kimmeridge Clay Formation of England is among the most poorly known ichthyosaurs of the Late Jurassic. It was erected by Huene in 1922 to receive *Ichthyosaurus enthekiodon* Hulke, 1871, which is known from a single relatively complete, but poorly preserved skeleton. This was a moderately long (c. 3 m) ichthyosaur with slender rostrum and peculiar tiny forelimbs. The holotype and several fragmentary specimens of dubious affinity are the only material assigned to *Nannopterygius*. An additional issue is that the holotype is on display in the Natural History Museum, London, mounted high on the wall (c. 5 m) and under glass. To assess the holotype, I attached a camera with a polarizing filter to a fishing rod and connected it to a computer. The collected data reveals previously unknown morphological features of the pectoral girdle and forelimb. New observations on the holotype allowed to identify additional specimens of *Nannopterygius* in the collections of Natural History Museum and Oxford University Museum of Natural History. Apart from the overlapping elements, the newly identified specimens have representative cranial remains (including isolated elements of dermatocranium and basicranium) some of which either poorly known or unknown in the holotype. The new data increase our knowledge of *Nannopterygius* and allow the suggestion that two problematic Late Jurassic genera from Russia, *Paraophthalmosaurus* Arkhangelsky, 1997 and *Yasykovia* Efimov, 1999, are subjective junior synonyms of *Nannopterygius*, rather than of *Ophthalmosaurus* as was supposed by some previous researchers.





