



# ABSTRACT BOOK



FACULDADE DE  
CIÊNCIAS E TECNOLOGIA  
UNIVERSIDADE NOVA DE LISBOA



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## **ABOUT THE LOGO**

The XVI EAVP Annual Meeting logo is a composite of the skull and part of the anterior neck of the stegosaur *Miragaia longicollum*, superimposed on the outline of the mouth of the Tagus River, the vibrant city of Lisbon, and the Setúbal Peninsula. In this area, several vertebrate fossils have been found from the Late Jurassic, Cretaceous, and Miocene, including bones and footprints.

*Miragaia longicollum* is a species of stegosaur erected in 2009 after the partial anterior skeleton was excavated from Upper Jurassic Lourinhã Formation rocks near the village of Miragaia. The specimen is now on display in the Museum of Lourinhã. Another more complete specimen of *Miragaia* recently studied, which was found in the Upper Jurassic of Peniche, confirms the validity of *M. longicollum* as distinct from all other species of stegosaurs. This second specimen of *Miragaia* is, to date, not only the most complete dinosaur found in Portugal, but also the most complete stegosaur ever found in Europe. Stored at LNEG (Laboratório Nacional de Energia e Geologia), this new specimen of *Miragaia* has been the main focus of a Master's thesis in Paleontology from FCT-UNL.

The illustration of the XVI EAVP Annual Meeting logo is part of a full body reconstruction of *Miragaia longicollum*, based on the holotype and the above-mentioned new specimen, and is credited to Oliver Demuth (<https://odemuth.wordpress.com>).

Marzola, Mateus and Moreno-Azanza, 2018

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Welcome to EAVP 2018, this year in Caparica, Portugal, hosted by the Faculdade de Ciências e Tecnologia of Universidade Nova de Lisboa.

The Annual Meeting of the European Association of Vertebrate Palaeontology is one of the most important and renowned conferences of its kind. Every year, hundreds of researchers from all over Europe and other continents meet at the Annual EAVP Meeting, with a significant and increasing presence of young researchers in the initial stages of their career.

The Annual EAVP Meeting offers a unique opportunity to all its participants to share knowledge on their latest works and to have it disseminated in a nice, welcoming, and colloquial environment.

In 2018, we are hosting the Annual EAVP Meeting at the FCT Campus in Caparica, in Portugal, surrounded by marvelous fossiliferous sandy beaches and paramount vertebrate fossils from close localities.

This XVI Annual Meeting of the European Association of Vertebrate Palaeontologists is receiving about 190 participants from 23 countries. All abstracts in this volume passed a peer review process, assuring the quality standard required in science.

As in many other countries, the impact and role of science and scientists is increasing in Portugal. Paleontology is no exception, with the addition of new museums, visited fossils sites, geoparks and activities every year. In addition, the Master of Paleontology program hosted by FCT-UNL and Universidade de Évora and other programs of study around the country are contributing to interest in paleontology in Portugal, with a new generation of skilled researchers and multidisciplinary approaches.

The XVI EAVP Meeting is also remarkable for hosting completely free workshops to participants. This year, we offered a workshop on “Photogrammetry basics for paleontologists” (host by Matteo Belvedere and Heinrich Mallison) and one on “First Steps Into Geometric Morphometrics” (host by Soledad De Esteban-Trivigno). Plus, our meeting this year proudly hosts two socially important roundtables: the first “LGBTQIA visibility in science and museum exhibits” (host by João Muchagata, Simão Mateus and Vincent Cheng, Francesc Gascó) and the second edition of the “Women in Palaeontology: addressing gender inequalities and stereotyping in Palaeontology and science in general” (host by Femke Holwerda).

Marco Marzola, Octávio Mateus  
and Miguel Moreno-Azanza

Host committee



Dear Delegates

On behalf of the Board of the European Association of Vertebrate Palaeontologists, it gives us great pleasure to welcome you all to this meeting. We have been planning to hold our annual meeting in Portugal for more than five years, so it is most satisfying to finally see you all here. Portugal has a proud heritage of vertebrate palaeontology, and it is a privilege for this to be the venue for our 16th assembly. We look forward to three days of provocative presentations and stimulating networking in this beautiful setting.

Welcome All!

Eberhard 'Dino' Frey, EAVP President

Jeff Listn, EAVP Vice President





## CONTENTS

FOREWORD	v
WELCOME TO THE EAVP	vii
PEER COMMUNITY IN PALEONTOLOGY (PCI PALEO): A COMMUNITY-DRIVEN, TRANSPARENT, FREE AND OPEN PLATFORM FOR PEER-REVIEW IN PALEONTOLOGY J. Anquetin and G. Billet	15
ORNAMENTATION OF ARTHRODIRAN DERMAL PLATES FROM THE LOWER DEVONIAN OF MOROCCO M. Antczak, M. Ruciński and B. Berkowski	16
POST-GLACIAL RECOLONIZATION OF EUROPE BY MICROTUS ARVALIS - EVIDENCE FROM ANCIENT DNA. M. Baca, D. Popović, I. Horáček, P. Pazonyi, J.M. Lenardić, J.M. López-García and A. Nadachowski	17
SYSTEMATIC REASSESSMENT OF THE LATE BARREMIAN FROG WEALDENBATRACHUS JUCARENSIS FROM THE IBERIAN RANGES, EASTERN SPAIN A.M. Báez and R.O. Gómez	18
VERTEBRATE REMAINS IN THE COPROLITE ASSOCIATION FROM LAS HOYAS FOSSIL SITE S. Barrios-de Pedro, F.J. Poyato-Ariza and A.D. Buscalioni	19
THE FIRST DINOSAURIAN BRAINCASE FROM THE MIDDLE EAST: AN ENIGMATIC ORNITHOPOD BRAINCASE FROM THE LATEST CRETACEOUS (MAASTRICHTIAN) AL-KHOD FORMATION OF THE SULTANATE OF OMAN D. Bastiaans, A.-F. Hartman, M. Al-kindī, Y. Al Sinani and A.S. Schulp	20
GRAČANICA (BOSNIA AND HERZEGOVINA) AND GRATKORN (AUSTRIA): NEW MIDDLE MIOCENE CARNIVOROUS GUILDS K. Bastl, D. Nagel, M. Morlo and U.B. Göhlich	21
A WALK IN THE MAZE: DISCRIMINATING SMALL TRIDACTYL TRACKS FROM THE LATE JURASSIC OF JURA (NW SWITZERLAND) M. Belvedere, D. Castanera, D. Marty and C.A. Meyer	22
NEW SKELETONS OF THE MESOZOIC ORNITHURINE ICHTHYORNIS J. Benito, B.-A. Bhullar, D. Burnham, L.E. Wilson and D.J. Field	23
REFUGIA INSIDE A REFUGIUM: SMALL MAMMALS FROM THE ITALIAN PENINSULA DURING THE LATE PLEISTOCENE C. Berto, J.M. López-García and E. Luzi	24
CALIBRATING PLEISTOCENE AND HOLOCENE PALEOENVIRONMENTAL RECONSTRUCTIONS USING AN ACTUALISTIC HERPETOLOGICAL APPROACH: THE CASE OF ATAPUERCA (BURGOS, SPAIN) J.F. Bisbal-Chinesta, H.-A. Blain, R. Sánchez, L. Alberó, C. Ortega and G. Cuenca-Bescós	25
AMPHIBIANS AND SQUAMATE REPTILES FROM THE LATEST PLEISTOCENE OF THE CAVERNE MARIE-JEANNE (HASTIÈRE-LAVALUX, NAMUR) AND A REVIEW OF THE QUATERNARY HERPETOFAUNA FROM BELGIUM H.-A. Blain, A. Martínez-Monzón, J.M. López-García, I. Lozano-Fernández and A. Folie	26

THE ARCHOSAURIAN ASSEMBLAGE FROM THE BASTURS POBLE BONEBED (LATE CRETACEOUS, SPAIN): AN UPDATE A. Blanco	27
ASSESSING THE CROCODYLOMORPH DIVERSITY IN THE MAASTRICHTIAN (LATE CRETACEOUS) OF IBERO-ARMORICA, BASED ON TOOTH QUALITATIVE TRAITS A. Blanco <sup>1,2,*</sup> , E. Puértolas-Pascual <sup>3,4</sup> and J. Marmi <sup>5</sup>	28
PALAEOECOLOGY OF THE FISH ASSEMBLAGE FROM PONTILS (MIDDLE EOCENE, EBRO BASIN, NE SPAIN) A. Blanco, J. Marigó and R. Minwer-Barakat	29
CLETHRIONOMYINI FROM THE QUATERNARY DEPOSITS OF TETYUKHINSKAYA CAVE (FAR EAST, RUSSIA) A. Borodin, M. Fominykh, M. Tiunov, A. Usoltseva and S. Zykov	30
NEW DATA ON THE MIDDLE PLEISTOCENE MICROMAMMAL FAUNAS OF THE NORTH OF WESTERN SIBERIA A.V. Borodin <sup>1</sup> , L.E. Yalkovskaya <sup>1</sup> , and E.A. Markova <sup>1,*</sup>	31
PTEROSAUR TRACKS AND PHOTOGRAMMETRIC ICHNOLOGY: NEW VISUALIZATIONS OF THE THREE-DIMENSIONAL, TERRESTRIAL WORLD OF THE “DRAGON REPTILES” B.H. Breithaupt and N.A. Matthews	32
HISTORIC DISCOVERIES OF THE FIRST SAUROPODS FOUND IN THE “WILD WEST” OF WYOMING: FOUNDATIONAL RESEARCH ON COLOSSAL ANIMALS OF WORLD RENOWN B.H. Breithaupt and N.A. Matthews	33
RECOGNITION OF CROCODYLIFORM SPECIES IN THE FOSSIL RECORD: CHALLENGES AND OPPORTUNITIES FROM MODERN CRYPTIC SPECIES C.A. Brochu	34
THERAPSID SCRATCHES FROM THE MIDDLE TO LATE PERMIAN OF NORTHERN GERMANY AND THE EVOLUTION OF TETRAPOD SCRABBLING BEHAVIOR M. Buchwitz, M. Jansen, L. Marchetti, J. Lallensack, L. Luthardt and F. Trostheide	35
STUDY OF THE LOWER DENTITION OF THE CAMELID PARACAMELUS AGUIRREI FROM VENTA DEL MORO (VALENCIA, SPAIN) Ó. Caballero, V.D. Crespo, A. Fagoaga, R. Marquina, J. Abella, J. Morales and P. Montoya	36
A TENTATIVE ASSESSMENT OF THE PHYLOGENETIC RELATIONSHIPS OF PYRENASAURUS (SQUAMATA) M. Camaiti, A. Villa, A. Bolet and M. Delfino	37
THE FIRST RECORD OF PLACODONTS IN PORTUGAL AND ITS CHRONOLOGICAL AND PALEOECOLOGICAL IMPLICATIONS H. Campos and O. Mateus	38
PHYLOGENETIC SIGNAL OF MOLAR OUTLINES OF TWO RODENT GENERA (CRICETODON AND HISPANOMYS) P.M. Carro-Rodríguez, P. López-Guerrero, A.R. Gómez Cano and Á. Álvarez-Sierra	39
COMPLETENESS OF THE TEMNOSPONDYL AMPHIBIAN FOSSIL RECORD D.D. Cashmore, G.T. Lloyd and R.J. Butler	40

JURASSIC RACE: A COLLABORATIVE PEDAGOGICAL ACTIVITY BETWEEN PALEONTOLOGISTS, MATHEMATICS AND SCIENCE EDUCATION TEACHERS B. Cavadas , N. Mestrinho and O. Mateus	41
INDIAN TREMATOSAURID AMPHIBIANS: A TALE OF TWO FORMS S. Chakravorti and D.P. Sengupta	42
ACINONYX PARDINENSIS (FELIDAE, MAMMALIA) 'RE-DISCOVERED' AT MONTE ARGENTARIO (ITALY, EARLY PLEISTOCENE) THANKS TO SYNCHROTRON MICROTOMOGRAPHY M. Cherin , D.A. Iurino , M. Zanatta , V. Fernandez , A. Paciaroni , C. Petrillo , R. Rettori and R. Sardella	43
ECOLOGICAL NICHE MODELLING SUPPORTS SUSTAINED DINOSAUR DIVERSITY TRENDS PRIOR TO THE CRETACEOUS/PALEOGENE MASS EXTINCTION A.A. Chiarenza , P.D. Mannion , P.A. Allison , D.J. Lunt , A. Farnsworth and S. Kelland	44
REAPPRAISAL OF THE DISTRIBUTION AND STRATIGRAFIC RECORD OF THE ALLIGATOROID DIPLOCYNODON RATELII POMEL, 1847 IN EUROPE M. Chroust *, A. Čerňanský , M. Ivanov and Ā.H. Luján	45
NEW MORPHOLOGICAL, EVOLUTIONARY AND PALEOECOLOGICAL INTERPRETATIONS ON THE GENUS EOCAIMAN (CROCODYLIA, CAIMANINAE) FROM THE CENOZOIC OF SOUTH AMERICA G.M. Cidade * and A.S Hsiou	46
THE EVOLUTIONARY, BIOGEOGRAPHICAL AND ECOLOGICAL HISTORY OF SOUTH AMERICAN CENOZOIC CROCODYLOMORPHS: AN UPDATED REVIEW WITH NEW PERSPECTIVES G.M. Cidade * and A.S Hsiou	47
GEOGRAPHIC SAMPLING BIASES LIMIT OUR UNDERSTANDING OF THE FOSSIL RECORDS OF NON-MARINE LEPIDOSAURS AND TURTLES T.J. Cleary , R.B.J. Benson , S.E. Evans and P.M. Barrett	48
LOWER TETRAPODS FROM THE EARLY OLIGOCENE OF TRANSYLVANIA V.A. Codrea and M. Venczel	49
ALCOVASAURUS LONGISPINUS AS A DACENTRURINE STEGOSAUR (DINOSAURIA) AND CONTRIBUTIONS TO THE DIAGNOSIS OF DACENTRURINAE F. Costa and O. Mateus	50
EARLY MIOCENE MAMMAL ASSEMBLAGES FROM THE CAMPISANO RAVINE IN THE RIBESALBES-ALCORA BASIN (EASTERN SPAIN) V.D. Crespo , O. Suárez-Hernando , R. Marguina , A. Fagoaga , X. Murelaga , F.J. Ruiz-Sánchez and P. Montoya	51
PRELIMINARY REPORT OF A FOSSIL LIZARD SKULL FROM LA PALMA (CANARY ISLANDS) P. Cruzado-Caballero , C. Castillo , J. Fortuny , A. Bolet , R. Casillas , F. Bernardini and J.R. Colmenero	52
MIND THE GAP! – SIGNIFICANCE OF A NEW LATEST CRETACEOUS FOSSILIFEROUS SITE IN THE NORTHERN HAȚÉG BASIN, ROMANIA Z. Csiki-Sava , Ș. Vasile , D. Grigorescu and M. Vremir	53
SCANNING THE SKULL OF PELECANIMIMUS POLYODON (ORNITHOMIMOSAURIA, EARLY CRETACEOUS, SPAIN): OSTEOLOGICAL APPROACH E. Cuesta , F. Ortega and J.L. Sanz	54

CINGULATA JAW DISPARITY S. De Esteban-Trivigno	55
REVISITING THE BIODIVERSITY CURVE OF MODERN CROCODILES (CROCODYLIFORMES, EUSUCHIA) A. de Celis , I. Narváez and F. Ortega	56
DISCOVERY OF A TRICERATOPS BONEBED: TRICERATOPS LONG BONE HISTOLOGY AND THE LATITUDINAL GRADIENT HYPOTHESIS J. de Rooij , A.S. Schulp , J.W.F Reumer and K. Stein	57
USING THE MUSCULOSKELETAL SYSTEM AS AN INTERDEPENDENT METHOD TO COMPARE LOCOMOTOR HABITS: TWO TENDAGURU SAUROPODS (DINOSAURIA) AS CASE STUDY V. Díez Díaz , H. Mallison and D. Schwarz	58
THE LATE CRETACEOUS TITANOSAURIAN SAUROPOD DINOSAURS OF EUROPE AND AFRICA: UPDATE AND SYNTHESIS V. Díez Díaz , E. Gorscak , M.C. Lamanna , P.D. Mannion , F. Holwerda , X. Pereda Suberbiola and I.A. El-Dawoudi	59
A NEW TITANOSAURIAN SAUROPOD FROM THE LATE CRETACEOUS OF VELAUX-LA BASTIDE NEUVE (SOUTHERN FRANCE) V. Díez Díaz , G. Garcia , X. Pereda Suberbiola , B. Jentgen-Ceschino , K. Stein , P. Godefroit and X. Valentin	60
SMALL MAMMALS FROM THE HOLOCENE ARCHAEOLOGICAL SITE OF CASTILLEJO DEL BONETE (TERRINCHES, CIUDAD REAL, SPAIN) A.C. Domínguez García , C. Laplana , P. Sevilla , H.-A. Blain , N. Palomares Zumajo and L.B. de Lugo Enrich	61
A CUON SP. OCCURRENCE IN THE UPPER PLEISTOCENE DEPOSITS OF STOieni CAVE, SOUTHWESTERN ROMANIA V. Drăguşin , Ş. Vasile , A. Petculescu , S. Constantin , U.H. Taron , M. Hofreiter , and J.L.A. Paijmans	62
ADAPTATIONS FOR SCRATCH-DIGGING BEHAVIOUR IN FORELIMBS OF THE AETOSAUR STAGONOLEPIS OLENKAE (ARCHOSAURIA; PSEUDOSUCHIA) FROM KRASIEJÓW LOCALITY IN POLAND D. Drózdź	63
NEW MATERIAL OF ANKYLOPOLLEXIAN ORNITHOPODS FROM THE UPPER JURASSIC OF PORTUGAL F. Escaso , E. Malafaia , E., P. Mocho , I.Narváez , J.L. Sanz , F. Ortega	64
THE HISTORY OF THE QUATERNARY VERTEBRATE PALEONTOLOGY IN PORTUGAL D. Estraviz López and O. Mateus	65
INSECTIVOROUS MAMMALS OF THE SOUTHERN URAL (LATE PLEISTOCENE – PRESENT TIME) T. Fadeeva , P. Kosintsev and D. Gimranov	66
PALAEOECOLOGICAL INSIGHTS FOR THE DISAPPEARANCE OF NEANDERTHALS THROUGH SMALL MAMMALS FROM EL SALT (SPAIN) A. Fagoaga , Francisco J. Ruiz-Sánchez , R. Marquina-Blasco , C. Laplana , C.M. Hernández , C. Mallol and B. Galván	67
A NEW EARLY EOCENE LOCALITY WITH PRIMATE REMAINS IN THE IBERIAN PENINSULA J. Femenias-Gual , R. Minwer-Barakat , J. Marigó and S. Moyà-Solà	68

UNRAVELLING THE OXYGEN ISOTOPE SIGNAL FROM RODENT TEETH IN NORTHEASTERN IBERIA: THE XARAGALLS CAVE CASE M. Fernández-García , A. Royer and J.M. López-García	69
GEOMETRIC MORPHOMETRICS AS A COMPLEMENTARY METHOD IN THE STUDY OF CHONDRICHTHYES DENTAL MORPHOLOGIES P.R. Fialho and A.C. Balbino	70
ORNITHOPOD DINOSAURS FROM THE PAPO-SECO FORMATION (CABO ESPICHEL, WESTERN CENTRAL PORTUGAL) S.D. Figueiredo , X.P. Suberbiola , P.P. Cunha , M.F. Sousa and M. Gomes	71
10 MILLION YEARS OF SOLITUDE: THE SCARCE PALEOCENE VERTEBRATE RECORD OF THE SOUTHERN PYRENEES V. Fondevilla , R. Minwer-Barakat , J. Marigó , J. Femenias-Gual and S. Moyà-Solà	72
TREMATOSAURS: A NEW LOOK TO THE EARLY TRIASSIC GENUS ANGUSAURUS (TEMNOSPONDYLI: STEREOSPONDYLI) BASED ON X-RAY MICROCT SCANNING J. Fortuny , M. Fernández-Coll , T. Arbez and F. Bernardini	73
A MILLION YEARS OF BAT FOSSIL RECORD FROM TWO OF THE ATAPUERCA CAVE-LOCALITIES J. Galán , C. Núñez-Lahuerta , R. Moya-Costa , J.M. López-García and G. Cuenca-Bescós	74
USING 3D GEOMETRIC MORPHOMETRICS TO ESTIMATE MISSING VERTEBRAE IN A SPINOPHOROSAURUS DORSAL SPINE (MIDDLE JURASSIC, NIGER) D. García-Martínez , D. Vidal and F. Ortega	75
NEW INSIGHTS INTO THE PALAEOHISTOLOGY OF THE TITANOSAUR SAUROPODS FROM THE UPPER CRETACEOUS OF LO HUECO (CUENCA, SPAIN) F. Gascó , D. Vidal , A. Paramo , P. Mocho and F. Ortega	76
NEW IGUANODON BERNISSARTENSIS CRANIAL MATERIAL FROM THE UPPER BARREMIAN MAS DE LA PARRETA QUARRY (MORELLA FORMATION) IN MORELLA (SPAIN) J.M. Gasulla , F. Escaso , I. Narváez , J.L. Sanz and F. Ortega	77
AMPHIBIANS AND REPTILES FROM THE EARLY MIOCENE OF WEISENAU IN THE HISTORICAL COLLECTIONS OF THE UNIVERSITY OF TORINO S. Gobbi , A. Villa and M. Delfino	78
PALEOPATHOLOGICAL TRAITS IN THE CAUDAL VERTEBRAE OF THE TITANOSAUR DINOSAURS OF THE UPPER CRETACEOUS OF LO HUECO (FUENTES, CUENCA) A. Guerrero and F. Ortega	79
CROCODYLOMORPH TEETH FROM THE LOURINHÃ FORMATION, PORTUGAL (LATE JURASSIC) A.R.D. Guillaume , M. Moreno-Azanza , E. Puértolas-Pascual and O. Mateus	80
THE TAPHONOMY OF ICHTHYOSAURS: WHAT “LANDING POSITIONS” CAN TELL US ABOUT PALEOBIOLOGY J. Heijne and P.M. Sander	81

THE DIVERSE DISARTICULATION PATTERNS OF MARINE REPTILES FROM THE MIDDLE TRIASSIC LAGERSTÄTTE OF WINTERSWIJK, THE NETHERLANDS, PROVIDE INSIGHTS INTO THEIR PALEOENVIRONMENT J. Heijne , N. Klein and P.M. Sander	82
TITANOSAURIAN TEETH TELL TALE OF TRANS-MEDITERRANEAN TRAVEL F. Holwerda , V. Díez Díaz , R. Montie and J. Reumer	83
MARK, SHELLY, AND THE PHILLIPS JOIN THE PARTY: ADDITIONAL SAUROPOD MATERIAL FROM THE CALLOVIAN PETERBOROUGH OXFORD CLAY F. Holwerda , M. Evans and J. Liston	84
RUTLAND REVISITED: THE RUTLAND CETIOSAURUS F. Holwerda , P. Upchurch , J. Martin and M. Evans	85
THE EARLY HOLOCENE FAUNAL REARRANGEMENTS IN A HIGH-RESOLUTION FOSSIL RECORD I. Horáček , M. Knitlová , T. Putalová , J. Wagner and S. Čermák	86
LIGHTNING AND THE THUNDER: INSULAR DWARFISM INFERRED FROM LONG BONE HISTOLOGY OF THE TITANOSAURIAN ATsinganosaurus velauciensis B. Jentgen-Ceschino , K. Stein , V. Díez Díaz , G. Garcia , X. Valentin and V. Fischer	87
EVOLUTIONARY RELATIONSHIPS WITHIN TELEOSAUROIDEA (CROCODYLOMORPHA, THALATTOSUCHIA) AND IMPLICATIONS FOR MARINE ADAPTATIONS M.M. Johnson , M.T. Young and S.L. Brusatte	88
BODY MASS RECONSTRUCTIONS OF LATE PLEISTOCENE SPOTTED HYAENAS (CROCUTA CROCUTA, ERXLEBEN 1777) FROM EUROPE A.K. Jones , D. Schreve and C. Carbone	89
PLEISTOCENE SMALL VERTEBRATE STUDIES IN SERBIA (BALKAN PENINSULA, SE EUROPE): STATE OF THE ART AND PERSPECTIVES M. Jovanović , D. Đurić , K. Bogićević , D. Nenadić , J. Agustí and H.-A. Blain	90
SEMANTOR MACRURUS ORLOV, 1931 – NEW VIEW ON ITS MORPHOLOGY AND PALEOBIOLOGY A.V. Lavrov , K.K. Tarasenko and A.N. Vlasenko	91
MANUS EVOLUTION IN DINOSAURIA – PATTERNS OF DIGIT REDUCTION AND LOSS J.V. Leite , A. Goswami and P.M. Barrett	92
THE SHOCK OF UNEXPECTED CONSERVATISM: A COUNTER-SIGNAL TO PACHYCORMID DIVERGENCE? Jeff Liston and Anthony Maltese	93
HIGH DIVERSITY OF SMALL DINOSAURS PRECEDING THE CRETACEOUS/ PALEOGENE MASS EXTINCTION N. Longrich and A.A. Chiarenza	94
THREE NEW SPECIES OF MIDDLE TRIASSIC EOSEMIONOTUS STOLLEY, 1920 (ACTINOPTERYGII: NEOPTERYGII) FROM MONTE SAN GIORGIO A. López-Arbarello *, T. Bürgin , H. Furrer and R. Stockar	95

NEW CLUES ABOUT THE LATE EARLY PLEISTOCENE PEOPLING OF WESTERN EUROPE: SMALL VERTEBRATES FROM THE BOIS-DE-RIQUET ARCHEO-PALEONTOLOGICAL SITE (LÉZIGNAN-LA-CÈBE, SOUTHERN FRANCE)	96
I. Lozano-Fernández, H.-A. Blain, P. Piñero, J. Agustí, D. Barsky, J. Ivorra and L. Bourguignon	
FOSSIL CROCODYLIANS FROM THE MIOCENE OF THE VALLÈS-PENEDÈS BASIN (NE IBERIAN PENINSULA)	97
À.H. Luján, M. Delfino, J.L. Díaz-Aráez, M. Ivanov, I. Casanovas-Vilar and D.M. Alba	
THE FIRST RECORD OF THE GIANT TORTOISE FROM THE MIDDLE MIOCENE OF THE CZECH REPUBLIC	98
À.H. Luján, J. Březina, M. Ivanov and G. Calábková	
RELATIVE SIZE VARIATIONS OF MICROTUS ARVALIS AND MICROTUS AGRESTIS AS CLIMATIC PROXY: THE CASE OF GROTTA FUMANE	99
E. Luzzi, J.M. López-García and M. Peresani	
THE TAPIR FORELIMB AS A MORPHOFUNCTIONAL ANALOGUE FOR EOCENE EQUOID LOCOMOTION	100
J.A. MacLaren* and S. Nauwelaerts	
NEW THEROPOD POSTCRANIAL REMAINS FROM THE UPPER BARREMIAN OF SPAIN AND ITS IMPLICATION FOR BARYONICHINE DIVERSITY	101
E. Malafaia, J.M. Gasulla, F. Escaso, I. Narváez, J.L. Sanz and F. Ortega	
RAPID LOCOMOTION IN SAUROPODOMORPH DINOSAURS: RATHER WALKING INSTEAD OF RUNNING AS A MEANS TO DEAL WITH LARGE BODY MASS?	102
H. Mallison and O.E. Demuth	
WEAPONS-GRADE SAUROPODS OF THE BLACK HILLS: A RADIOACTIVE ASSEMBLAGE OF JURASSIC SKELETONS AWAITING DESCRIPTION	103
A. Maltese, F. Holwerda and E. Tschopp	
EVOLUTIONARY RELATIONSHIPS AND BIOGEOGRAPHIC HISTORY OF EUSAUROPOD DINOSAURS	104
P.D. Mannion and P. Upchurch	
RESPONSE SURFACE OPTIMIZATION METHODS TO INFER MUSCLE FORCES IN FOSSIL TAXA: EKEMBO AS AN EXAMPLE	105
J. Marcé-Nogué	
CLEANING PELECANIMIMUS (ORNITHOMIMOSAURIA, EARLY CRETACEOUS, SPAIN)	106
F. Marcos-Fernández, S. Bartolomé, S. López, I. Martínez, M. Onrubia, A. Yagüe and F. Ortega	
REDISCOVERY OF THE LOCALITY OF MURS (OLIGOCENE, SOUTHEASTERN FRANCE): FIRST RESULTS OF THE NEW EXCAVATIONS	107
O. Maridet, C. Balme, O. Lapause, S. Legal, X.-Y. Lu, B. Mennecart, J. Tissier, D. Vasilyan and L. Costeur	
LOCOMOTOR BEHAVIOR OF ADAPIS PARISIENSIS REVISITED: INSIGHTS FROM HUMERAL REMAINS OF HIGH MORPHOLOGICAL DIVERSITY	108
J. Marigó, N. Verrière and M. Godinot	
A FOSSIL PREPARATION LABORATORY AS A PEDAGOGICAL FACILITY: THE DINOPARK LOURINHÃ (PORTUGAL)	109
J. Marinheiro, A. Saleiro and S. Mateus	



WILD-CAT SCATS: TAPHONOMIC ANALYSIS OF SMALL MAMMAL REMAINS M.D. Marin-Monfort , S. García-Morato R.Olucha , A. Fagoaga and Y. Fernández-Jalvo	110
YES, WE CAN HOMOLOGIZE SKULL (AND OTHER) BONES OF ACTINOPTERYGIANS AND TETRAPODS D. Marjanović	111
EFFECTS OF POPULATION BOTTLENECKS ON PHENOTYPIC VARIATION IN EXTANT ARVICOLINE RODENTS: IMPLICATIONS FOR STUDIES OF THE QUATERNARY FOSSIL RECORD E.A. Markova , A.V. Bobretsov , P.A. Sibiryakov , N.G. Smirnov , S.V. Zykov and L.E. Yalkovskaya	112
HERPETOFAUNAL REMAINS FROM UPPER UNIT V FROM EL SALT (ALCOI, SPAIN): PRELIMINARY STUDY R. Marquina-Blasco , F.J. Ruiz-Sánchez ,A. Fagoaga , S. Bailon , C.M. Hernández , C. Mallol and B. Galván	113
MICROVERTEBRATES (AMPHIBIA, SQUAMATA, LAGOMORPHA, RODENTIA AND INSECTIVORA) FROM STRATIGRAPHICAL UNIT XB OF EL SALT (MIDDLE PALAEOLITHIC; ALCOI, SPAIN) R. Marquina-Blasco , A. Fagoaga , F.J.Ruiz-Sánchez , S. Bailon , C.M. Hernández , C. Mallol and B. Galván	114
THE FIRST FIND OF THE MAMMUTHUS TROGONTERII (POHLIG, 1885) SKELETON FROM THE PLEISTOCENE OF PERM REGION AND POLYTYPICAL MORPHOLOGY OF THE EURASIA STEPPE MAMMOTH E. Maschenko and E. Voskresenskaya	115
NEW INFORMATION ON THE DEEP-BODIED ACTINOPTERYGIAN DAPEDIUM FROM THE TRIASSIC-JURASSIC OF EUROPE E.E. Maxwell and A. López-Arbarello	116
TRACKING EARLY SAUROPODOMORPHS C.A. Meyer , M. Belvedere , H. Klein , J. Lallensack , O. Wings and S.G. Lucas	117
ONTOGENETIC CHANGES IN THE BRAINCASE OF STENOPTERYGIUS F. Miedema and E.E. Maxwell	118
A NEW SPANISH PLACODONT THAT PROVIDES NEW INFORMATION ON THE EVOLUTION OF THE BIZARRE HENODONTIDAE C. de Miguel Chaves , F. Ortega and A. Pérez-García	119
ON THE DISPERSAL OF THE AFRICAN RODENT MYOCRICETODON INTO EUROPE AT THE END OF THE MESSINIAN R. Minwer-Barakat , J. Agustí , A. García-Alix and E. Martín-Suárez	120
REVISION OF THE PRIMATE MATERIAL FROM ROC DE SANTA (LATE EOCENE, NE SPAIN) R. Minwer-Barakat , J. Marigó and S. Moyà-Solà	121
RECENT DISCOVERIES OF MICROCHOERINAE (PRIMATES) FROM THE EOCENE OF WESTERN AND CENTRAL EUROPE SHED NEW LIGHT ON THE EARLY EVOLUTION OF HAPLORHINES R. Minwer-Barakat , J. Marigó , J. Femenias-Gual , L. Costeur , S. De Esteban-Trivigno and S. Moyà-Solà	122



DIPLODOCINES OF THE GNATALIE QUARRY, A NEW BONE-BED ACCUMULATION FROM SOUTHERN UTAH (MORRISON FM., USA) P. Mocho and L. Chiappe	123
NEW INFORMATION ABOUT THE APPENDICULAR SKELETON OF SPINOPHOROSAURUS NIGERENSIS (MIDDLE JURASSIC, NIGER) P. Mocho, D. Vidal, A. Aberasturi, R. Kosma and F. Ortega	124
LATE JURASSIC SAUROPODS OF PORTUGAL: WHERE ARE WE NOW? P. Mocho, R. Royo-Torres and F. Ortega	125
THE MORPHOLOGICAL VARIABILITY ON TITANOSAUR CAUDAL SERIES FROM LO HUECO: TAXONOMIC DIVERSITY, INTRA-SPECIFIC VARIABILITY OR BOTH? P. Mocho, F. Escaso, F. Marcos-Fernández, A. Parámo, D. Vidal and F. Ortega	126
ON THE WAY TO ISLANDS: ASSESSING THE DISPERSAL WAYS USED BY INSULAR EXTINCT RODENTS TO SETTLE IN MEDITERRANEAN ISLANDS (PLIO- QUATERNARY) B. Moncunill-Solé and A. Blanco	127
FIRST RECORD OF A PALEOPATHOLOGY IN A TIBIA OF A LAGOMORPH (MIDDLE MIOCENE, GERMANY) B. Moncunill-Solé, X. Jordana, G. Rössner and C. Angelone	128
ARCTIC HABITAT AND CLIMATE CHANGE: MORPHOLOGICAL VARIATION IN EXTANT AND FOSSIL DICROSTONYX SPECIES S. Montuire, A. Royer, R. Laffont, E. Steimetz and N. Navarro	129
SHAPE DESCRIPTORS AND STATISTICAL CLASSIFICATION OF MORPHOLOGICALLY CLOSE SPECIES: THE CASE OF TWO MICROTINES (RODENTIA) AND PALEOBIOGEOGRAPHICAL IMPLICATIONS S. Montuire, A. Royer, R. Laffont, E. Steimetz and N. Navarro	130
DIGITAL RECONSTRUCTION OF THE SKULL OF TWO EARLY PLEISTOCENE SHREWS R. Moya-Costa and G. Cuenca-Bescós	131
TREASURES FROM THE DEPTHS: FIRST RECORD OF TUSCIZIPHIUS (FOSSIL BEAKED WHALE) FROM THE AZORES ISLANDS DEEP WATERS AND THE IMPORTANCE OF LOCAL COMMUNITIES TO SCIENCE J. Muchagata, O. Mateus and R. Prieto	132
ARCHOSAUIROMORPH LOCOMOTION IN THE EARLY-MIDDLE TRIASSIC: AN APPROACH BASED ON TRACKS AND TRACKWAYS FROM THE CATALAN PYRENEES (NE IBERIAN PENINSULA) E. Muijal, J. Fortuny, A. Bolet and O. Oms	133
SUBTROPICAL STEPPE IN THE LATE PLEISTOCENE OF EASTERN MIDDLE EUROPE D. Nagel, J. Lindenbauer, N. Kavcik-Graumann and G. Rabeder	134
SYSTEMATICS OF ALLODAPOSUCHID CROCODYLIFORMS FROM THE MAASTRICHTIAN (LATE CRETACEOUS) OF ROMANIA AND THE STATUS OF ALLODAPOSUCHUS PRECEDENS NOPCSA 1928 I. Narváez, C.A. Brochu, A. de Celis, M. Delfino, A. Pérez-García, M. Rabi and F. Ortega	135
AN UPDATE ON THE CROCODYLIFORM FAUNA FROM THE CENOMANIAN SITE OF ALGORA (GUADALAJARA, SPAIN) I. Narváez, F. Escaso, F. Ortega, and A. Pérez-García	136

THEROPOD GREGARIOUSNESS: POSSIBLE EVIDENCES IN TRACKSITES FROM LA RIOJA, SPAIN P. Navarro-Lorbés , E. Torices , E. García-Ortiz and I. Díaz-Martínez	137
BEAR TRACKS IN THE PLEISTOCENE AT NORTH OF PRAIA DO CAVALO, ODEMIRA (PORTUGAL) C. Neto de Carvalho	138
GEOMETRY MORPHOMETRIC APPLIED ON THE OCCLUSAL SURFACE OF THE UPPER MOLARS OF YINDIRTEMYS DEFLEXUS (CTENODACTYLIDAE, RODENTIA, MAMMALIA) A. Oliver and A.R. Gómez Cano	139
A NEW TRIASSIC (LADINIAN/CARNIAN) VERTEBRATE LOCALITY FROM VILLÁNY, SOUTHERN HUNGARY A. Ősi , M. Szabó , M. Segesdi and G. Botfalvai	140
SEASONAL PATTERNS AND ECOLOGY OF TARBOSAURUS BATAAR (NEMEGT FORMATION, MONGOLIA) INFERRED FROM STABLE OXYGEN AND CARBON ISOTOPES IN TOOTH ENAMEL K. Owocki , H. Bocherens , B. Kremer , G. Niedźwiedzki and M. Cotte	141
PUTATIVE ONTOGENIC AND INDIVIDUAL NICHE SPECIALIZATION OF TARBOSAURUS BATAAR (NEMEGT FORMATION, MONGOLIA) INFERRED FROM STABLE CARBON ISOTOPES K. Owocki , H. Bocherens , G. Niedźwiedzki and M. Cotte	142
INTRA-INDIVIDUAL VARIABILITY AND STRONTIUM ISOTOPE MEASUREMENTS IN TARBOSAURUS BATAAR (LATE CRETACEOUS, MONGOLIA) K. Owocki , H. Bocherens , G. Niedźwiedzki and M. Cotte	143
EARLY MIOCENE SNAKES FROM THE LOCALITY OF WINTERSHOF-WEST (GERMANY) V. Paclík , M. Ivanov and À.H. Luján	144
NEW MAMMALIAN TRACKS FROM A PALEOGENE (EOCENE-OLIGOCENE) LOCALITY OF PUEBLA, CENTRAL MEXICO A. Palma-Ramírez , I. López-Palomino , R. Sáenz-Pita , V. Bravo-Cuevas , M. Cabral- Perdomo and A. Monier-Castillo	145
MODULARITY IN THE TITANOSAURIAN APPENDICULAR SKELETON: INSIGHTS FROM LO HUECO FOSSIL SITE A. Páramo , F. Ortega and J.L. Sanz	146
INTRASPECIFIC VARIABILITY IN AND ITS EFFECTS ON SYSTEMATIC ASSESSMENT OF THE TITANOSAURS FROM LO HUECO (LATE CRETACEOUS. CUENCA, SPAIN) A. Páramo , P. Mocho , F. Ortega and J.L. Sanz	147
FACTORS AFFECTING THE INCIDENCE OF PALAEOPATHOLOGY IN EARLY JURASSIC ICHTHYOSAURS	148
J. PARDO-PÉREZ , E. MAXWELL AND B. KEARA NEW SPECIMEN OF «ARCHAEOTHERIUM» CLAVUM (ARTIODACTYLA, ENTELODONTIDAE) AND A PHYLOGENETIC PROPOSAL FOR THE ENTELODONTIDAE R.V. Pêgas , K.L.N. Bandeira , I. Bonilla-Salomón , B. Holgado , A.S. Brum , D.A. Campos and R.G. Souza	149

NEW DATA ON THE BOTHREMYDID TURTLES FROM THE SPANISH UPPER CRETACEOUS SITE OF LO HUECO A. Pérez-García and F. Ortega	150
IDENTIFICATION OF THE EUROPEAN CENOMANIAN BOTHREMYDID TURTLE ALGORACHELUS IN MIDDLE EAST AND NORTH AMERICA A. Pérez-García	151
NEW INFORMATION ABOUT THE EARLY EOCENE BOTHREMYDID REMAINS FROM THE BRITISH RECORD A. Pérez-García	152
THE ARARIPEMYDID TURTLES FROM THE AFRICAN APTIAN LOCALITY OF GADOUFAOUA (NIGER): AN UPDATE A. Pérez-García	153
THE HINDLIMB MUSCULATURE OF THE TRIASSIC DINOSAURIFORM <i>SILESAURUS OPOLENSIS</i> R. Piechowski and M. Tałanda	154
DISTRIBUTION OF THE SPECIES MAMMUTHUS TROGONOTHERII ON THE TERRITORY OF OLTENIA (SW OF ROMANIA) A. Popescu	155
FRILL ONTOGENY, MODULARITY AND HETEROCHRONY IN NEOCERATOPSIAN DINOSAURS A. Prieto-Márquez, S.H. Joshi, J. García-Porta and P.J. Makovicky	156
A FOSSIL MORID COD (MORIDAE) FROM OLIGOCENE DEPOSITS OF MORAVIA (CZECH REPUBLIC) T. Přikryl	157
A NEW 3D PRESERVED ARTICULATED PARTIAL SKELETON OF NEOSUCHIA FROM THE UPPER JURASSIC OF PORTUGAL E. Puértolas-Pascual and O. Mateus	158
AN ALLOSAUROID FROM THE EARLY-MIDDLE JURASSIC OF PATAGONIA AND PHYLOGENETIC UNCERTAINTY AT THE BASE OF TETANURAE O.W.M. Rauhut and D. Pol	159
A REASSESSMENT OF THE PHYLOGENY OF BASAL SAUROPODOMORPHS THROUGH COMPARATIVE CLADISTICS AND THE SUPER-MATRIX APPROACH O.R. Regalado-Fernandez, P. Upchurch, P.M. Barrett, P. Mannion and S. Maidment	160
THE DENTITION OF THE LATE JURASSIC DWARF SAUROPOD EUROPASAURUS HOLGERI FROM NORTHERN GERMANY: ONTOGENY AND FUNCTION V.S. Régent, P.M. Sander, K. Wiersma* and O. Wings	161
SMALL VERTEBRATE ASSEMBLAGE FROM THE LATE PLEISTOCENE OF KALDAR CAVE (KHORRAMABAD VALLEY, IRAN) I. Rey-Rodríguez, J.M. López-García, H.-A. Blain, E. Stoetzel, C. Denys, M. Fernández-García, L. Tumung, A. Ollé and B. Bazgir	162
FOSSIL VERTEBRATES IN THE PALEONTOLOGICAL COLLECTIONS OF THE SCIENCE MUSEUM (UNIVERSITY OF COIMBRA, PORTUGAL) C. Ribeiro, P. Callapez and O. Mateus	163

VALIDATED 3D RECONSTRUCTIONS OF THE HOMININ AXIAL SKELETON: THE THORACIC SPINE	164
A. Riesco López , B. Beyer , D. Garcia Martínez , S. Nalla , J.A. Sanchis Gimeno and M. Bastir	
FOSSIL LAND TORTOISES OF THE CANARY ISLANDS	165
S. Rodríguez-González , C. Castillo , E. Martín-González and P. Cruzado-Caballero	
DRYOSAURID ORNITHOPODS FROM THE LATE JURASSIC OF PORTUGAL: AN OVERVIEW	166
F.M. Rotatori , M. Moreno-Azanza and O. Mateus	
ASSESSING THE MESOZOIC RECORD OF IBERIAN THEROPODA	167
F. Sanguino and A.D. Buscalioni	
A REAPPRAISAL OF THE BIOCHRONOLOGY OF THE VILLAGRANCIAN FAUNAL ASSEMBLAGE OF COLLEPARDO (CENTRAL ITALY)	168
R. Sardella , L. Bellucci , J. Conti , D.A. Iurino , F. Strani and I. Mazzini	
THE PLEISTOCENE VERTEBRATES FROM GROTTA ROMANELLI (APULIA, SOUTHERN ITALY)	169
R. Sardella , L. Bellucci , F. Bona , J. Conti , D.A. Iurino , B. Mecozzi , F. Strani and I. Mazzini	
DO DIFFERENT METHODS OF MEASURING MORPHOLOGICAL DISPARITY SHOW SIMILAR SIGNALS? A STUDY OF THE THEROPOD MANDIBLE	170
J. Schaeffer , T.L. Stubbs , M.J. Benton and E.J. Rayfield	
RECENT DEVELOPMENTS AND CURRENT QUESTIONS IN QUATERNARY MICROVERTEBRATE STUDIES	171
D. Schreve	
THALATTOSUCHIAN CROCODYLOMORPHS - A MAJOR EVOLUTIONARY TRANSITION FROM LAND TO WATER	172
J. Schwab , M.T. Young , S. Walsh , L.M. Witmer , Y. Herrera and S.L. Brusatte	
A NEW NOTOSUCHIAN CROCODYLOMORPH FROM THE EARLY MAASTRICHTIAN OF NORTHEASTERN IBERIAN PENINSULA	173
A.G. Sellés , A. Blanco , J. Marmi , F.J. López-Soriano , B. Vila À. Galobart	
“NEW” OLD ICHTHYOSAURS FROM THE VERONA MUSEUM: THREE RE-DISCOVERED MARINE REPTILES FROM THE UPPER JURASSIC OF VENETO REGION (NORTHERN ITALY)	174
G. Serafini , L. Giusberti , E. Maxwell , M. Cobianchi , B. Fornaciari , C.A. Papazzoni and G. Roghi	
THE FIRST RECORD OF DORMOUSE (GLIRIDAE, RODENTIA) IN THE PLEISTOCENE OF NORTH-WESTERN ALTAI (RUSSIA)	175
N.V. Serdyuk and A.I. Krivoschapkin	
NEUROANATOMY OF LOHUECOSUCHUS MEGADONTOS (EUSUCHIA, ALLODAPOSUCHIDAE) FROM THE CAMPANIAN-MAASTRICHTIAN (LATE CRETACEOUS) OF SPAIN	176
A. Serrano-Martínez , F. Knoll , I. Narváez , S. Lautenschlager and F. Ortega	
BETTER PHYLOGENIES FROM MORPHOLOGY: DATA FROM EXTANT CROCODYLIANS	177
R.B. Sookias	

BISON REMAINS FROM THE LATEST EARLY PLEISTOCENE OF VALLPARADÍS SECTION (VALLÈS-PENEDÈS BASIN, IBERIAN PENINSULA) AND COMPARISON WITH THE BOVID SAMPLE FROM ELLERA DI CORCIANO (ITALY) L. Sorbelli , M. Cherin , D.M. Alba and J. Madurell-Malapeira	178
A REVIEW OF ICHTHYOSAURIA FROM PORTUGAL J. Sousa and O. Mateus	179
EGGSHELL OF EARLY JURASSIC BASAL SAUROPODOMORPH DINOSAURS K. Stein , E. Prondvai , T. Huang , J.-M. Baele , P.M. Sander and R. Reisz	180
STATE OF THE ART ON QUATERNARY MICROVERTEBRATES FROM NORTHWESTERN AFRICA E. Stoetzel	181
BONE MICROSTRUCTURE OF OSMOLSKINA CZATKOWICENSIS, AN EARLY TRIASSIC ARCHOSAURIFORM FROM POLAND P. Świś , J. Słowiak and L. Fostowicz-Frelik	182
HOW MESOZOIC PALAEOGEOGRAPHY AFFECTS THE PRESENT DISTRIBUTION OF SQUAMATES M. Tałanda	183
A NEW FINDING OF A PERINATE BALEEN WHALE (MAMMALIA: CETACEA) FROM LOCALITY FORTEP'YANKA 2 (REPUBLIQUE ADYGEA, RUSSIA) K.K. Tarasenko	184
TO BE OR NOT TO BE (HEAVIER) – PRELIMINARY DELIBERATIONS ON THE FUNCTION OF THE THICK DERMAL SKELETON OF METOPOSAURUS E.M. Teschner and D. Konietzko-Meier	185
CHOOSING THE RIGHT METRIC: A COMPARISON OF MOLAR RELIEF ESTIMATES USED IN DENTAL TOPOGRAPHY G. Thiery , F. Guy and V. Lazzari	186
“RHABDODON-LAND”: NEW DISCOVERIES OF RHABDODON FROM THE CAMPANIAN OF THE NATIONAL NATURAL RESERVE OF SAINTE-VICTOIRE (SOUTHERN FRANCE) T. Tortosa and Y. Dutour	187
UPPER LUTETIAN-LOWER BARTONIAN FISH FROM THE TRANSYLVANIAN BASIN, ROMANIA. PRELIMINARY RESULTS N. Trif , V.A. Codrea and V. Arghiuş	188
A NEW MARINE SNAKE (PALAEOPHIIDAE) FROM THE EARLY PALEOGENE OF MOROCCO, A SIGNAL OF EARLY CENOZOIC DIVERSIFICATION C. van den Ende , E. Randle , A. Roberts and N. Longrich	189
THE LARGE MAMMALS ASSEMBLAGE FROM BUDA (EASTERN ROMANIA) AND ITS IMPLICATIONS ON PALAEOLITHIC HUNTING BEHAVIOUR Ş. Vasile and V. Dumitraşcu	190
THE MICROVERTEBRATE FOSSIL ASSEMBLAGE FROM ABRI 122 MIDDLE PALAEOLITHIC SITE IN THE VÂRGHIŞ GORGES (ROMANIA) Ş. Vasile , A. Petculescu , V. Dumitraşcu , M. Cosac , G. Murătoareanu , R. Alexandru and D. Vereş	191

VARIABILITY OF CERVICAL INTERVERTEBRAL SPACE, POSTURE AND RANGE OF MOTION: COMPARING SAUROPOD AND GIRAFFE ONTOGENY D. Vidal *, P. Mocho , A. Parámo , J.L. Sanz and F. Ortega	192
THE REDISCOVERY OF THE ORCAU DINOSAUR: FOLLOWING THE STEPS OF WALTER GEORG KÜHNE IN THE TREMP BASIN (CATALONIA) B. Vila , A.G. Sellés and À. Galobart	193
NEW TITANOSAURIAN FINDINGS FROM HISTORICAL LOCALITIES OF THE TREMP BASIN (MAASTRICHTIAN, PYRENEES) B. Vila , A.G. Sellés , À. Galobart , J.I. Canudo , J. Marmi and R. Gaete	194
PRELIMINARY REPORT ON THE AMPHIBIANS AND REPTILES FROM THE LOWER PALAEOLITHIC PALAEOANTHROPOLOGICAL SITE OF VISOGLIANO (NE ITALY) A. Villa , G. Boschian , C. Tozzi and M. Delfino	195
CONSERVATION-RESTORATION STRATEGIES IN HARD SEDIMENTS. THE CASE OF A BEAR MANDIBLE FROM THE MIDDLE PLEISTOCENE SITE POSTES CAVE, (EXTREMADURA, SPAIN) M. Villalba , M.C. Ortega , J.L. Arsuaga , H. Collado and J.R. Bello	196
AN ARBOREAL AVIFAUNA FROM THE EARLY–MIDDLE MIOCENE BOUNDARY OF EASTERN SIBERIA N.V. Volkova	197
NEW DATA ON THE TAXONOMIC DIVERSITY OF THE MAASTRICHTIAN MULTITUBERCULATE MAMMALS FROM TRANSYLVANIA BASED ON POSTCRANIAL ELEMENTS M. Vremir , J. Meng , Z. Csiki-Sava , S.L. Brusatte and M.A. Norell	198
GROWTH RATES AND AGE DISTRIBUTION OF DIFFERENT JURASSIC SAUROPOD TAXA- DORSAL RIB HISTOLOGY REVEALS LONGER GROWTH TIMES FOR MACRONARIANS THAN FOR DIPLODOCIDS K. Waskow and P.M. Sander	199
RAPID RADIATION OF LACERTID LIZARDS (SQUAMATA, SCINCOMORPHA) IN THE OLIGOCENE OF FRANCE L.C.M. Wencker , E. Tschopp , A. Villa , J.-C. Rage and M. Delfino	200
THE MOSAIC ACQUISITION OF MARINE ADAPTATIONS IN METRIORHYNCHOID CROCODYLOMORPHS, FURTHER EVIDENCE FROM A NEW LARGE-BODIED SPECIES FROM HUNGARY M.T. Young , A. Ósi , A. Galács and M. Rabi	201
WHERE DO THALATTOSUCHIANS GO IN THE CROCODYLOMORPH TREE? INTRODUCING THE CROCSUPERMATRIX PROJECT M.T. Young , A.K. Hastings , M.B. Andrade , E. Wilberg , T.J. Smith , D. Foffa , M.M. Johnson , Y. Herrera and S.L. Brusatte	202
THE LATE TRIASSIC DINOSAUR LOCALITY FRICK – NEW SAURISCHIA M. Zahner and W. Brinkmann	203
NEOGENE EVOLUTION OF CONTINENTAL ASIAN WATERFOWL COMMUNITIES (AVES, ANATIDAE) N. Zelenkov	204

# PEER COMMUNITY IN PALEONTOLOGY (PCI PALEO): A COMMUNITY-DRIVEN, TRANSPARENT, FREE AND OPEN PLATFORM FOR PEER-REVIEW IN PALEONTOLOGY

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**Keywords:** *academic publishing, peer-review, preprints, open access*

Academic publishing is becoming increasingly costly for institutions, users, and ultimately the taxpayer. This system is undergoing major changes, but the current transition from subscription journals towards an author-pays model (Gold Open Access or Hybrid) is unlikely to significantly reduce the overall cost of publishing.

A faster, more transparent, completely open access, and free publishing system is now possible thanks to modern technologies. This system can be based on preprints, which have successfully been in use for more than 25 years in physics, mathematics, astronomy and computer sciences. Preprints provide a way to freely and rapidly diffuse research results and to promote early feedback from a wider audience, but remain fundamentally non-peer-reviewed.

The Peer Community In (PCI) project calls for the creation of non-profit communities of researchers to peer-review articles available as preprints outside of conventional journals. The first community (PCI Evolutionary Biology) now counts more than 360 scientists. Launched in early 2018, Peer Community in Paleontology is backed up by an international Managing Board and a growing group of recommenders (= editors).

PCI Paleo is completely free and transparent. Submitted preprints are evaluated by an editor and at least two external referees. If the paper is finally accepted, a final version is uploaded online and permanently linked to a recommendation text (written by the editor) and the peer-review reports, which are published by PCI Paleo. Papers recommended by PCI Paleo are therefore transparently peer-reviewed, fully citable (DOI) and Open Access, obviating the need to publish them in conventional journals.

# ORNAMENTATION OF ARTHRODIRAN DERMAL PLATES FROM THE LOWER DEVONIAN OF MOROCCO

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**Keywords:** *Placodermi, dermal bones, sculpture, fish*

Dermal bones are bones formed without cartilage stadium as the body coverage (fish scales, reptile osteoderms) or elements of internal skeleton close to the skin (skulls and pectoral girdles of temnospondyl amphibians). Characteristic of dermal bones is rich ornamentation composed of ridges, tubercule, grooves and pits. Such sculpture is often used as a taxonomic tool (e.g. in Aetosauria, Dipnoi, Actinopterygii) to species level. However, it has not been utilised to the same extent in placoderms.

Fragmentary remains of dermal plates of Early Devonian arthrodiran placoderms from Hamar Laghdad, Morocco were examined, applying optical and scanning electron microscopy, to determine whether it is possible to distinguish armoured Palaeozoic fishes species based on several ornamentation characters. Histological structure of the bones was also considered.

Four distinct morphotypes were differentiated, being different in nodules, base of the nodules diameter, nodules density and other. These distinct ornamentation types may be the result of either different location of dermal plates on the body, ontogenetic (intraspecific), but most probably interspecific variation. Analysis on a larger and more complete data set looks promising.

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## POST-GLACIAL RECOLONIZATION OF EUROPE BY *MICROTUS ARVALIS* - EVIDENCE FROM ANCIENT DNA.

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**Keywords:** *Common vole, mtDNA, post-glacial recolonization, Younger Dryas*

Analyses of ancient DNA have proven to be one of the most effective approaches to investigate evolutionary history of species. So far most of the attention goes to the large mammals while studies of small mammals, remains underrepresented. Here we used ancient DNA to investigate post-glacial recolonization of Europe and in particular the impact of Younger Dryas (YD; ca. 12.7 – 11.5 ka) cooling on common voles' (*Microtus arvalis*) populations. Genetic diversity of the contemporary common voles suggests that populations of this species may have survived cold episodes, like Last Glacial Maximum, not only in traditional Mediterranean glacial refugia, but also at higher latitudes. Central France, Alpine region and especially Carpathians were indicated as a possible northern refugia for this species. Recent studies of Late Pleistocene faunas showed that YD cooling affected populations of many mammalian species leading to extinctions or population replacements. However, analyses of the contemporary genetic diversity were not able to trace any impact of YD on common vole populations.

We analysed mtDNA cytochrome *b* sequences obtained from more than 50 *Microtus arvalis* specimens from multiple paleontological sites across Europe. On one hand we found a discontinuity in Late Glacial and Holocene populations in the Carpathian area while on the other there was continuity in populations from Northern Spain. This suggests different impact of YD on common vole populations across Europe. From the local extinctions and population replacements in some parts to virtually no effects in the others.

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# SYSTEMATIC REASSESSMENT OF THE LATE BARREMIAN FROG *WEALDENBATRACHUS JUCARENSIS* FROM THE IBERIAN RANGES, EASTERN SPAIN

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

The putative costatan *Wealdenbatrachus jucarensis* was erected by Fey in 1988 based on incomplete, disarticulated, and displaced bones preserved in several slabs. The material was collected in the Late Barremian coal-rich clays of the La Huerquina Formation, Uña, Cuenca Province, and is now housed in the Museum für Naturkunde, Berlin, Germany. Previously, a close resemblance to *Eodiscoglossus santonjae* from the Lower Barremian of Spain has been stressed by different authors. Former comparisons with *Eodiscoglossus* have been based on specimens from European fossil sites of different ages although their referrals to genus and/or species level have been recently considered arguable and, thus, calling for a critical systematic revision of *W. jucarensis*. First-hand examinations of the original material described by Fey, as well as several fossils ascribed to *Eodiscoglossus*, allowed us to complete and reinterpret the osteology of these taxa and revise their putative phylogenetic placement. Some bones of *W. jucarensis*, such as atlas and nasals, were newly identified, whereas others, such as frontoparietals, were thoroughly reinterpreted. Our observations also led us to validate this taxon as distinct from *Eodiscoglossus santonjae* and also to reconsider its inaccurate available restoration. It is noteworthy that many of the features that have been used to ally *W. jucarensis* with *Eodiscoglossus* and costatans are plesiomorphic at this phylogenetic level, widely occurring among basal frogs, and contrast sharply with the condition in extant costatans. Although available evidence is not conclusive to determine the systematic affinities of *W. jucarensis*, it points to its exclusion from crown group Costata.

**Acknowledgments:** We thank Florian Witzmann (Humboldt Museum, Berlin) for granting access to the type of *W. jucarensis* under his care and Borja Sanchíz (MNCN, Madrid) for the loan of comparative material.

## VERTEBRATE REMAINS IN THE COPROLITE ASSOCIATION FROM LAS HOYAS FOSSIL SITE

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**Keywords:** *Cretaceous, Iberia, Diet, Fish, Pycnodont*

A remarkably new coprolite association, currently under study, comes from the Barremian (Early Cretaceous) of Las Hoyas in Cuenca, Central Spain. Twelve different morphotypes of coprolites have been distinguished. Most of them show vertebrate inclusions (differing among specimens): Thin lace, straight lace and bump-headed lace morphotypes tend to show higher density of inclusions, whereas others as spiral, circular and some cylinders usually show lower density. The inclusions of the morphotypes with the highest density are easier to identify, probably due to the different digestive process of the producer.

The most complete identifiable vertebrate remain is a partial pycnodont dentition in a 25,6 x 10 mm coprolite. The coprolite is irregular, probably cylindrical in original shape. SEM analyses revealed that pycnodont teeth have suffered from the acid attack of a digestive process as slight pitting on the surface of the teeth (surface etching) and little polished enamel are observed.

There are three tooth rows on the preserved part of the lower jaw (prearticular, possibly only the anterior part). Based on the exposed length of the jaw, it was possible to infer that the preyed pycnodont was around 170 mm (total length). In addition, it is possible to observe ganoid scales and other bony fish remains. In comparison with other coprolites, the scarcity of the inclusions and their good preservation (even after a digestive process) is exceptional, and it allows the taxonomic assessment of the prey inclusions.

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# THE FIRST DINOSAURIAN BRAINCASE FROM THE MIDDLE EAST: AN ENIGMATIC ORNITHOPOD BRAINCASE FROM THE LATEST CRETACEOUS (MAASTRICHTIAN) AL-KHOD FORMATION OF THE SULTANATE OF OMAN

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**Keywords:** *Ornithopoda, Gondwana, Endocast, Oman, Maastrichtian*

The Arabian fossil potential had been largely unexplored until the last two decades. Although its fossil record has improved considerably in terms of quantity, it still largely consists of poorly preserved undiagnostic material. Here we describe a newly discovered enigmatic ornithopod braincase from the Al-Khod Conglomerate Formation of Oman. This formation fills an important spatio-temporal gap, given its position in between Africa and Eurasia, its long palaeogeographic relationship with Africa and being latest Cretaceous (post-Cenomanian) in age. It has produced one of the most taxonomically diverse latest Cretaceous faunas for any Gondwanan landmass and a significant portion of all dinosaur records from the Arabian Peninsula. The braincase is assigned to Ornithopoda on the basis of: a U-shaped occipital condyle, the dorsoventral proportions of the posterior braincase and the angle of the exoccipital-supraoccipital contact. Unlike typical ornithopods it displays short and laterally restricted basiptyergoids, prominent basal tuberi and a narrow dorsal skull margin. Endocranial features including a very narrow and steep median ridge, the inner ear morphology and the hypoglossal arrangement are more typical of ornithopods. A unique combination of features, most notably: the separate canal for the ophthalmic branch of the trigeminal nerve (CN V), the large fossa above the cerebral carotid foramen, and an almost total absence of a floccular recess, justify an identification as a non-hadrosaurid ornithopod. The presence of various (generally small-sized) ornithopod lineages combined with peculiar morphologies in the Al-Khod vertebrate fauna paradoxically hints at periodic isolation and potentially trans-Tethys faunal connectivity between Afro-Arabia and Eurasia.

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## GRAČANICA (BOSNIA AND HERZEGOVINA) AND GRATKORN (AUSTRIA): NEW MIDDLE MIOCENE CARNIVOROUS GUILDS

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**Keywords:** *Carnivora, Middle Miocene, Gračanica, Gratkorn, Europe*

Not much is known about the Central European carnivoran fauna from the Middle Miocene. In most sites, like Göriach or Sandelzhausen, remains of carnivores are scarce. In here, we compare the carnivoran faunas of the new sites Gračanica (MN5, Bosnia and Herzegovina) and Gratkorn (MN7/8, Austria) with those from Prebreza (MN6, Serbia) and Göriach (MN5, Austria) with the aim to receive more information on grade of similarity of the carnivore faunas in the area of Central to South-Eastern Europe.

The site of Gračanica yields material of the caniform families Amphicyonidae (*Amphicyon giganteus*), Ursidae (*Hemicyon goeriachensis*, *Ursavus brevirohinus*), Mustelidae (indet.) and the feliform family Percrocutidae (*Percrocuta miocenica*).

The site of Gratkorn comprises of the taxa of Babourofelidae (*Albanosmilus*), Mustelidae (*Paralutra*, *Ischyriactis*) as well as Hyaenidae (*Protictitherium* sp.).

Carnivorans from Göriach belong to the families Amphicyonidae, Hemicyonidae, Ursidae, Mustelidae and Felidae but the species assignment needs re-evaluation. The following Carnivora are known from Prebreza: *Percrocuta miocenica* and a large amphicyonid (*Agnotherium*).

The Carnivora described let infer the presence of a diverse community covering the dietary niches from omnivore to hypercarnivore. Similarities between the discussed Middle Miocene sites are the occurrence of *Amphicyon*, *Hemicyon* and *Paralutra*/small mustelid. Differences exist in the occurrence of Felidae (present in Gratkorn; lacking of Felidae in Gračanica) and Percrocutidae (present in Gračanica; missing in the Styrian basin). The carnivoran fauna of Sandelzhausen (Molasse basin Bavaria, Germany) is more diverse, but mirrors the results from Gratkorn and Göriach (presence of felids, but no percrocutids).

## A WALK IN THE MAZE: DISCRIMINATING SMALL TRIDACTYL TRACKS FROM THE LATE JURASSIC OF JURA (NW SWITZERLAND)

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**Keywords:** *Dinosaur ichnology, theropods, 3d models, Kimmeridgian, Switzerland*

Minute (PL<10cm) to medium sized (FL<30cm) tridactyl tracks are the most common in the Kimmeridgian (Late Jurassic) ichnoassociation excavated along the Highway A16 tracksites in the Swiss Jura Mountains. We present here the result of the study of the tracks collected during the excavations (n=93), analyzed through the use of 3D models and false-colour depth maps. Two morphotypes, a gracile and a robust, were identified: the first is characterized by a high FL/FW ratio, high mesaxony, low divarication angles, clear claw marks and a 2-3-4 phalangeal formula; the second type has a lower FL/FW ratio, slightly wider divarication angle, and, when preserved, sharp claw mark.

The analyses show that there is a morphological gap between the two morphotypes, therefore they cannot be a consequence of extramorphological variation of the tracks made by differently-sized track-makers of the same species. The comparison with the larger morphotypes of the ichnocoenosis (e.g., *Megalosauripus transjuranicus* and *Jurabrontes curtedulensis*) also shows no strong relationship. The morphometric data of some specimens of the robust morphotype suggest that the tracks attributed to the robust morphotype may represent more than one ichnotaxon. The features of the gracile morphotype are typical of "grallatorid" ichnotaxa characterized by a low mesaxony and it is classified as cf. *Kalohipus*, whereas the robust morphotype is reminiscent of *Therangospodus pandemicus*.

## NEW SKELETONS OF THE MESOZOIC ORNITHURINE ICHTHYORNIS

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**Keywords:** *Aves, fossil bird, Mesozoic, Computed tomography*

The Late Cretaceous toothed bird *Ichthyornis dispar* was one of the first known Mesozoic avialans, and is recognized today as one of the closest relatives of crown birds among Mesozoic stem birds. As such, the skeletal morphology of *Ichthyornis* may be more representative of the ancestral condition of crown birds than that of any other known Mesozoic avialan, and its study has crucial implications for understanding the origins and early evolution of crown birds.

Previous work on *Ichthyornis* has largely been based on limited fossil material discovered over a century ago. Here we present high resolution scans of new, exquisitely preserved three-dimensional specimens of *Ichthyornis* from the Late Cretaceous of Kansas, focusing on the pectoral girdle and wing elements. The new specimens are more complete and in better condition than the classic material, and include some previously unrepresented elements, as well as better preserved examples of several bones. The novel morphology preserved comprises most of the posterior sternal region, including robust caudolateral processes and relatively developed sternal incisures, very large and recurved acrocoracoid and procoracoid processes, and a robust, pointed and hook-shaped acromion process in the scapula, which differs from previously referred specimens. This last character is of singular importance, as it represents one of the autapomorphies of *Ichthyornis dispar*. Carpal and hand elements are well preserved as well, including the first known radiale from this taxon.

Ongoing work in these and other new *Ichthyornis* specimens will shed new light on proximal-most part of the stem-bird phylogenetic tree.

## REFUGIA INSIDE A REFUGIUM: SMALL MAMMALS FROM THE ITALIAN PENINSULA DURING THE LATE PLEISTOCENE

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**Keywords:** *Late Pleistocene, small mammals, paleoenvironment, paleoclimate, refuge areas*

During the Quaternary the Italian Peninsula has acted as one of the Mediterranean refugia together with the Iberian and Balkan Peninsulas. Recent studies on Late Pleistocene small mammals from this area contribute to understand modes and times of species range evolution and to identify micro refugia.

Starting from the late Middle Pleistocene, in the Italian Peninsula two great areas acted differently as refuge areas. The Northern Adriatic region (including the Prealps and the Po Plain) was suitable, especially during stadials, for Eastern European species such as *Microtus oeconomus*, *Dinaromys bogdanovi*, *Sicista* ssp., and *Microtus gregalis*; the Southern Italy, instead, can be considered a refugium for species adapted to temperate climate and as an endemism area. In this region Apennines functioned as a barrier that strongly influenced the species distribution with two different sub-areas that can be observed: the Southern Tyrrhenian region, suitable for glirids and forest-related species (i.e. *Glis glis*, *Apodemus* gr. *sylvaticus-flavicollis*, *Clethrionomys glareolus*) and the Southern Adriatic region (southern Abruzzo and Apulia) where species adapted to arid or Mediterranean conditions are always dominant (*Microtus arvalis* and the endemic *Microtus (Terricola) savii*).

These refuge areas changed after the Bölling-Alleröd Interstadial with a contraction of “cold” climate species distribution (disappearance of Eastern Europe species and reduction of *M. arvalis* range) together with an expansion of forest-related species.



**CALIBRATING PLEISTOCENE AND HOLOCENE PALEOENVIRONMENTAL  
RECONSTRUCTIONS USING AN ACTUALISTIC HERPETOLOGICAL APPROACH: THE  
CASE OF ATAPUERCA (BURGOS, SPAIN)**

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**Keywords:** *Amphibians, Reptiles, Paleoenvironment, Actualism, Quaternary.*

Paleoenvironmental quantitative reconstruction (habitat weighting and habitat optimum methods) using the small-vertebrate fossil record allowed an approximation to the former landscapes of the Sierra de Atapuerca (Burgos, Spain) over the last 1,2 million years. However, even if some of the represented species have modern representatives, we know that there may be significant differences in the environmental preferences of the taxa used for such analyses, owing to the geographical location and regional orography, having in mind that species may evolve in its ecological preferences.

In order to appreciate how such probable regional variations may affect paleoenvironmental reconstructions, an extensive prospecting was carried out in June 2017, in some 72 UTM 10x10km grids in the northern half of the province of Burgos (Spain), including the Atapuerca area. Selected area includes the succession of regional environments, from continental Mediterranean to Cantabrian and Montane, and with an altitudinal range comprised between 180 and 1.700 meters above sea level.

A total of 8298 individual records of 30 species of herpetofauna were obtained. A tendency towards the concurrence of four different associations was observed in accordance with environmental and climatic variables. From a paleobiogeographic point of view, the recoil of some temperate species (like *Rana temporaria* and *Vipera aspis*) towards the north is confirmed. These species were present up to the most recent Holocene levels of the Atapuerca sequence. Such actualistic approach would help to better understand both the current and past herpetofaunal successions, in the frame of the Quaternary environmental and biogeographical changes.

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# AMPHIBIANS AND SQUAMATE REPTILES FROM THE LATEST PLEISTOCENE OF THE CAVERNE MARIE-JEANNE (HASTIÈRE-LAUAUX, NAMUR) AND A REVIEW OF THE QUATERNARY HERPETOFAUNA FROM BELGIUM

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**Keywords:** *Herpetofauna, Late Pleistocene, Paleoenvironment, Paleoclimate, North-western Europe*

Archaeological sites usually provide important information about the past distribution of the small vertebrate fauna, when archaeologists have taken care to recover such tiny remains. Behind the biological information about the occurrence of some taxa currently absent from a territory (because of climate change and/or habitat destruction), such data are also useful for archaeologists as, by comparison with their present distribution, small vertebrates are much better than large mammals at reconstruction of past environments and climate in which human activities took place. Within small vertebrate fauna, amphibians and reptiles, because of their precise climatic and environmental requirements, are good proxies for such reconstructions.

In this context, Belgium has an interesting location in North-western Europe between the fully studied zooarchaeological record of Germany and England, and also because only a very few sites have delivered Late Pleistocene amphibians and reptiles in Northern France. We present here the revision of the collection of the Caverne Marie-Jeanne, by far the largest collection at RBINS with more than 20.500 recognized bones of amphibians and reptiles. We also present the first study of the herpetofauna from Cavernes de Goyet (Gesves), Trou du Chêne (Montaigle), Trou de Praules (Furfooz), Trou du Frontal (Furfooz), Trou de Praules (Furfooz), Trou des Blaireaux (Walsin), Caverne de Freyr (Hastièrre), Trou Balleux (Walsin), Trou de Pont-à-Lesse (Dinant), Reuviau (Furfooz), Trou des Nutons (Furfooz) and Trou de la Naulette (Walsin), recently localized within the RBINS collections and covering the last 60.000 years.

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# THE ARCHOSAURIAN ASSEMBLAGE FROM THE BASTURS POBLE BONEBED (LATE CRETACEOUS, SPAIN): AN UPDATE

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**Keywords:** *Hadrosauroidea, Dinosauria, Eusuchia, Sebecosuchia, Tremp Formation*

The Basturs Poble site (Tremp basin, Spain) probably represents the largest hadrosaurian bonebed in southwestern Europe. This site is placed on the middle of the 'lower red' unit (upper lower Maastrichtian) of the Tremp Formation, equivalent to the Casa Fabà site – the type locality of *Allodaposuchus hulki*. The vertebrate fossil remains found at Basturs Poble consist of hundreds of isolated bones of several archosaurian taxa, showing important abrasion marks, breaking and transport evidences.

The hadrosaur sample recovered from Basturs Poble has been considered as belonging to a single monospecific population by preliminary studies. However, this hypothesis is poorly supported due to the lack of articulated specimens, the poor preservation of the fossils, and the predominance of undiagnostic bones (e.g., femurs, tibiae). Recently, the most informative bones of the sample – the dentaries – were distinguished into two morphotypes, regarded as a non-hadrosaurid hadrosauroid and an indeterminate lambeosaurine. Even though, the absence of additional diagnostic (cranial) remains totally prevents the taxonomic classification at generic or specific level.

The crocodilian fauna is currently under study. Three taxa were identified amongst the bone sample: one sebecosuchian, one small- and one large-sized eusuchians. These taxa are represented by isolated teeth, mandibular, axial and appendicular elements. Of special interest are one maxilla and one dentary which could be referred to *Allodaposuchus*. However, some features cannot be associated to any known mandibular allodaposuchian remain.

The new evidences of Basturs Poble give support to a multi-taxic bonebed, with two different hadrosaurs and three crocodyliforms co-occurring at this site.

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# ASSESSING THE CROCODYLOMORPH DIVERSITY IN THE MAASTRICHTIAN (LATE CRETACEOUS) OF IBERO-ARMORICA, BASED ON TOOTH QUALITATIVE TRAITS

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**Keywords:** *Eusuchia*, *Sebecosuchia*, *Gavialoidea*, *dentition*, *palaeoecology*

During the last years many palaeontological efforts have been focused on the microvertebrate fossil record from the Maastrichtian (Late Cretaceous) of the southern Pyrenees (northeastern Spain), assessing the diversity and the palaeoecology of the non-dinosaurian fauna. Fifteen localities ranging from the lower to the end of the Maastrichtian were sampled along the different geological units of the Trespalud Formation, reaching a total amount of 9825 Kg of sediment. Isolated crocodylomorph teeth are, by far, one of the most frequently recovered elements after the screen-washing of microvertebrate samples. A preliminary study of these teeth allowed the identification of 15 different morphotypes that might represent, at least, 9 different taxa including one sebecosuchian, cf. *Theriosuchus* sp., ?*Acynodon* sp., three allodaposuchids, one gavialoid, and other two indeterminate mesoeucrocodylians.

Such crocodylomorph diversity could be explained in terms of different ecological niches. The Pyrenean faunal assemblage contains large and small freshwater semiaquatic taxa, but also fully-terrestrial cursorials and marine species, associated to a variety of palaeoenvironments including transitional to freshwater wetlands and fluvial settings. Besides variation in the dental series, the tooth shape also reflects specialization into different trophic guilds. This crocodylomorph assemblage is composed of generalist semiaquatic predators, cursorial carnivores, piscivores, durophagous malacophages and probable entomophages. The further study of these dental remains will help us to obtain a more complete picture of the small- and medium sized secondary-consumers from Ibero-Armorica during the last six millions of years before the Cretaceous-Paleogene (K/Pg) biotic crisis.

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# PALAEOECOLOGY OF THE FISH ASSEMBLAGE FROM PONTILS (MIDDLE EOCENE, EBRO BASIN, NE SPAIN)

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**Keywords:** *Palaeoichthyology, chondrichthyans, actinopterygians, palaeoecology*

The fossil site of Pontils (Middle Eocene, Ebro Basin, NE Spain) was discovered in the 1980s, after the finding of scarce rodent remains along several levels of this locality. It is composed by a sequence of limestones, marls and lignites representing a transitional continental-to-marine environment. The lowest levels of the sequence of Pontils have yielded relatively abundant continental vertebrate remains (mainly rodents, primates, crocodilians and squamates). In contrast, the uppermost levels record a change from continental to marine conditions. In PO-39 scarce marine fish teeth are identified together with terrestrial mammals, whereas in PO-40, on the top of the sequence, fish remains are associated with abundant marine invertebrate shells.

The ichthyofaunal assemblage is composed of marine chondrichthyans (at least two sharks and three batoids) and saltwater or euryhaline actinopterygians (phyllodontids and pycnodontiforms). Although a further taxonomic study might reveal the presence of additional taxa, the predominance of batoids amongst the identified fish assemblage point to a shallow coastal ecosystem. The abundance of active swimmers (sharks and phyllodontids) might also suggest a connection with open sea waters. From an ecomorphological viewpoint, the fish assemblage includes benthonic durophages, pelagic durophages, and active predators. The fish assemblage from Pontils does not include representatives of all the trophic guilds. The absence of microphagous and filter feeder taxa can be explained by a taphonomic bias.

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## CLETHRIONOMYINI FROM THE QUATERNARY DEPOSITS OF TETYUKHINSKAYA CAVE (FAR EAST, RUSSIA)

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**Keywords:** *taphonomy, molars, voles, Late Pleistocene, Holocene*

Possibilities of using the remains of Clethrionomyini for paleoecological and taphonomic analyses of the Quaternary micromammal assemblages are considered and illustrated by the examination of the Late Pleistocene-Holocene deposits in Tetyukhinskaya Cave (Middle Sikhote-Alin, 44° 35'N, 135° 36'E). The occurrence of micromammal remains in the deposits owes to small mustelids (sable, Siberian weasel) and badgers that regularly accessed the cave, and also to eagle-owl pellets. Among micromammals, *Craseomys rufocanus* and *Clethrionomys rutilus* are the most numerous. These species are the only representatives of Clethrionomyini in modern fauna of the Sikhote-Alin, where the former prefers mixed broadleaved and Korean pine - broadleaved forests and the latter prefers fir and spruce forests. Throughout the entire depth of the cave filling, the remains of small mammals have different colors from very light to practically black. Bone color depends primarily on host sediments and on the length of time that bones have been deposited. The presence of different color groups among micromammal remains may serve as a marker of assemblage heterogeneity. Vole teeth are graded by their colors and the ratio of different color groups is analyzed as a function of depth (according to conditional horizons of 10 cm). In all groups, *C. rufocanus* predominates over *C. rutilus* that may be indicative of both stable proportions of their preferred habitats in the nearby landscape during the Pleistocene-Holocene, and the factors of the accumulation of the remains of these species in the sediments.

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## NEW DATA ON THE MIDDLE PLEISTOCENE MICROMAMMAL FAUNAS OF THE NORTH OF WESTERN SIBERIA

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**Keywords:** *Quaternary small vertebrates, micromammals, paleoecology, terrestrial environment*

The Quaternary fossil record of small mammals in the north of the West Siberia is scarce, and the high latitudes remain less studied. The diagonal sands exposed in lower reaches of the Ob' River near Khashgort (65°30'N 65°40'E) represent the richest known source of information on the Middle Pleistocene fauna of small mammals in the high latitudes of the West Siberia. Since the first assemblage was uncovered in 1981, the two more have been excavated in 2016-2017. The assemblages exhibit good states of bone preservation, and the taxonomic compositions are nearly identical (*Lemmus sibiricus* - 54-63%, *Dicrostonyx* cf. *simplicior* – 32-40%, genus *Microtus* – 4-6%). According to the evolutionary level of *Dicrostonyx*, the age of the fauna has been estimated as the Middle Pleistocene. The combinations of M2 and m3 morphotypes are typical for the most advanced stage of *D. simplicior* suggesting the late Middle Pleistocene age. Scarce remains of *Microtus* include *M. gregalis*, *M. middendorffii*, and a molar of *M. oeconomus* (the northernmost record for the latter species in the Pleistocene of the West Siberia). According to the ecological preferences of the species, the fauna characterizes tundra-like environments with abundant mosses, shrubs, and subordinate grasses. A comparison with localities known for the north of the West Siberia suggests that during the late Middle Pleistocene, the tundra-like landscapes were spread over a wide area. Small mammals inhabiting those areas included the ancestors of all species known for the present-day tundra zone of the Eurasian Arctic.

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# PTEROSAUR TRACKS AND PHOTOGRAMMETRIC ICHNOLOGY: NEW VISUALIZATIONS OF THE THREE-DIMENSIONAL, TERRESTRIAL WORLD OF THE “DRAGON REPTILES”

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**Keywords:** pterosaur tracks, photogrammetric ichnology, *Pteraichnus*, 3D visualization, terrestrial locomotion

For nearly 170 years following the discovery of the first pterosaur fossils in Germany’s Solnhofen Limestone, the understanding of pterosaur terrestrial locomotion was based primarily on misidentifications and skeletal anatomy research. This changed in 1952, when geologist William Lee Stokes discovered an enigmatic trackway in the Saltwash Member of the Upper Jurassic Morrison Formation in northeastern Arizona. The footprints (preserved on a fluvial sandbar) were collected, documented, and compared with known fossil tracks at the time. In a dramatic interpretation, Stokes suggested that these “dragon reptile” tracks were new to science (establishing the ichnotaxon *Pteraichnus saltwashensis*) and were the first direct evidence of pterosaurs walking on land, as well as being only the second pterodactyl fossils from the Jurassic of the Western Hemisphere. Since this discovery, thousands of similar traces have been found on nearly every continent, yet Stokes’ fossil and description of the 9 consecutive pairs of tridactyl manus and tetradactyl pes prints have remained the “gold standard” for all pterosaur track studies. Reexamination of the surprisingly understudied ichnolotype with state-of-the-art, photogrammetric documentation techniques, allows for the subtle details of pterodactyloid locomotion (with an erect, quadrupedal, parasagittal gait) and ichnotaxonomy to be teased out of this unique ichnite. Close-range photogrammetric studies assist in the 3D visualization and quantification of pterosaur track morphology. Thus, supporting an objective understanding of ichnological variations, as well as the recordation of novel ichnites which reflect the kinetics of movements and activities, and provide valuable insights into pterosaur ichnotaxonomy, diversity, behaviors, trackmaker identity, and paleoecology.



# HISTORIC DISCOVERIES OF THE FIRST SAUROPODS FOUND IN THE “WILD WEST” OF WYOMING: FOUNDATIONAL RESEARCH ON COLOSSAL ANIMALS OF WORLD RENOWN

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**Keywords:** Wyoming, William Harlow Reed, Brontosaurus, Como Bluff, Diplodocus carnegii

With the construction of the transcontinental railroad, a veritable cornucopia of palaeontological resources in America's Wild West became accessible to researchers for the first time. In 1877, railroad worker William Harlow Reed's accidental encounter with “Tertiary Period *Megatherium*” remains (actually *Camarasaurus grandis*) at Como Bluff would be the first of many important discoveries of sauropod bones from southeastern Wyoming. Two years later, Reed would make a spectacular discovery of one of the largest dinosaurs known at the time, *Brontosaurus excelsus* (*Apatosaurus excelsus*). Described by O. C. Marsh, this dinosaur gained world acclaim, resulting in *Brontosaurus* becoming one of the world's best known dinosaurs. Discoveries in this region changed the scientific and public view of dinosaurs forever and inspired paleontologists worldwide. For the first time, nearly complete skeletons of sauropods were being uncovered and shipped off for display in museums around the country. Yet another discovery by Reed would also gain international notoriety. Nicknamed *Brontosaurus giganteus*, this animal was touted as the most “colossal” animal to ever walk the earth. Although this specimen and its story were highly exaggerated, this yellow journalism did result in the discovery of a new species of *Diplodocus* (*D. carnegii*). “Dippy” (as the specimen became known) was assembled, molded, casted, and distributed to museums around the world; making it arguably the most widely-seen dinosaur ever found. These sauropods, and others from the Frontier West, placed dinosaurs forever in the public consciousness, and established Wyoming as the “greatest burial ground of extinct monsters in the world.”

# RECOGNITION OF CROCODYLIFORM SPECIES IN THE FOSSIL RECORD: CHALLENGES AND OPPORTUNITIES FROM MODERN CRYPTIC SPECIES

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**Keywords:** *Crocodylia*, *Crocodylus*, *Mecistops*, *Species*, *Morphology*

Crocodylian systematists face several phylogenetic challenges, such as the gharial problem (with related issues surrounding thoracosaur relationships, tree rooting, and character independence) and identification of the most appropriate crocodylian outgroup, but the most profound arises from the discovery that many living crocodylian species are cryptic species complexes. Regardless of the species concept adopted, systematists work with operational species (smallest diagnosable units) that approximate actual species diversity. This approximation will always be imperfect, and the fossil record both underestimates and overestimates extinct diversity. Behavior, soft-tissue features, and molecular markers are usually unavailable, limiting our ability to delineate operational species within a time horizon, but discontinuous sampling of a single evolving lineage over time cannot be distinguished from sampling different closely related lineages. That the actual number of living crocodylian species may approach 40 has profound implications for our understanding of the crocodylian fossil record. It forces a wholesale reconsideration of ranges of morphological variation, which in turn will require a different approach toward morphological species delineation. Minor, but consistent, differences between samples that might previously have been regarded as species-level variation might instead indicate the presence of multiple species. But it also means we may no longer be able to refer fossil or subfossil specimens to the species level. Examples of this challenge can be found throughout the Late Cretaceous and Cenozoic.

## THERAPSID SCRATCHES FROM THE MIDDLE TO LATE PERMIAN OF NORTHERN GERMANY AND THE EVOLUTION OF TETRAPOD SCRABBLING BEHAVIOR

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**Keywords:** *Permian, ichnology, burrow, Cynodontia, Southern Permian Basin*

An assemblage of continental trace fossils has recently been found within Permian sedimentary rocks outcropping at Mammendorf quarry in the Flechtingen High area of Saxony-Anhalt, northern Germany. It includes different types of tetrapod tracks, scratches and invertebrate burrows preserved on thin mud-crack-bearing siltstone laminae within red and grey-white sandstones and conglomerates. Tetrapod tracks sized between 1.5 to 14 cm in length have been referred to therapsid and parareptilian trackmakers and agree with a Middle to Late Permian age of this assemblage. Apart from invertebrate burrows the most abundant type of traces are tetrapod scratches which form about 13 to 28 cm wide curved or rail-like structures composed of consecutive overlapping left- and right groups of (five) parallel elongate marks, preserved as concave epirelief or convex hyporelief. We consider these scratches as the product of a certain probing or search behaviour which could be termed “scrabbling” to emphasize their difference to scratches produced by the dragging of hands or feet in the course of locomotion. The scrabbling traces from Mammendorf show some similarity to previously described traces, especially (a) to supposed tetrapod scratches and shallow burrows from the Early Permian Bromacker locality (Central Germany) although detailed studies are needed for their correct interpretation and (b) to the wall structure of certain cynodont burrows from Late Permian to Middle Triassic South African localities. Footprints found on the same bedding plane that are comparable to a derived therapsid track type (*Dicynodontipus*) suggest that the conspicuous Mammendorf scratches were made by therapsid producers.

## STUDY OF THE LOWER DENTITION OF THE CAMELID *PARACAMELUS AGUIRREI* FROM VENTA DEL MORO (VALENCIA, SPAIN)

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**Keywords:** *Venta del Moro, Late Miocene, Paracamelus, Camelidae, Spain.*

Venta del Moro is a classical locality from late Turolian (or Ventian) (MN13, Late Miocene). This site is the type locality of the camelid *Paracamelus aguirrei* Morales, 1984, which was defined by its upper dentition. This genus is the only camelid present in Europe during the Mio-Pliocene and it rapidly expanded through all Eurasia from North America.

The main aim of this study is the description for the first time of the lower dentition of *P. aguirrei*, with the finality to obtain a better characterization of this species. Regarding the morphology, the i2 has a subelliptical shape while the i1 is quite straight and the i3 has more lobular shape. The isolated canines and the first premolar are similar so we have considered them as the same category denominated "caniniforms". The third and fourth premolars are very different between them, being the latest one more robust and big. The first and second molars can only be differentiated by the size; while the m3 presents a characteristic third smaller lobe.

In comparison with the extant genus *Camelus*, the fossil species shows a smaller reduction of the premolar series, preserves the p3 and have a better-developed p4. Moreover, the shape of the p4 of *P. aguirrei* presents an elongated parastilid and it lacks a metaconid while the p4 of *Camelus dromedarius* shows a shortened parastilid and in some specimens the metaconid is preserved. Furthermore the dentition of *P. aguirrei* is more robust and it has bigger dimensions than *C. dromedarius*.

# A TENTATIVE ASSESSMENT OF THE PHYLOGENETIC RELATIONSHIPS OF PYRENASAURUS (SQUAMATA)

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**Keywords:** *Squamata, Scincidae, late Eocene, osteology, phylogenetic analysis*

The extinct squamate *Pyrenasaurus evansae*, from the late Eocene of France and Spain, is considered a scincomorph with possible scincid affinities. In order to preliminary test its relationships, *Pyrenasaurus* is here included for the first time in a phylogenetic analysis as part of a broader study focused on the phylogeny of extant European scincids and their relationships with extinct forms.

The matrix, comprising a total of 148 cranial and postcranial characters, was created with Mesquite and analyzed with TNT, and it includes seven taxa of extant European scincids, the extinct *Pyrenasaurus* and an outgroup. All the specimens for each taxon were included in the matrix as distinct OTUs (operational taxonomic units), for a total of 12 OTUs. In the case of *Pyrenasaurus*, only the characters regarding the dentary could be scored. The preliminary analysis yielded a consensus tree in which *Pyrenasaurus* is part of a polytomy with all other OTUs but *Eumeces schneideri* and the outgroup. The application of the implied weighting tool resolved the polytomy, recovering *Pyrenasaurus* as the sister taxon to *Ophiomorus punctatissimus*. Of the four “K” values (K=5, K=10, K=50, K=100) used for the implied weighting analyses, only K=5 was able to resolve the polytomy.

The character that distinguishes *O. punctatissimus* and *P. evansae* from other European scincids is the elevation of the coronoid process of the dentary. This character is not shared by any other scincid included in this analysis. Further analyses, including a broader sample of taxa, will be needed to confirm this relationship.

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# THE FIRST RECORD OF PLACODONTS IN PORTUGAL AND ITS CHRONOLOGICAL AND PALEOECOLOGICAL IMPLICATIONS

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**Keywords:** *Penina, Late Triassic, placodont, osteoderm, Grés de Silves*

The base unit of the mesozoic sequence of the Algarve Basin in Portugal, standing over an unconformity, was first defined in 1850 by Charles Bonnet, who attributed it to the Triassic period. In 1887 it was named “Grés de Silves” by Paul Choffat. Since then the dating of the units that comprise it has been oscillating or not very precise, varying from the Lower Triassic to the Lower Jurassic, depending on the authors. In 2015 *Metoposaurus algarvensis* was described, a temnospondyl of the municipality of Loulé, coming from an almost monospecific bonebed with hundreds of bones. The distribution of the genus indicates a late Carnian age to the middle of the Norian for these layers (top of the term AB2) in the Grés de Silves Formation, where the fossil site was found. In the 2016 and 2017 expeditions, new fossil sites and more vertebrate material from the Algarve Triassic were discovered, namely the first record of placodonts in Portugal, based on osteoderms with an hexagonal and laterally elongated outline which have similarities with the genus *Henodus*. The genus *Henodus* is known from Lustnau Gipskeuper near Tübingen, of the Grabfeld Formation, Germany, from the lower Carnian, which suggests that the portuguese occurrences in units AA and AB2 are of the same age. This means that almost all the Grés de Silves is Carnian in age. The study of these fossils is a contribution to the knowledge of the geological heritage and palaeontological wealth of Algarve, namely the municipality of Loulé.

## PHYLOGENETIC SIGNAL OF MOLAR OUTLINES OF TWO RODENT GENERA (CRICETODON AND HISPANOMYS)

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**Keywords:** *rodents, geometric morphometrics, phylogeny*

*Cricetodon* and *Hispanomys* are two extinct genera of rodents belonging to the Tribe Cricetodontini (Rodentia, Mammalia). The first record of *Cricetodon* is dated on the Early Miocene of Anatolia while the first record of *Hispanomys* has been found in the Middle Miocene of South-Western Europe.

The outline of the upper first molar (M1) of these genera has revealed as a criterion to distinguish both genera. In this work, we evaluated the phylogenetic signal of the shape changes in the M1 outline of different species, in order to determine if the outline morphology is related to phylogenetic constraints or should be linked to environmental variables. Therefore, we collected morphometric and phylogenetic information for seventeen species. For that we used the outline analysis and Phylosig function included in Phytool R's package to quantify the phylogenetic signal and the disparity. The obtained results show that the relation between the components used to quantify the outline morphology and the phylogenetically close species is not obvious. The evaluation of disparity shows that this tends to be distributed within subclades instead of between clades.

To conclude, the main variations on outline shape may not be explained only by the phylogenetic relationship of the species; we observe that some species which have a similar morphology are away from each other in the phylogeny.

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## COMPLETENESS OF THE TEMNOSPONDYL AMPHIBIAN FOSSIL RECORD

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**Keywords:** *completeness, temnospondyl, record, character, skeletal*

Changes in fossil specimen completeness can alter the amount of observable character states per species, and therefore affect macroevolutionary interpretations. The quality of the tetrapod fossil record has previously been quantified as the proportion of phylogenetic characters that can be scored for an individual species. Here, we calculate this character completeness metric (CCM) for temnospondyl amphibians, a highly successful group of early tetrapods that first appeared in the Carboniferous, rapidly diversified after the Permian-Triassic extinction, and even survived into the mid-Cretaceous.

Results reveal temnospondyl character completeness is the highest of any previously studied tetrapod group, but has a similar range in values to Anomodontia. They have consistently very high mean completeness (~60-95%), with little fluctuation through time, apart from relative peaks in mid-late Mississippian and Ladinian, and lows in the Bashkirian and Capitanian. Completeness does not correlate with changes in taxonomic richness through time, which suggests that it is unlikely to be limiting our understanding of temnospondyl macroevolution.

The skull and mandible constitute 72.5% of all phylogenetic characters assigned to temnospondyls. Calculating how completely known the individual characters are through time, by an alternate implementation of CCM, shows that the mean completeness of the postcranial elements significantly diverge from the cranial. Currently we are aiming to quantify the skeletal completeness of individual specimens and the preservation potential of different skeletal elements. We will compare these to the CCM results using various statistical methods to attempt to explain the high quality of the temnospondyl record and uncover any potential bias.



# JURASSIC RACE: A COLLABORATIVE PEDAGOGICAL ACTIVITY BETWEEN PALEONTOLOGISTS, MATHEMATICS AND SCIENCE EDUCATION TEACHERS

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**Keywords:** *collaborative work, dinosaur trackways, Paleontology, teacher education*

Collaboration between scientists and educators is crucial to didactical transposition and dissemination of scientific knowledge. Profiting the appeal of dinosaurs in students to the benefit of teaching science and mathematics, we present the activity “Jurassic Race” and the collaborative work between a paleontologist, a mathematics teacher and a science education teacher, developed within a context of teacher education. The work was organized according to an inquiry strategy and the 6E teaching model.

The activity started with an engage moment, in which students participated in a fieldwork in Lourinhã, followed by a visit to Museu da Lourinhã and/or Dino-Parque Lourinhã. Afterwards, in an explain moment, attended to a conference given by a paleontologist. Having as a background the study of methods used by paleontologists in reconstruction of history of life on earth, students were placed before a simulated theropod trackway recreated in school yard. The question raised was: How fast did the dinosaur move? In an explore moment, students had to collect and exchange data of bipedal biodynamics, discuss ideas, construct and use mathematical models to answer the problem, such as Alexander's formula to estimate height to the hip and running velocity in bipedal dinosaurs based in tracks measurements. In an elaborate moment, students visited the theropods trackway in Vale de Meios, from the Middle Jurassic, and collected evidence of theropod foot structure and locomotion. This successful educational collaboration between a paleontologist and science educators led to the development, testing and publication of a teacher's guide of the activity.

## INDIAN TREMATOSAURID AMPHIBIANS: A TALE OF TWO FORMS

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**Keywords:** *Temnospondyl, Trematosaurid, Lonchorhynchinae, Morphospace, India*

Trematosauridae is a diverse family of temnospondyli but no detailed study of the Indian trematosaurids are available till date. Indian trematosaurids, mostly represented by fragmentary materials are recovered from Early Triassic Panchet Formation and Middle Triassic Denwa Formation. These fragments pose difficulty in establishing osteological details. However, these fragments could potentially add new information to the study of the trematosaurids. Therefore, shape analysis of those trematosaur fragments from India has been attempted. Two partly complete jaws and three best preserved fragments of the skulls from the Panchet Formation were studied. The Indian trematosaurids have external nares halfway between snout tip and orbits, long suture between the premaxillaries, presence of lacrimal, anteriorly directed pre-maxilla-nasal suture, presence of a pre-narial growth zone, posteriorly widened and knife edged cultriform process of the parasphenoid, palatine fangs only little larger than marginal teeth, presence of sensory sulcus in mandible and elongated meckelian foramen. These are all synapomorphies of the lonchorhynchine trematosaurids. Morphospace generated from the reconstructed skull outlines of Panchet fragments suggest the presence of two lonchorhynchine genera, *Aphaneramma* and *Wantzosaurus* from India. The first resembles *Aphaneramma givaliamis* and the other is positioned between *Wantzosaurus* and *Trematosaurus*. These two forms also differ in the curvature of their mandibles. In the *Aphaneramma*-like taxon, the skull is more slender and the curvature of the mandible at the anterior of angular towards the splenial, is nearly straight in contrast to the *Wantzosaurus*-like form which shows a more curved mandible. Indian trematosaurids thus strongly resemble Olenekian lonchorhynchines from Madagascar.

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# ACINONYX PARDINENSIS (FELIDAE, MAMMALIA) 'RE-DISCOVERED' AT MONTE ARGENTARIO (ITALY, EARLY PLEISTOCENE) THANKS TO SYNCHROTRON MICROTOMOGRAPHY

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**Keywords:** body size variation, Felidae, Plio-Pleistocene, synchrotron, Villafranchian

In this study, we describe a partial cranium with associated mandible of a large felid recovered from Monte Argentario, Italy (Late Villafranchian; Early Pleistocene; ~1.5 million years). Propagation x-ray phase-contrast synchrotron microtomography of the specimen, still partially embedded in the rock matrix, allows ascribing it reliably to *Acinonyx pardinensis*, one of the most intriguing extinct carnivorans of the Old World Plio-Pleistocene.

The analysis of images and 3D models obtained through synchrotron microtomography – here applied for the first time on a Plio-Pleistocene carnivoran – reveals a mosaic of *Acinonyx*-like and *Panthera*-like features, with the latter justifying previous attributions of the fossil to the leopard *Panthera pardus* or to the extinct Eurasian jaguar *Panthera gombaszoegensis*. Similarly, we reassign to *A. pardinensis* some other Italian materials previously referred to *P. gombaszoegensis* (sites of Pietrafitta and Ellera di Corciano).

The recognition of *Panthera*-like characters in *A. pardinensis* leads to reconsidering the ecological role of this species, whose hunting strategy was likely to be different from those of the living cheetah *A. jubatus*. Furthermore, we hypothesize that the high intraspecific variation in body size in *A. pardinensis* can be the result of sexual dimorphism, as observed today in all large-sized felids.

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# ECOLOGICAL NICHE MODELLING SUPPORTS SUSTAINED DINOSAUR DIVERSITY TRENDS PRIOR TO THE CRETACEOUS/PALEOGENE MASS EXTINCTION

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**Keywords:** *dinosaurs, extinction, palaeodiversity, macroecology, Cretaceous*

Dinosaur diversity in the lead-up to the Cretaceous/Paleogene mass extinction (66 Ma) remains a topic of heated debate. Whereas some authors argue that dinosaurs were already in long-term decline, others contend that they were thriving until their sudden demise. The latest Cretaceous (Campanian–Maastrichtian) of North America provides the best palaeontological record to address this debate, but even here diversity reconstructions are biased by uneven sampling. We combine fossil occurrence data with climatic and environmental model results to define latest Cretaceous North American dinosaur habitat availability. Using ecological niche modelling, habitability diminished through the Campanian to Maastrichtian based on areas with present-day rock outcrop. However, using a continent-wide projection, we show that habitat actually increased, but this is obscured by a reduction in our spatial sampling window. These changes result from the emergence of the proto-Rocky Mountains and the regression of the Western Interior Seaway, which shifted dinosaur environments into areas with less favourable taphonomic conditions. Maastrichtian North American dinosaur diversity is therefore likely to be underestimated and the 'apparent decline' a product of sampling bias. Our results suggest that long-term fluctuations in climate did not affect the ecological niches of dinosaurs over prolonged time scales during this critical period and that there would have been no K/Pg extinction of the dinosaurs without a geologically instantaneous, catastrophic event. Our novel approach highlights the impact of data absence in interpreting macroecological dynamics.

# REAPPRAISAL OF THE DISTRIBUTION AND STRATIGRAPHIC RECORD OF THE ALLIGATOROID DIPLOCYNODON RATELII POMEL, 1847 IN EUROPE

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**Keywords:** *Crocodylia, Diplocynodontidae, early Miocene, late Oligocene, chronostratigraphic range*

*Diplocynodon ratelii* is a fossil alligatoroid known from the Miocene of Europe. It is characterized by the presence of a crest-like thickening on the margin of the external naris; the anterior tip of the nasals reach externally (but do not bisect) the posterior rim of the external naris; a concavoconvex frontoparietal suture; a shorter mandibular symphysis that only reaches the fourth and fifth dentary alveoli; and the anterior ventral tip of the splenial longer than the dorsal one, without contacting the dentary symphysis. To date, the stratigraphic range of this species has been limited to early Miocene localities of Saint-Gérard-le-Puy (France, MN2), Skyřice (Czechia, MN3) and els Casots (Spain, MN4). We report new material of *D. ratelii* from the early Miocene site of Montaigu (MN2, France), as well as from the late Oligocene (MP29) sites of La Milloque (France) and La Rochette (Switzerland). In particular, findings from La Rochette represents the first report of *D. ratelii* in Switzerland, and together with La Milloque, both expands the chronostratigraphic range of this species back to the late Oligocene (MP29). A revision of the material from the French localities Artenay and Bézian (MN2), previously attributed to *D. styriacus*, shows that this material can be placed to *D. ratelii*. In the light of new information, the spatial and temporal distribution of *D. ratelii* has been markedly changed.

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# NEW MORPHOLOGICAL, EVOLUTIONARY AND PALEOECOLOGICAL INTERPRETATIONS ON THE GENUS *EOCAIMAN* (CROCODYLIA, CAIMANINAE) FROM THE CENOZOIC OF SOUTH AMERICA

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**Keywords:** *Eocaiman*, *Caimaninae*, *durophagy*, *cavernensis*, *palaeocenicus*

*Eocaiman* is a fossil Caimaninae genus occurring from the Paleocene to the Middle Miocene of South America. It comprises the species *E. cavernensis*, *E. palaeocenicus*, *E. itaboraiensis* and two specimens of *Eocaiman* sp. (UCMP-38878 and UCMP-39023) from the Middle Miocene of Colombia. As most of *Eocaiman* specimens are fragmentary, interpretations on its evolution and feeding habits are scarce. However, phylogenetic breakthroughs on Caimaninae and re-examinations of the morphology of the genus have allowed new perspectives about *Eocaiman*. The three species and UCMP-39023 exhibit the dentary, at level of 1st and 4th teeth, lower than at level of 11th-12th teeth, while *E. cavernensis*, *E. itaboraiensis* and UCMP-39023 have their first dentary teeth procumbent. Additionally, our phylogeny placed *Eocaiman* in the same basal caimanine clade with the Miocene durophagous genera *Globidentosuchus*, *Gnatusuchus* and *Kuttanacaiman*. This brings the possibility that *Eocaiman* might have had a feeding habit close to a durophagous one, although yet largely generalist and not very specialized in durophagy as that of the Miocene genera. As such, the aforementioned characters of *Eocaiman* could be adaptations to a “proto-durophagous” habit, allowing the animal to use the anterior part of the lower jaws to “scoop” margins and bottoms of water bodies in search of prey. A similar foraging habit was proposed for *Gnatusuchus*, which has “shovel-like” lower jaws. Consequently, we consider that while *Eocaiman* was a predominantly generalist taxon, it presented adaptations for a “proto-durophagous” feeding habit from which the durophagous habit of *Gnatusuchus*, *Globidentosuchus* and *Kuttanacaiman* may have evolved.

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# THE EVOLUTIONARY, BIOGEOGRAPHICAL AND ECOLOGICAL HISTORY OF SOUTH AMERICAN CENOZOIC CROCODYLOMORPHS: AN UPDATED REVIEW WITH NEW PERSPECTIVES

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**Keywords:** *Crocodylomorpha, Cenozoic, South America, Crocodylia, Caimaninae*

Only two crocodylomorph lineages that inhabited South America by the Late Cretaceous survived the Cretaceous/Palaeogene extinction event: Dyrosauridae and Sebecidae. Caimaninae (Alligatoroidea) arrived, either in the late Cretaceous or in the early Palaeocene, from North America. The fossil record of Caimaninae is present, however, only from the Palaeocene. By the Eocene, there are no records of Dyrosauridae in South America; this group was globally extinct after the Eocene, possibly due to the global cooling that occurred by the end of this epoch. Sebecids and caimanines solely comprised the crocodylomorph fauna of the continent until the Miocene, when the first Gavialoidea (Gryposuchinae) and the first dispersion of Crocodyloidea (with the tentative tomistomine *Charactosuchus*) are recorded. Gryposuchinae likely arrived to the continent from Africa or from Asia during the Oligocene. *Charactosuchus* and *Brasilosuchus* came likely from North America, where tomistomines lived from the Oligocene to the Pliocene. Sebecids were extinct after the Middle Miocene; *Charactosuchus*, Gryposuchinae and large, specialized caimanines, after the late Miocene. These extinctions are related to changes in the drainage basins caused by the elevation of the Andes chain. Only the extant caimanines *Caiman*, *Melanosuchus* and *Paleosuchus* would survive the Miocene, being enriched by *Crocodylus* from the Pliocene on. Although it is likely that *Crocodylus* arrived to the American continents from Africa, it is not clear whether the first South American *Crocodylus* arrived directly from Africa or from North America; the two extant species from the genus to inhabit the continent, however, are most likely from North America.

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# GEOGRAPHIC SAMPLING BIASES LIMIT OUR UNDERSTANDING OF THE FOSSIL RECORDS OF NON-MARINE LEPIDOSAURS AND TURTLES

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**Keywords:** *Lepidosauria, Testudinata, species-richness, subsampling*

Many recent studies have focused on biases in the fossil record and the effects they have on examining richness through time. A variety of methods have been proposed to 'correct' for these biases, particularly those caused by uneven sampling. We used Shareholder Quorum Subsampling (SQS) to investigate the richness of non-marine lepidosaurs and turtles from the Triassic–Paleogene (252–23 Ma). Additionally, generalized least-squares regression (GLS) allowed us to test which proxies for biases and environmental factors correlate best with the richness record of both clades. Palaeolatitudinal distributions of both groups are also addressed, in relation to past climates. The turtle record is more robustly sampled than the lepidosaur record, but in both cases the northern hemisphere is far better sampled than the southern hemisphere, which affects apparently 'global' patterns through time. At continental-level, we observe interesting similarities and differences in the richness records of both clades. Of particular interest is the Cretaceous–Paleogene boundary, where lepidosaurs fall in richness but turtles increase in richness. Conversely, there are similar fluctuations in richness throughout the Paleogene that suggest a shared response to climatic changes or a common sampling issue for both groups. GLS analyses suggest the 'uncorrected' face-value data are significantly affected by sampling issues, particularly the number of collections available to sample. We must continue to sample more intensely in areas that are historically understudied, in order to reduce the effect of geographic sampling biases on the records of both lepidosaurs and turtles, and for the fossil record as a whole.



## LOWER TETRAPODS FROM THE EARLY OLIGOCENE OF TRANSYLVANIA

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**Keywords:** *Urodela, Anura, Reptilia, Oligocene, Faunal links*

Knowledge on lower tetrapods from the Palaeogene of Romania is rather scanty even if some of the fossil vertebrate localities were known for more than a century. Here we report a diverse fossil assemblage of lower tetrapods (salamanders, frogs, lizards, snakes and crocodylians) from the early Oligocene localities of Suceag and Cluj-Napoca (Rupelian, MP 23/24; Dâncu Formation, Romania). Among salamanders, the proteid *Mioproteus* sp., may represent a new taxon and the first fossil record of a proteid from the Cenozoic of Europe. Rare remains of the alytid frog *Latonia* and the ranid frog *Pelophylax* may correspond to one of the earliest fossil records from the European Palaeogene, while the palaeobatrachid *Albionbatrachus oligocenicus* may be considered a survivor of the Eocene/Oligocene extinction event. The amphibian assemblage probably preferred fluvial and/or marshy-lacustrine paleoenvironments. In the studied localities, the taxa inhabiting terrestrial ecosystems are relatively rare [the anguid lizard *Ophisaurus* sp., the small-sized snakes *Eoanilius* sp. (Aniliidae) and “Tropidophiidae” indet (Boidea)] and probably these forms inhabited the areas with azonal vegetation surrounding the rivers and wetlands. The palaeoclimate was relatively temperate, as it is suggested by the presence of *Diplocynodon* (mean annual temperature at least of 14.5 °C, or even higher). The assemblage as a whole documents the existence of terrestrial corridors and suggest important zoogeographic connections (e.g. link with N-America is suggested by the presence of proteids, whereas that with former Gondwana by the ranid frogs).

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# ALCOVASAURUS LONGISPINUS AS A DACENTRURINE STEGOSAUR (DINOSAURIA) AND CONTRIBUTIONS TO THE DIAGNOSIS OF DACENTRURINAE

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*Miragaia longicollum* Mateus *et al.*, 2009 (Late Jurassic of Portugal) is a species of stegosaur based on a specimen consisting essentially of the anterior part of the skeleton. *Alcovasaurus longispinus* Galton and Carpenter, 2016 (Late Jurassic of Wyoming, USA) was defined on the basis of a stegosaur specimen first described in 1914 - but only the femur, spines and posteriormost caudal vertebrae were described before it was destroyed in a flood in the 1920s. In the latest phylogenetic analysis of Stegosauria, *A. longispinus* was found outside Eurypoda, due to the lack of known features shared with other stegosaur species.

A new specimen (MG 4863) from Atouguia da Baleia (Portugal), with representative anterior and posterior skeleton, was classified as *M. longicollum*, and is distinguishable from its sister taxon, *Dacentrurus armatus* Owen, 1875. The comparisons revealed four features shared only by *M. longicollum* and *A. longispinus* (transverse processes present in all caudal vertebrae, apple-shaped outline of mid and posterior caudal centra, neural arch of mid and posterior caudal vertebrae one third or less the height and width of the centrum, lateral ossification of the posterior rim of the posteriormost caudal centra) thus suggesting congenericity. Another three characters (mid and posterior caudal centra wider than tall, taller than long, with deeply concave lateral sides) were shared by both taxa as well as *D. armatus*, therefore could be diagnostic of Dacentrurinae. These results suggest that *A. longispinus* is a dacentrurine stegosaur, resolving its phylogenetic placement, and is the first evidence of Dacentrurinae in America.

## EARLY MIOCENE MAMMAL ASSEMBLAGES FROM THE CAMPISANO RAVINE IN THE RIBESALBES-ALCORA BASIN (EASTERN SPAIN)

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**Keywords:** *Ribesalbes-Alcora Basin, Early Miocene, mammals, biostratigraphy, Spain*

The palaeontological record of the Ribesalbes-Alcora Basin (eastern of the Iberian Peninsula) is known traditionally by fossil vertebrates and insects of a Early Miocene age from the Konservat-Lagerstätte of La Rinconada, near to the locality of Ribesalbes. The first mammal remains from this basin were described from deposits of the Campisano ravine of the Araia/Mas de Antolino outcrop, near the village of Araia d'Alcora in the 80s. The deposits of this ravine are divided in the sections of Mas dels Coixos, Mas de Torner, Araia Cantera Sud, Barranc de Campisano, Foieta la Sarra, Mas d'Antolino B and Corral de Brisca. Based on the study of the faunal remains of forty-five fossiliferous levels located in these sections, we have inferred an Early Aragonian age (MN4, Early Miocene). The presence of the Cricetodontinae *Megacricetodon* and *Democricetodon*, together with the Eomyidae *Ligerimys* in all the localities (with the exception of the last genus, that is absent in Mas dels Coixos section) have allowed to correlate these sites with zones Ca and Cb of the Aragonian age in the Calatayud-Montalbán Basin (Spain). The fossil record of these localities contains up to 50 taxa of mammals, including: the southernmost record of the herpetotheriid *Amphiperatherium frequens*; the oldest record in the Iberian Peninsula of the insectivore *Plesiodimylus*, described recently as a new species *P. Ilercavonicus*; one of the oldest European record of the genus *Eumyarion*; and one of the youngest records of the rare rodent *Melissiodon*.

## PRELIMINARY REPORT OF A FOSSIL LIZARD SKULL FROM LA PALMA (CANARY ISLANDS)

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**Keywords:** *Gallotia*, *Squamata*, *Lacertidae*, *micro-computed tomography*

Canary Islands, a volcanic archipelago formed during Neogene and Quaternary periods located north-west of Africa are a great natural lab to understand evolutionary processes thanks to the diverse presence of endemic taxa. On this aim, the giant lizard genus *Gallotia* is an emblematic and endemic taxon with extinct and extant record. Regarding giant forms *Gallotia* four living species (*G. bravoana*, *G. intermedia*, *G. simonyi* and *G. stehlini*), one fossil (*G. goliath*) and one possibly extinct (*G. auaritae*) are known. The fossil record includes disarticulated and articulated specimens mainly preserved in volcanic tubes showing different ontogenetic stages. Here we describe the best-preserved material recovered from La Palma Island representing an almost complete skull and a partial endocast thanks to X-ray micro-computed tomography that allowed to digitally preparing the material embedded in a sedimentary matrix. This specimen shows some characters of the group formed by the species *G. auaritae*, *G. bravoana*, *G. intermedia* and *G. simonyi*: 1) big skull (between 20-40 mm), 2) maxillary tooth crown size and height constant throughout tooth row, 3) maxillary tooth count more than 25, 4) frontals unfused, and 5) occiput fully covered by the parietal, or nearly so, in dorsal view. Of particular interest, the almost straight lateral margins of the paired frontals are shared only with *G. auaritae*, suggesting affinities of this specimen with this taxon.

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## MIND THE GAP! – SIGNIFICANCE OF A NEW LATEST CRETACEOUS FOSSILIFEROUS SITE IN THE NORTHERN HAȚEG BASIN, ROMANIA

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**Keywords:** *Maastrichtian, Hațeg Basin, eggs, microvertebrates, stratigraphy*

The Maastrichtian continental deposits from the Hațeg Basin have yielded one of the most important European Late Cretaceous vertebrate assemblages, known for its dwarf dinosaurs, nesting localities and peculiar multituberculates. Several fossil-rich localities are spread over the central-eastern parts of the basin, whereas the northwestern areas are less well sampled palaeontologically, due to their poor outcrop conditions. Two important northern sites, Vălioara and Tuștea, fall most probably within the lower, respectively the 'middle' Maastrichtian, but the transitional section between these was largely barren until recently. Despite a century-long history, prospecting in the area between these two important sites failed to identify significant fossil accumulations, only very scarce isolated remains being reported in the 1980ies near Boița. In the last two years, seven important vertebrate localities were discovered in this area, first by surface prospecting, followed by small-scale excavations and screen-washing; preliminary results of this effort are presented here. Stratigraphically, the Boița deposits fall between those from Vălioara and Tuștea, and thus their fossils fill an important gap in the stratigraphic distribution of the local vertebrate assemblages. Among the new localities, most significant are a disperse bonebed yielding a wide variety of taxa (turtles, crocodyliforms, hadrosauroids, titanosaurs), and a remarkably thin-shelled dinosaur egg clutch. More typical megaloolithid egg remains and microvertebrates were also discovered. The recovered fossils document the continuous presence of several (at least 6) higher-level taxa from the early into the 'mid'-Maastrichtian. Furthermore, Boița can now be added to the short list of nest-bearing localities known from the basin.

# SCANNING THE SKULL OF PELECANIMIMUS POLYODON (ORNITHOMIMOSAURIA, EARLY CRETACEOUS, SPAIN): OSTEOLOGICAL APPROACH

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**Keywords:** *Theropoda, Coelurosauria, Basal Ornithomimosauria, Las Hoyas, Cuenca*

*Pelecanimimus polyodon* was discovered in 1993 in the Spanish Barremian fossil site of Las Hoyas, being the first ornithomimosaurian described in Europe. So far, there is no detailed description of the holotype of *Pelecanimimus* that is composed by the anterior half of an articulated skeleton that preserves evidence of soft-tissues as a soft occipital crest and a gular structure.

A detailed osteological description of the skull of *Pelecanimimus* has been carried out, and its features have been compared with those of other ornithomimosaurian. A CT scan and 3D reconstruction have allowed to decipher some features not previously available.

*Pelecanimimus* shares with other ornithomimosaurians an enlogated premaxilla, a sharp posterior margin of the maxilla, a well-developed jugal ramus of palatal, a hypertrophied prefrontal, and a parasphenoid bulba. However, *Pelecanimimus* also have several primitive features such as a subnarial foramen, a premaxillary process not reaching the antorbital fossa and a pneumatic recess in the anterior ramus of jugal. Undoubtedly, the most striking feature of *Pelecanimimus* is the presence of approximately 200 premaxillary, maxillary and dentary teeth, present only also in *Nqwebasaurus*.

Over the last 25 years, the known diversity of the ornithomimosaurians has increased throughout the world. The placement in context of *Pelecanimimus* features in current phylogenetic proposals is especially interesting to shed light on the feeding behaviour of Ornithomimosauria.

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## CINGULATA JAW DISPARITY

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**Keywords:** *Xenarthra, Geometric Morphometrics, Mandible, Disparity*

Xenarthrans are a strictly American clade which had a huge diversity in the past. This diversity was correlated with a high disparity in size, shape and ecology; including some bizarre forms such as the giant ground sloth *Megatherium* and the glyptodonts; mammals with bony carapace the size of a small car.

Cingulata was the most diverse clade of xenarthrans in terms of ecology and size, including species covering the whole spectrum of diets (carnivorous, insectivorous, and herbivorous) and sizes; from a few grams to a few tones. Glyptodonts are included within the subclade Cingulata, together with pampaterids and armadillos, the only surviving group; and have been traditionally placed in different clades. Nevertheless, recent studies on molecular data from ancient DNA support glyptodonts being nested inside the armadillo's clade.

The objective of this work is to quantify the disparity of the Cingulata family based on the shape of the lower jaw. Using 2D Geometric Morphometrics the morphological disparity was measured and evaluated in the light of the new evolutionary hypothesis based on molecular data. Armadillos has been shown to have a large mandible disparity, however when glyptodonts are considered as nested inside the family Chlamyphoridae this family alone accounts for much of the described disparity. The evolutionary causes of why this family shows such a huge shape differences remain unknown.

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## REVISITING THE BIODIVERSITY CURVE OF MODERN CROCODILES (CROCODYLIFORMES, EUSUCHIA)

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**Keywords:** *Shareholder quorum subsampling, Crocodylia, Alligatoroidea, Crocodyloidea, Gavialoidea*

The fossil record of modern crocodiles (Eusuchia) shows that, although their diversity is currently restricted to 23 recognized species circumscribed in three major lineages, in the past they were more abundant and had a wider distribution. Historically, many fragmentary fossils with limited diagnostic characters have been assigned to certain species exclusively on the basis of a shared spatiotemporal distribution. The large amount of these improperly justified taxonomic assignments should be taken into account in order to reconstruct the paleodiversity of any clade, as these occurrences could introduce another bias.

Regarding this issue, an exhaustive review of more than one thousand eusuchian body fossil occurrences at specific level has been carried out in order to build a new dataset, excluding dubious fossil occurrences. Following previous works, these occurrences were sorted into time-bins of about 9 million years and shareholder quorum subsampling (SQS) was applied to the dataset, obtaining a subsampled biodiversity curve comprising the entire timespan of Eusuchia.

The resulting curve shows two great increases in eusuchian biodiversity, the first one during the Paleocene and the second one during the Middle-Late Miocene. These results are quite consistent with proposals already known. However, in contrast with previous works, our results suggest that the Middle-Late Miocene biodiversity peak was bigger than that of the Paleocene. The Middle-Late Miocene biodiversity peak is related to the great expansion of alligatoroids in South America, with minor contributions of the gavialoid expansion in South America alongside the crocodyloid expansion in Africa and Australasia.

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## DISCOVERY OF A TRICERATOPS BONEBED: TRICERATOPS LONG BONE HISTOLOGY AND THE LATITUDINAL GRADIENT HYPOTHESIS

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**Keywords:** *Triceratops*, *bonebed*, *histology*, *latitudinal gradient*, *sociality*

*Triceratops* was as herbivorous dinosaur that lived during the Late-Cretaceous of North-America and is relatively well-known from a large number of fossil discoveries. Although these discoveries have yielded a high number of fossils, numerous aspects about *Triceratops* palaeobiology remain unknown. Ongoing fieldwork in the Lance Formation in Wyoming, USA by the Dutch museum of natural history Naturalis, Leiden has yielded a multi-generation bonebed of at least five *Triceratops* individuals. The uniqueness of this site is characterized by the high amount of post-cranial material of different-sized individuals, hinting towards the presence of different ontogenetic stages. This assemblage provided an opportunity to document images on *Triceratops* long bone histology and allow for direct comparison with other ceratopsian taxa. Examination of six *Triceratops* femora suggests a steady growth rate that is comparable to other related ceratopsian taxa of which comparative histological data is available (including *Einosaurus*, *Kosmoceratops*, *Utahceratops*) as indicated by the organized bone tissue and degree of remodeling. Moreover, the femora did not contain clear LAGs in the cortex. The lack of such histological markers is attributed to a latitudinal gradient that seems to determine the composition of osteohistological characteristics and is recurrent in several ceratopsian and hadrosaurian histological studies, and is determined by seasonal changes in climate. Furthermore, the discovery of this monospecific bonebed of *Triceratops* provides further evidence for the notion that *Triceratops* lived in a coherent social structure and, combined with histological data, provides insights into dinosaur behavioural patterns. Future research will focus on osteological parameters indicating annual cyclicity.

# USING THE MUSCULOSKELETAL SYSTEM AS AN INTERDEPENDENT METHOD TO COMPARE LOCOMOTOR HABITS: TWO TENDAGURU SAUROPODS (DINOSAURIA) AS CASE STUDY

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**Keywords:** *Sauropoda, Macronaria, Mamenchisauridae, tail, musculoskeletal system.*

The Late Jurassic Tendaguru site (Tanzania, East Africa) is well-known from the German expeditions made at the beginning of the 20<sup>th</sup> century, and the impressive dinosaur specimens that were recovered from there. The most frequently found dinosaurs from Tendaguru are sauropods, which are preserved with nearly complete or partial skeletons and isolated bones. At least seven caudal series of Tendaguru sauropods are present in the collections of the Museum fuer Naturkunde Berlin, of the macronarian *Giraffatitan*, the diplodocoids *Tornieria* and *Dicraeosaurus*, and a problematic caudal series MB.R.2091.1-30 previously referred to *Janenschia*. Although its procoelous anterior vertebrae were thought to indicate a titanosaurian affinity, recent research suggests close relation with mamenchisaurids. Here, we assess the similarities and divergences between the caudal musculoskeletal systems of the Tendaguru sauropods *Giraffatitan* and the series MB.R.2091.1-30. For example, the horizontal cross-section of the neural spines of MB.R.2091.1-30 is quadrangular, whereas those of *Giraffatitan* are transversely compressed. Also, the spines of *Giraffatitan* are more anteroposteriorly elongated. This proportional difference indicates differences in the epaxial (deep and medial) musculature. In addition, the transverse processes are larger and more laterally expanded, and lateroventral faces of the vertebral centra are larger in *Giraffatitan*, pointing to a larger caudofemoralis longus muscle. These divergences, together with the different articulations and ranges of motion, are indicative of the diversity of the main locomotive 'engine', the M. caudofemoralis system and its action on hip extension, of the sauropod fauna found at Tendaguru.

**Acknowledgments:** VDD acknowledges the Alexander von Humboldt Stiftung, which helped her developing a project about the biomechanics of the tail of several taxa within Neosauropoda, by doing photogrammetry and 3D modelling.

# THE LATE CRETACEOUS TITANOSAURIAN SAUROPOD DINOSAURS OF EUROPE AND AFRICA: UPDATE AND SYNTHESIS

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**Keywords:** *titanosaurs, Cretaceous, palaeobiogeography, Europe, Africa*

Titanosaurs were the last-surviving group of sauropod dinosaurs, having persisted until the end-Cretaceous. Since the early 21st century, knowledge of this diverse and cosmopolitan group of dinosaurs has greatly improved, although many aspects of their biology and evolutionary history remain poorly understood. In particular, knowledge of Late Cretaceous titanosaurs of Europe and continental Africa has been scarce until recently. New discoveries, taxonomic revisions, and recent analytical studies of titanosaurs from these landmasses have begun to shed light on their histories within and between these regions. Here, we synthesize and assess the latest paleobiogeographic and phylogenetic hypotheses concerning both European and African titanosaurs, and what they mean for Afro-European Cretaceous faunas more broadly. One of the most significant results recovered by these works is a relationship between Late Cretaceous titanosaurs from northeastern Africa (i.e., Egypt) and southwestern Europe (i.e., the Ibero-Armorican Island), which counters some past hypotheses positing that African faunas were isolated during the Late Cretaceous. In addition, the Late Cretaceous titanosaurian faunas from both landmasses seem to be more diverse than previously thought, with six formally recognized taxa from the Cenomanian–Campanian of Africa, and the same number from the Campanian–Maastrichtian of Europe. Works currently in progress, including the description of several new African and European specimens, will help to further expand upon and test the hypotheses presented here.

# A NEW TITANOSAURIAN SAUROPOD FROM THE LATE CRETACEOUS OF VELAUX-LA BASTIDE NEUVE (SOUTHERN FRANCE)

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**Keywords:** *titanosaur, Late Cretaceous, France, new taxon*

The Upper Cretaceous site of Velaux-La Bastide Neuve (Bouches-du-Rhône Department, France) is well-known for its dinosaur specimens, more specifically the titanosaurian remains. The taxon *Atsinganosaurus velauciensis* is represented by several partially articulated skeletons found in this upper Campanian site; some of this material was described by Garcia and collaborators in 2010 based on teeth, elements of the axial skeleton, scapular girdle and limb bones. After a detailed revision of the fossil remains, including the study of new material collected during the 2009 and 2012 campaigns, the occurrence of a second titanosaurian species can be stated due to the morphological and histological dissimilarities present in the appendicular skeleton and the pelvic girdle. The long bone histology of the new taxon indicates slowly growing individuals near their growth end to fully grown individuals. Compared to the propodials of *A. velauciensis* which are fully grown, as indicated by their histology, but shorter than those of the new taxon, this osteological-histological combination points to bigger titanosaurian individuals. A phylogenetic analysis (in which all the Cretaceous European titanosaurs have been scored) recovers this new taxon in a polyphyletic group within Lithostrotia, together with the Iberoarmoric titanosaurs *Lirainosaurus*, *Ampelosaurus* and *Atsinganosaurus*, the African *Rapetosaurus*, and the Argentinean *Bonatitan*. Although its noticeable anatomical divergences with the rest of the European titanosaurs, this new taxon was probably closely related with other Iberoarmoric forms. New works on the European and African faunas will help to clarify these affinities.

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## SMALL MAMMALS FROM THE HOLOCENE ARCHAEOLOGICAL SITE OF CASTILLEJO DEL BONETE (TERRINCHES, CIUDAD REAL, SPAIN)

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**Keywords:** *Rodentia, Iberian Peninsula, Holocene, Paleobiogeography*

Castillejo del Bonete is an exceptional archaeological site, composed by a tumulus complex associated to a natural cave that was used as a funerary place during the Chalcolithic and Bronze Age periods. Abundant microvertebrate remains have been recovered from the west test pit dug in a sedimentary package inside the cave, dated 4,416-4,161 cal. BP. The mammal assemblage of Castillejo del Bonete constitutes one of the richest described up to now from the Holocene in Spain. Over 8,000 remains have been identified, belonging to a minimum number of 1,152 individuals. They pertain to eleven species, two of which are lagomorphs, another is an erinaceomorph, two other are soricomorphs and finally, six rodents. The faunal spectrum is clearly dominated by *Apodemus sylvaticus* and *Oryctolagus cuniculus* ( $\approx 60\%$  of MNI). From a paleobiogeographical point of view, the presence and relative abundance ( $12,59\%$  of MNI) of the Algerian mouse (*Mus spretus*) is most remarkable, since there are very few sites of this age in Iberian Peninsula where its record can be considered reliable. The precise age in which this species colonised the Iberian Peninsula remains still unclear. Another interesting feature of this assemblage is the presence of heavy to extreme digestion observed in most of the specimens and of coprolites with microvertebrate remains inside. This evidence supports the interpretation of a mammalian carnivore predator as the main agent responsible for the origin of the small vertebrate assemblage.

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## A CUON SP. OCCURRENCE IN THE UPPER PLEISTOCENE DEPOSITS OF STOIENI CAVE, SOUTHWESTERN ROMANIA

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**Keywords:** *late Pleistocene, dhole, Canidae*

The dhole (*Cuon alpinus*) currently occurs only in Asia, yet during the Pleistocene it was widespread throughout the entire Eurasian continent. Fossil European dholes are rare, and difficult to distinguish from wolf remains.

We present several canid specimens from Stoieni Cave (SW Romania), one right mandible and several metapodia, which show morphological similarities to *Cuon* sp. The mandible is radiocarbon dated to around 27,000 years BP, placing it among the most recent European dhole occurrences. The metapodia are small when compared to *Canis lupus*, but remain larger than those known from *Cuon alpinus*. The mandible presents the diagnostic *Cuon* feature of an absent third molar (and its respective alveolus), a very rare, ~2% occurrence in present-day wolves. Nevertheless, when compared to other European dholes, the mandible and dentition measurements hint toward a large *Cuon alpinus* or a different, more archaic, species (e.g. *Cuon priscus*), but with the reduced probability of it pertaining to a smaller, anomalous, wolf.

As the morphological and dimensional analyses were inconclusive, ancient DNA analyses were carried out. Phylogenetic analyses using complete mitochondrial genomes recovered from the metapodia places these specimens with wolf mitochondrial lineages. Unfortunately, this investigation was not helpful for the mandible, since the DNA extracted from this specimen proved too degraded. The DNA evidence thus points more towards a wolf identification of the metapodia, although other explanations are conceivable (wolf-dhole hybridisation). Dental morphology and the absence of the third lower molar, support, however, the assignment of the mandible to a large archaic *Cuon* sp.

# ADAPTATIONS FOR SCRATCH-DIGGING BEHAVIOUR IN FORELIMBS OF THE AETOSAUR STAGONOLEPIS OLENKAE (ARCHOSAURIA; PSEUDOSUCHIA) FROM KRASIEJÓW LOCALITY IN POLAND

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**Keywords:** *Archosauria, Aetosauria, forelimbs, scratch-digging, Krasiejów*

Aetosaurs are armoured basal archosaurs that played a significant role in land ecosystems during the Late Triassic (237–201 Ma). Most of them were large to middle size animals (from 1 - 6 meters in length) in appearance similar to modern living pangolins or armadillos as most of their bodies were protected by armour composed of plate like osteoderms. They were probably omnivorous and most species, including polish *Stagonolepis olenkae*, Sulej 2010, have a shovel like expansion at the tip of tapering snout. Abundant and well-preserved material from Krasiejów locality (southern Poland), including partially articulated specimens, allows for a detailed description of forelimbs in this species. Several characters recognized in the forelimbs of *Stagonolepis olenkae* suggest its adaptation for a scratch-digging. The most indicative are: short forearm, carpus, and hands, with the radius shorter than the humerus, carpus and manus shorter than the radius (excluding terminal phalanges); a prominent deltopectoral crest that extends distally on the humerus and a wide prominent entepicondyle, a long olecranon process with well-marked attachment of triceps muscle; hooked, laterally compressed, claw-like terminal phalanges with ornamentation of small pits (indicative of well-developed keratin sheaths). *Stagonolepis olenkae* might have used its robust forelimbs to break through the compacted soil with its claws and proceed the digging in search of food in softened substrate with the shovel-like expansion at the tip of its snout.

## NEW MATERIAL OF ANKYLOPOLLEXIAN ORNITHOPODS FROM THE UPPER JURASSIC OF PORTUGAL

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**Keywords:** *Ankylopollexia, Upper Jurassic, Lusitanian Basin, Portugal*

The most common medium to large-sized ornithopod dinosaurs in the Late Jurassic are non-styracosternan ankylopollexians. The ankylopollexian record from the Upper Jurassic of Portugal is not well-known and mainly based on fragmentary material from few fossil-sites located in the Lusitanian Basin. To date the presence of two species have been documented: *Draconyx loureiroi* and *Camptosaurus aphanoecetes*. In this context ankylopollexians discoveries in the Lusitanian Basin are noteworthy. Here additional material from three new localities is presented. Two localities have provided a set of well-preserved caudal vertebrae, whereas a third locality have just provided an isolated femur. The former specimens (SHN 075 and SHN 074) come from the Sobral Formation at Atalaia (Lourinhã) and Praia da Amoreira-Porto Novo Formation at Atougua da Baleia (Peniche) late Kimmeridgian-early Tithonian and late Kimmeridgian in age, respectively. The isolated femur [SHN(JJS) 073] comes from the locality of Peralta (Lourinhã. Sobral Formation, late Kimmeridgian-early Tithonian in age). Due to its fragmentary nature, the caudal vertebrae reported here cannot be assigned to none of the taxa described in the present-day Portuguese fossil record, and given the absence of diagnostic features are considered as *Ankylopollexia* indet. The femur from Peralta resembles those of *Camptosaurus*, but any autapomorphic feature can be confirmed, and lacks the autapomorphic character combination of the femur of *Draconyx loureiroi*. Therefore, the femur is here better to referred to *Ankylopollexia* indet. The new occurrences of non-styracosternan ankylopollexians indicates that medium to large-sized ornithopods were common dwellers during the Late Jurassic of southwestern Europe.



## THE HISTORY OF THE QUATERNARY VERTEBRATE PALEONTOLOGY IN PORTUGAL

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**Keywords:** *Pleistocene, Paleontologists, Iberian Peninsula, History of Science*

The History of the Quaternary vertebrate paleontology in Portugal began in the XIX century with the labour of the 2<sup>nd</sup> Geological Commission, which started its work in 1857. During the second half of the XIX century Portugal was in the frontline of this field in Europe, thanks to the works of the pioneers Carlos Ribeiro and Nery Delgado, which crystallized in the IX International Congress of Anthropology and Pre-historic Archaeology that was organized in Lisbon in 1880. After the death of Nery Delgado in 1908 one of the top researchers in Quaternary fauna during that time; Édouard Harlé, published a work in 1910 that would be the major reference for the Portuguese Quaternary vertebrates during more than 80 years. After a phase of stagnation during the first half of the XX century; between 1950 and 1980 the works of Octávio da Veiga Ferreira and over all Georges Zbyszewski restarted the interest on the field. Between 1980 and 2000 the CEPUNL at Caparica, under the lead of Miguel Telles Antunes carried several excavations and formation of new personal, one of them (João Luis Cardoso) would mark a milestone for the area publishing in 1993 his PhD thesis, that even nowadays is a key reference for the study of big Pleistocene mammals of Portugal. In the XXI century the works of E. G. Crespo in the Quaternary reptiles, Carlos Pimienta and Sivério Figueiredo in avifauna, Simon Davis and mostly Cardoso in mammals, have filled gaps in our knowledge of those groups.

# INSECTIVOROUS MAMMALS OF THE SOUTHERN URAL (LATE PLEISTOCENE – PRESENT TIME)

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**Keywords:** insectivorous mammals, Late Pleistocene, Holocene, Southern Ural

Five species of shrews – the common shrew (*Sorex araneus*), tundra shrew (*S. tundrensis*), Laxmann's shrew (*S. caecutiens*), lesser shrew (*S. minutus*), European water shrew (*Neomys fodiens*) and common mole (*Talpa europaea*) inhabit the Southern Urals (54°0'–55°0'N; 56°50'–58°50'E) from the beginning of the Late Pleistocene to the present time. The taiga shrew (*S. isodon*), the least shrew (*S. minutissimus*) and hedgehog (*Erinaceus* sp.) were recorded on this territory in the same time interval except for the second half of the Late Pleistocene. The remains of the white-toothed shrews (*Crocidura leucodon*, *C. suaveolens*) were found only in the deposits dated to the first half of the Late Pleistocene and the Holocene. Several teeth of the flat-skulled shrew (*S. roboratus*), the Siberian large-toothed shrew (*S. daphaenodon*) were recovered from the sediments dated to the second half of the Late Pleistocene. One fragment of an incisor of the Russian desman (*Desmana* sp.) was found associated with deposits dated to the first half of the Late Pleistocene.

In the relatively warm periods common and Laxmann's shrews were dominant species in the small mammal communities, while in the relatively cold periods the tundra shrew prevailed.

For three dominant species, wide limits of morphometric variability were established. These data suggest the presence of different geographical populations in the common and tundra shrews. The size of the Laxmann's shrew decreased from the first half of the Late Pleistocene to the Holocene. The size of the lesser shrew and the least shrew remained much the same during this time interval.

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## PALAEOECOLOGICAL INSIGHTS FOR THE DISAPPEARANCE OF NEANDERTHALS THROUGH SMALL MAMMALS FROM EL SALT (SPAIN)

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**Keywords:** *small mammals, palaeoecology, Neanderthals, El Salt, Late Pleistocene*

The disappearance of Neanderthals is one of the most recurrent debates in the European prehistory. Empirical data for rejecting or not the proposed hypothesis have not been discovered yet, therefore the question of its disappearance remains unresolved. Part of the debate is focused on the Iberian Peninsula as it records the last Neanderthal populations. To understand human dispersion and/or extinction, knowledge about the ecology of past environments appears as a requisite. Site-specific information from localities where the human remains have been found appears to be necessary for the environmental reconstruction. Thus, the study of the small mammals from the sites constitutes a powerful tool for the environmental reconstruction, as they are very linked to climatic conditions.

Research developed at El Salt site has provided valuable data for the context of the disappearance of these groups in this region, as it contains proofs of the decrease and disappearance of evidences from the Middle Palaeolithic. The study of different proxies from the Stratigraphic Unit V from this site has revealed a drift to cooler and more arid conditions that could affect the past species populations. The aim of this work is to contribute with accurate palaeoecological data through the small mammals' study, in order to characterize that moment related with the survival of Neanderthals. Some of the species identified in this unit are also present in older units of the site as *Microtus arvalis*, *M. duodecimcostatus*, *Apodemus sylvaticus* or *M. cabreræ*. Moreover, squirrels appear for the first time at the fossil site.

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## A NEW EARLY EOCENE LOCALITY WITH PRIMATE REMAINS IN THE IBERIAN PENINSULA

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**Keywords:** *Adapiformes, Notharctidae, Paleogene, Spain, fossil site.*

During the last decade, the intensive fieldwork developed in the early Eocene deposits of the Àger Basin (Central Pyrenees, NE Spain) has allowed the publication of several new discoveries dealing with early primates. Among them, the description of two new species, the adapiforms *Agerinia smithorum* from Casa Retjo-1 and *Agerinia marandati* from Masia de l'Hereuet, were the most relevant. During the field campaign carried out in this area in 2015, a new fossil site was discovered, named Cabana del Llúcio-1. After the recovery and screen-washing of more than 300 kg of sediment from this new locality, several fossils were identified, including turtle, artiodactyl, rodent and primate remains. Regarding primates, the sample from this new level consists of a fragmentary calcaneus and nine isolated teeth that include an incisive fragment, a P<sub>3</sub>, a P<sub>4</sub>, an M<sub>1</sub> trigonid, an M<sub>2</sub> or M<sub>3</sub> trigonid, an M<sub>3</sub>, a P<sup>2</sup>, an M<sup>1</sup> and an M<sup>2</sup>. After a preliminary study, we have concluded that the size and morphology of the teeth and the calcaneus allow their assignment to the genus *Agerinia*. However, further analyses are needed for a specific allocation of this material. In any case, the fossil richness of this locality could represent a good opportunity to increase the current knowledge about the first primates that inhabited the Iberian Peninsula.

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## UNRAVELLING THE OXYGEN ISOTOPE SIGNAL FROM RODENT TEETH IN NORTHEASTERN IBERIA: THE XARAGALLS CAVE CASE

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Keywords: small mammals, stable isotopes, geochemistry, palaeoclimate, Late Pleistocene

Recent studies have demonstrated the relation between the stable oxygen isotope compositions from rodent teeth biogenetic phosphates ( $\delta^{18}\text{Op}$ ) with the  $\delta^{18}\text{O}$  from meteoric water ( $\delta^{18}\text{Omw}$ ) that could thus offers the possibility to reconstruct past temperatures. From modern and fossil material, this work explores the  $\delta^{18}\text{Op}$  from teeth enamel of Murinae and Arvicolinae subfamilies to understand paleoclimate conditions of Marine Isotope Stage 3 (MIS 3; ca. 60-30 ka) in northeastern Iberia. Based on  $\delta^{18}\text{O}$  analyses from modern samples, results from  $\delta^{18}\text{O}$  of small mammals have been discussed to define the limitations of their use and to propose one methodological approach. For Iberian palaeoclimatic reconstructions two factors must be kept in mind: the singularity of Iberian  $\delta^{18}\text{Omw}$  trends and the preferential moment of the year during which the accumulation of small mammals can be potentially produced. This methodology is applied on Xaragalls cave (Vimbodí-Poblet, Tarragona, Spain), a paleontological site dated from MIS 3, with a high number of identified small mammal remains, where fifty-one  $\delta^{18}\text{O}$  analyses have been performed on *Apodemus sylvaticus* incisors. The results suggest that Xaragalls cave levels are probably related with spring-summer accumulation of small mammals. In coherence with previous environmental studies of the site, oxygen isotope composition suggests a global stable climatic period that was cooler than nowadays (summer mean temperature between - 2.9 and - 1.9 °C). Furthermore, slight variations have been detected throughout the sequence that could be related to the usual MIS 3 stadial-interstadial alternations that seems coherent with variations of small-mammal assemblages.

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# GEOMETRIC MORPHOMETRICS AS A COMPLEMENTARY METHOD IN THE STUDY OF CHONDRICHTHYES DENTAL MORPHOLOGIES

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**Keywords:** *Chondrichthyes, geometric, morphometrics, teeth, fossils*

Chondrichthyes are known to have a great diversity of dental morphologies, both in fossil and recent organisms, primarily due to their diet, sexual dimorphism, and ontogeny. Usually found isolated, the teeth of cartilaginous fishes are the basis for the separation and cataloguing process of chondrichthyan species. Throughout the development of palaeontological methods, the most commonly used in the classification of fossil teeth of these organisms is a qualitative one based on elaborate descriptions of the biological structures. Though they might change according to the researcher, these descriptions have allowed for a steady and coherent study of these beings.

With the introduction of new technologies and mathematical processes, this strictly qualitative method is beginning to change. Over the past 20 years, several studies have aimed to update and improve the descriptions by complementing them with the information obtained through geometric morphometrics, which analyses and compares the shape and size of fossils. This quantitative method, that relies on spatial coordinates known as landmarks and semilandmarks, has allowed researchers to add greater depth to their studies and support qualitative classifications with statistical data. The present work aims to further the advances in this particular subject, by updating the classification of fossil teeth from several collections, utilising both the qualitative and quantitative methods.

## ORNITHOPOD DINOSAURS FROM THE PAPO-SECO FORMATION (CABO ESPICHEL, WESTERN CENTRAL PORTUGAL)

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**Keywords:** *Early Cretaceous, vertebrates, dinosaurs, Espichel Cape, Portugal*

New ornithopod remains are reported from the Papo-Seco Formation at the Espichel Cape, situated about 40 km south of Lisbon, western central Portugal. The Papo-Seco Formation, stratigraphically located between the Areias do Mastro Formation and the Boca do Chapim Formation and assigned to the Lower Barremian (Lower Cretaceous), is 18.5 m-thick and characterized by marls and green silty clays with lignite and gypsum, interbedded with sandstones, displaying horizontal stratification. Marine, lagoonal and estuarine sedimentary records, consisting in limestones, marls, sands and conglomerates, have yielded fossil remains of dinosaurs and other vertebrates since the 19<sup>th</sup> century. In the scope of the recent palaeontological research carried out by the Centro Português de Geo-História e Pré-História, several vertebrate remains were found, including turtle shell fragments, crocodilian teeth, fish, pterosaurs and dinosaurs. The study also identified bones and teeth of ornithopod dinosaurs. This study is based on ornithopod bones, teeth and a footprint cast from three sites: Areias do Mastro; Praia do Guincho and at Boca do Chapim. In Areias do Mastro site, two teeth and a maxilla fragment were attributed to *Mantellisaurus atherfieldensis*. At Praia do Guincho, a phalanx of *cf. Mantellisaurus* and a natural cast of a footprint related to the ichnogenus *Iguanodontipus* were discovered. At Boca do Chapim, several bones of a big ornithopod were discovered and in actual stage of the study we can include it in the taxon *Ankilopollexia*. The identification of this ornithopod remains increases the records and diversity of these dinosaurs from the Portuguese Lower Cretaceous.

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# 10 MILLION YEARS OF SOLITUDE: THE SCARCE PALEOCENE VERTEBRATE RECORD OF THE SOUTHERN PYRENEES

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**Keywords:** *Paleocene, Cretaceous, Eocene, Tremp Group, vertebrate localities*

The South-Central Pyrenean unit has yielded a renowned palaeontological record found in continental successions from the Cretaceous to the Paleogene. However, most of the palaeontological localities are concentrated in the Late Cretaceous and the Eocene epochs, being the Paleocene fossil record intriguingly scarce.

The Mesozoic stratigraphic interval of the Tremp Group has provided hundreds of vertebrate-bearing sites that allowed the identification of several dinosaur clades and other faunas such as crocodylomorphs, testudines, amphibians, squamates and fishes. In contrast, in the Paleocene deposits of the same group only three mammal localities have been discovered until now, which contain scarce remains of the multituberculate *Hainina pyrenaica*. In the lower Eocene rocks of the Ager Basin, the palaeontological record highly increases and becomes a reference sector for studies concerning early primates. In this respect, these deposits have yielded the first remains of Plesiadapiformes from Spain, together with three different species of the adapiform *Agerinia*.

The apparent Paleocene fossil gap can be explained by different factors: i) possible ecological disturbances after the Cretaceous-Paleogene event that significantly reduced the taxonomic diversity in the region; ii) a taphonomic bias due to the predominance of reddish, highly oxidized fluvial facies; iii) lack of intensive research on these continental deposits. With the aim of elucidate which cause could better explain the scarcity of palaeontological localities during this stage, fieldwork campaigns have been scheduled in the continental exposures of the southern Pyrenees that include prospection, sediment collection and screen-washing in order to recover small vertebrate remains of this age.

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# TREMATOSAURS: A NEW LOOK TO THE EARLY TRIASSIC GENUS *ANGUSAURUS* (TEMNOSPONDYLI: STEREO SPONDYLI) BASED ON X-RAY MICROCT SCANNING

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**Keywords:** *Triassic, Tetrapod, Trematosaurinae*

The origin and radiation of trematosaurs started in the earliest Triassic, just after the End Permian mass extinction, and survived up to the Late Triassic. This group is currently known from over all continents except South America and Antarctica. Except for basal members, trematosaurs are mainly divided into two clades: Trematosaurinae (short-snouted members) and Lonchorhynchinae (long-snouted members). Several trematosaurine taxa have been described, mainly from Central European basins and the Russian Eastern Platform but also from Africa and Australia. However, their phylogenetic relationships are still debated. Here, the Early Triassic trematosaurine *Angusaurus* from Russia is re-described based on an almost complete skull (SMNS 81782), never described, referred to *A. cf. tsylmensis*, using X-ray microCT scanning. *Angusaurus* present few key anatomical characters as A) skulls about 200 mm long (adult size), B) small orbits (compared to other trematosaurines), C) elongated postorbitals and postfrontals, D) a very reduced interchoanal tooth row and E) ventral opening of the orbits in the middle part of the skull. To date, four species have been erected (*A. dentatus*, *A. weidenbaumi*, *A. succedaneus* and *A. tsylmensis*). However, validity of some of them is controversial and a re-evaluation is required to assess the intraespecific variability of this genus based on a new phylogenetic analysis. Deciphering the evolution of trematosaurines is necessary in order to understand how anamniotes evolved and which are the key processes explaining their survival to the End Permian mass extinction. It also provides elements to clarify their origin and the different paleobiogeographical scenarios that remain open.

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## A MILLION YEARS OF BAT FOSSIL RECORD FROM TWO OF THE ATAPUERCA CAVE-LOCALITIES

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**Keywords:** *Chiroptera, Sima del Elefante, Gran Dolina, Early Pleistocene, Middle Pleistocene*

The Atapuerca sites (Burgos, Spain) provide a complete, wide quaternary stratigraphic and archaeo-paleontological record. Here we present the first comparison between the bat fossil associations from two Atapuerca sites: the Sima del Elefante Lower Red Unit (TELRU) and the Gran Dolina (TD), one located about 500 m from the other. Both consist of long sequences of cave-filling sediments: the TELRU sequence is Pre-Jaramillo (Early Pleistocene), comprising levels TE-7 to TE-14 (TE9 dated as 1.22 Ma); the TD sequence is late Early to Middle Pleistocene, comprising lithostratigraphic units TD3-4 to TD-10 (TD-6 dated as 0.78 Ma).

The small vertebrate fossil remains were picked up from the finer sediment excavated at the archaeological sites after washing and sieving it with 0.5 mm size meshes.

The bat taxa identified at TELRU are *Rhinolophus ferrumequinum*, *Rhinolophus mehelyi*, *Myotis myotis*, cf. *Eptesicus*, *Myotis* sp. and *Miniopterus schreibersii*; the ones identified at TD are *R. ferrumequinum*, *R. mehelyi*, *Rhinolophus* cf. *hipposideros*, *M. myotis*, *Myotis bechsteinii*, *Myotis* cf. *capaccinii*, *Myotis* sp., *Plecotus* sp., *M. schreibersii*. The *M. myotis* presence is continuous and dominant along both sequences, showing the local great stability of this species populations; the remaining taxa appear discontinuously. The high Chiroptera diversity in TD layers is remarkable, contrasting with the much lower one of TELRU levels. The non-chiropteran small mammal associations from both sequences also show strong differences, interpreted as a temporary gap between them. At TD-10 the specific diversity of order Chiroptera decreases, which could be related to an environmental change towards greater aridity.

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## USING 3D GEOMETRIC MORPHOMETRICS TO ESTIMATE MISSING VERTEBRAE IN A SPINOPHOROSAURUS DORSAL SPINE (MIDDLE JURASSIC, NIGER)

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**Keywords:** 3DGM, semilandmarks, spine, Spinophorosaurus, Middle Jurassic

Missing data estimation is a challenge when studying the fossil record. Research on the humans has estimated missing elements in the thoracic spine, based on 3D geometric morphometrics and exploiting metamerism. However, this protocol has never been used for other vertebrates. Since all vertebrates share an embryological metameric origin of the vertebral sequence from the paraxial mesoderm regulated by *Hox* genes, we expect that the same protocol could be used for other clades.

In this context, *Spinophorosaurus* is a sauropod dinosaur with an almost uninterrupted vertebral series with some damaged vertebrae. Here, we apply the hominin vertebrae estimation protocol to estimate the shape of a badly damaged D2 vertebra using information from the complete D1 and D5. We quantified the vertebrae using a protocol of 394 landmarks and sliding semilandmarks, measuring both the body and arch with emphasis on laminae. We used GPA analysis and average coordinates calculation between D1 and D5 to estimate D2.

The reconstructed D2 vertebra fits perfectly with its rib head and adjacent vertebrae, the spine orientation matches field pictures and centrum length has been accurately reconstructed. However, the shape of the preserved real centrum is less trapezoidal than the reconstructed vertebra, suggesting a cervicalization process for D1 that did not affect D2.

This is the first time this method is applied non-hominin vertebrates. It promises to be a useful tool for reconstructing sauropod vertebral sequences and contribute to the understanding of paleobiological aspects of this group of dinosaurs, such as their locomotion and biomechanics.

# NEW INSIGHTS INTO THE PALAEOHISTOLOGY OF THE TITANOSAUR SAUROPODS FROM THE UPPER CRETACEOUS OF LO HUECO (CUENCA, SPAIN)

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**Keywords:** *Upper Cretaceous, Sauropoda, Titanosauria, Paleohistology, Lo Hueco, Lohuecotitan.*

Titanosaurs are the most abundant group in the Lo Hueco site (Upper Cretaceous, Cuenca). Preliminary comparisons indicated the presence of at least two different titanosaurian morphotypes based on the morphology of cranial and appendicular bones. Recent analyses on the axial skeleton have revealed a higher variability, with four caudal vertebrae morphotypes. The occurrence of several individuals of different sizes -some possibly belonging to the same taxon- is a unique opportunity to study morphological variability related to ontogeny.

A histological analysis has been carried out to test this hypothesis. A small sample of at least 2 appendicular elements and dorsal ribs from 4 different specimens have been analyzed, including the holotype of *Lohuecotitan pandafilandi* (HUE-EC1) and a slightly smaller partial skeleton (HUE-EC2). Some morphological variability was previously identified in these two specimens justifying the establishment of two different caudal morphotypes.

The bone walls possess features that have been listed as typically 'titanosaurian'. The sampled ribs of *Lohuecotitan* have a Histological Bone Type "E" related to a Histological Ontogenetic Stage 11-12. Furthermore, an incipient EFS can be seen. The equivalent Biological Ontogenetic Stage is an "Adult II-III". HUE-EC2 shows a more immature bone lacking EFS. This fibrolamellar bone shows a few secondary osteons near the medullary cavity. This relates to Histological Ontogenetic State 6, equivalent to a juvenile or subadult. The analysis reveals that the *Lohuecotitan* holotype HUE-EC1 and the specimen HUE-EC2 are in different ontogenetic stages, which will be crucial to consider when evaluating potential taxonomic differences among the two specimens.

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**NEW IGUANODON BERNISSARTENSIS CRANIAL MATERIAL FROM THE UPPER  
BARREMIAN MAS DE LA PARRETA QUARRY (MORELLA FORMATION) IN MORELLA  
(SPAIN)**

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

The Barremian Arcillas de Morella Formation (Eastern Spain) has yielded a high diversity of vertebrates. The most representative fossil site of this formation is the Mas de la Parreta quarry (CMP), located at the southwest of the locality of Morella (Castellón province, Spain). The best represented dinosaur group are styracosternan ornithopods that are by far the most abundant dinosaurs throughout the Iberian Lower Cretaceous. To date, three styracosternan species have been recognized: *Iguanodon bernissartensis*, *Mantellisaurus atherfieldensis* and *Morelladon beltrani*. Several individuals of *I. bernissartensis* have been recovered in different sites of CMP being the most common styracosternan in the formation.

CMP-11 is one of the sites inside the CMP in which cranial and postcranial bones of *I. bernissartensis* have been discovered. Previously, two isolated maxillae have been reported from this site providing new information about the skull anatomy of *I. bernissartensis*. Here, new cranial bones have been examined for the first time. These bones correspond to the rostral portion of both sutured premaxillae, a second incomplete right premaxilla, a nearly complete dentary, two quadrates and several isolated dentary and maxillary teeth. The presence of two right premaxillae indicates the presence of at least two individuals. These cranial bones can be confidently referred to *Iguanodon bernissartensis* based on a unique combination of shared characters, as an autapomorphic extensive vertical buttress of the quadrate. This new material corroborates the abundant presence of a form compatible with *I. bernissartensis* in the Iberian Peninsula that would constitute the southern limit of its current distribution.

**Acknowledgments:** We thank Morella municipality and Vega del Moll S.A. Company for collaboration.

# AMPHIBIANS AND REPTILES FROM THE EARLY MIOCENE OF WEISENAU IN THE HISTORICAL COLLECTIONS OF THE UNIVERSITY OF TORINO

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**Keywords:** Germany, early Miocene, Serpentes, Anguidae, Amphibian

The early Miocene (MN1) locality of Weisenau, near Mainz (Germany), is well known for having yielded some important remains of amphibians and reptiles, among which the type material of the amphisbaenian *Palaeoblanus tobieni*. We here report on a previously undescribed, small set (159 bones) of herpetofaunistic remains coming from this locality stored in the historical collections of the Museo di Geologia e Paleontologia of the Università degli Studi di Torino (Italy). The fossils from Weisenau exclusively represent vertebral elements of both amphibians and reptiles.

Amphibian remains include only few vertebrae of a medium-large-sized caudate (total length of the specimens reaching up to 0.8 cm) similar to *Salamandra sansaniensis*. As for reptiles, numerous snakes have been identified, including members of Boidae, “colubrines” and Viperidae. *Vipera* cf. *antiqua* was already reported from Weisenau and it is possible that the vertebrae herein attributed to viperids belong to the same taxon. Anguid lizards are also present, being referable to only one taxon, *Pseudopus*. Due to the unknown origin of the material and to its scarce representativeness it is not possible to draw any palaeoecological conclusion, but it represents at least an interesting comparative material available for study.

# PALEOPATHOLOGICAL TRAITS IN THE CAUDAL VERTEBRAE OF THE TITANOSAUR DINOSAURS OF THE UPPER CRETACEOUS OF LO HUECO (FUENTES, CUENCA)

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**Keywords:** *Lo Hueco, Upper Cretaceous, titanosaurs, pathologies, caudal series.*

The paleontological site of Lo Hueco (Upper Cretaceous, Spain, Cuenca) has provided a great variety of partial skeletons of articulated titanosaurs, providing a unique paleontological record in Europe. In the present study, some titanosaur series of caudal vertebrae from the site were revised for the first time in order to determine possible pathologies affecting these individuals.

A comparative anatomical study was carried out to determine the diversity of morphologies present in the titanosaurs of Lo Hueco and to discriminate possible pathological conditions from intraspecific variability, and diagenetic or biostratinomic deformation.

Subsequently, 14 pathological elements have been identified, 10 corresponding to caudal vertebrae and 4 belonging to haemal arches. Differential diagnosis has been carried out on all of the specimens based on a macroscopic analysis occasionally supplemented with computerized tomography (CT) scan explorations.

As results, spondylosis deformans has been identified in two vertebral centra, two cases of subchondral cysts, three fissured haemal arches, a dislocation of the chevron in a vertebral centrum, several elements affected by enthesophytes, and a vertebra with a modified prezygapophysis and outline of the anterior articular face of congenital or traumatic origin.

## CROCODYLOMORPH TEETH FROM THE LOURINHÃ FORMATION, PORTUGAL (LATE JURASSIC)

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**Keywords:** *Crocodile dentition, Palaeoecology, Microvertebrates, Lourinhã Formation, Upper Jurassic*

The Upper Jurassic outcrops of Portugal have yielded five crocodylomorph species: the marine *Machimosaurus hugii*; the generalist *Goniopholis baryglyphaeus*; and the insectivorous/carnivorous *Knoetschkesuchus guimarotae*, *Lisboasaurus estesi* and *Lusitanisuchus mitracostatus*. Additionally, two crocodylomorph ootaxa have been described: *Suchoolithus portucalensis* and *Krokoolithes dinophilus*.

Here we describe 125 teeth recovered by screen washing of sediments from Valmitão (Ribamar, Lourinhã), a microfossil site in the Lourinhã Fm. (Late Kimmeridgian — Tithonian) of the Lusitanian Basin, located 65 km north of Lisbon (Portugal).

Conical teeth are the most common in the sample, as often observed in other localities, and are related to generalist taxa. The most abundant generalist crocodylomorphs during this temporal and geographical range belonged to the Goniopholididae. Ziphodont teeth are present in several clades and can be related to highly predatory crocodylomorphs. Molariform teeth are very similar to those observed in bernissartiids, being related to durophagous diets. Lanceolate to leaf-shaped teeth are characteristic of atoposaurids, being usually related to an insectivorous diet that may also include small vertebrates. The absence of large robust durophagous forms, such as *Machimosaurus*, present in other Portuguese localities, may be either the result of a sampling bias related to specimen size, or because the Valmitão microfossil site represents a freshwater environment deposit. This is supported by the relatively high number of lanceolate and leaf-shaped teeth, often related to continental crocodylomorphs.

This association is taxonomically similar to other contemporaneous west-central European localities, with a diverse and disparate fauna, where different crocodylomorphs lived together, avoiding direct ecological competition through niche partitioning.



# THE TAPHONOMY OF ICHTHYOSAURS: WHAT “LANDING POSITIONS” CAN TELL US ABOUT PALEOBIOLOGY

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**Keywords:** *Ichthyosauria, fossilization, marine reptiles, comparative anatomy, biomechanics*

Ichthyosaurs, a very successful group of Mesozoic marine reptiles globally represented until the end of the Cenomanian, show one of the largest sample sizes of articulated specimens in amniote paleontology. Even though these animals are well-studied, questions still remain regarding their paleobiology. It has been discussed whether ichthyosaurs were positively or negatively buoyant, requiring a different use of the tail fluke. In addition to anatomical and biomechanical evidence, information on their biology might be provided by taphonomy. Specifically, the mode of carcass arrival on the sea floor (“landing mode”) provides insights into the weight distribution in the animal at a time when the tail fluke no longer influenced movement. Here, the landing modes of ichthyosaur skeletons of wide spatial and temporal distribution are discussed. A high number of specimens seem to have reached the sea floor head-first, which resulted in spectacular fossils with a broken snout and the skull embedded at an angle to the bedding plane. After the initial contact with the sediment, these carcasses shifted into a more stable position. This landing mode, most likely caused by the greater mass of the skull compared to the rest of the body, is seen often in Ichthyopterygia but is not common in other marine amniotes. Most of these have a lower skull to total body weight ratio than ichthyosaurs. Generally, the anterior landing mode is more commonly observed in larger specimens which would have had a greater impact on the sea floor and could have penetrated the sediment accordingly.

# THE DIVERSE DISARTICULATION PATTERNS OF MARINE REPTILES FROM THE MIDDLE TRIASSIC LAGERSTÄTTE OF WINTERSWIJK, THE NETHERLANDS, PROVIDE INSIGHTS INTO THEIR PALEOENVIRONMENT

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**Keywords:** *Muschelkalk, Sauropterygia, Germanic Basin, taphonomy*

Articulated marine reptile skeletons are extremely rare in the Muschelkalk of the Germanic Basin with the exception of the Winterswijkse Steengroeve locality in the Netherlands. Recently, several new species of marine reptiles (mostly Eosauropterygia), have been described from the Anisian Vossenveld Formation at Winterswijk, showing the scientific importance of this locality. The finds represent a large variety of disarticulation patterns, ranging from full articulation to isolated bones. This suggests a complicated taphonomy of the locality that must have been influenced by various factors. Despite this large variety, with no two specimens looking alike, there are recurring patterns. We observed twelve disarticulation patterns in a dataset of 327 specimens and provide new insights into the taphonomy and paleoenvironment of the locality. Some of these patterns differ between the two most common taxa, the pachypleurosaur *Anarosaurus heterodontus* (39%) and the nothosaur *Nothosaurus* spp. (36%). This variation can be attributed to differences in anatomy and habitat preference. Generally, the larger *Nothosaurus* are disarticulated to a higher degree, indicating longer transport than in the pachypleurosaur carcasses. This study provides further evidence for an environment of hypersaline, very shallow water with weak currents and microbial activity which tacked the carcasses to the substrate. Furthermore, little evidence could be found for scavenging, indicating that Winterswijk most likely records a hostile environment where carcasses remained largely undisturbed before burial.

## TITANOSAURIAN TEETH TELL TALE OF TRANS-MEDITERRANEAN TRAVEL

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**Keywords:** *Titanosauria, tooth morphotypes, Late Cretaceous, North Africa, Palaeobiogeography*

The Late Cretaceous (Cenomanian, 100.5Ma – 93.9Ma) Kem Kem beds of Morocco and equivalent beds in Algeria have produced a rich fossil assemblage, yielding, among others, many isolated teeth which can be used in species diversity studies. As this area is rare in herbivore body fossils, these isolated teeth provide a different approach to analyzing past faunal assemblages. Eight isolated sauropod teeth from these North African sites are studied here, to assess sauropod species diversity in the Late Cretaceous of Northwest Africa. Two general morphotypes are found, based on enamel wrinkling and general tooth morphology, as well as by comparison with other Late Cretaceous sauropods from North Africa and Southern Europe. All morphotypes are titanosaurian in origin; even though rebbachisaurids have been reported in earlier studies, these were not convincingly found amongst the tooth sample. Moreover, striking similarities are found between the Moroccan/Algerian tooth morphotypes and morphotypes from the Campanian-Maastrichtian (83.6Ma – 66.0Ma) of the Iberoarmoricain Island, namely 'morphotype B' from Lo Hueco (Spain), as well as the 'cylindrical morphotype' from Fox-Amphoux-Métisson (France). This result suggests the presence of landbridge connections in the Cretaceous between North Africa and Southern Europe, as has been proposed by previous authors.

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# MARK, SHELLY, AND THE PHILLIPS JOIN THE PARTY: ADDITIONAL SAUROPOD MATERIAL FROM THE CALLOVIAN PETERBOROUGH OXFORD CLAY

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**Keywords:** *Jurassic, Neosauropoda, vertebra, caudal, dorsal*

Two isolated caudal vertebrae (anterior and middle), as well as an associated posterior dorsal and anterior caudal, from sauropods of the Oxford Clay (Callovian, Middle Jurassic) near Peterborough, UK, are described and discussed. The anterior caudal ('Shelly') has an extensive covering of bivalves, however diagnostic features are visible, including the presence of a ventral keel, a 'shoulder' indicating a wing-like transverse process, along with a possible prespinal lamina. This indicates derived eusauropod or neosauropod affinities. The isolated middle caudal ('Mark') also shows diagnostic features, despite the neural spine and neural arch not being preserved, and the neurocentral sutures being unfused. The presence of faint ventrolateral crests, as well as a rhomboid anterior articulation surface, show neosauropod affinities. The presence of possible nutrient foramina are only tentative evidence of a neosauropod origin, as these also appear in Late Jurassic non-neosauropod eusauropods. Finally, the dorsal and associated anterior caudal centra ('the Phillips') show a complex neural arch morphology, and nutrient foramina, indicative of a neosauropod origin. As these elements differ from similar elements from the other sauropods from the Oxford Clay, *Cetiosauriscus stewarti*, '*Ornithopsis*' and an unnamed brachiosaurid, they hint towards a higher taxon count. A phylogenetic analysis using these caudal and dorsal characters shows a diplodocoid affinity for the anterior caudal, a diplodocid origin for the middle caudal, and even apatosaurine affinities for the associated dorsal and caudal. Together with *Cetiosauriscus*, and other material assigned to different sauropod genera, this study shows a high sauropod biodiversity in the Callovian Oxford Clay.

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## RUTLAND REVISITED: THE RUTLAND CETIOSAURUS

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**Keywords:** *Middle Jurassic, Eusauropoda, Cetiosauridae, UK, phylogeny*

*Cetiosaurus oxoniensis*, from the Bathonian Forest Marble of Bletchington Station, Oxfordshire, UK, is the oldest named sauropod, coined by Richard Owen in 1841. The type material, housed at OUMNH, Oxford, consists of appendicular, pelvic and pectoral elements. However, axial material is scarce, apart from caudal vertebrae and chevrons. A new specimen of *Cetiosaurus* was uncovered in 1968 from Bajocian sediments in Rutland County, UK. This material, assigned to *C. oxoniensis*, and housed in the New Walk Museum and Art Gallery, Leicester, consists of a much more complete axial record than the type material, and includes parts of the sacrum, ilium and right femur. There is, therefore, some overlap in material, though largely limited to caudals, chevrons, ilium and femur.

Recently, several palaeontologists visiting both collections have remarked on differences between the Oxford *Cetiosaurus oxoniensis* type material, and the Leicester 'Rutland' *Cetiosaurus*. Moreover, recent phylogenetic analyses on Middle Jurassic sauropods placed it as sister taxon to the Aalenian-Bajocian *Patagosaurus*, with this pair being the sister-taxon of *C. oxoniensis*.

As *Cetiosaurus* is somewhat of a 'wastebasket' taxon, (having remains ascribed to it from all over the UK, the Ardennes, and Morocco), it is possible that several types of sauropods were present in the Bajocian-Bathonian of the UK. Here, we present a new phylogeny in order to assess the degree of support existing for the Rutland *Cetiosaurus* to be a distinct taxon. Both outcomes are discussed, however, characters that support a new taxon for the Rutland *Cetiosaurus* are particularly focused on.

# THE EARLY HOLOCENE FAUNAL REARRANGEMENTS IN A HIGH-RESOLUTION FOSSIL RECORD

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**Keywords:** *Holocene, Preboreal, mammals, Central Europe*

Regarding appearance in fossil record, the extant fauna of Central Europe splits in three chorologic units: (i) paleochoric elements composing interglacial communities, (ii) those of the glacial communities, and (iii) the Holocene apochoric elements not recorded in previous stages. A rich fossil record (including more than 200 continuous faunal sequences) suggests more or less gradual rearrangements in community structure during the early Holocene and considerable geographic variation in post-glacial history of particular (i) and (ii) elements. A high-resolution record provided by a 10 m thick sedimentary sequence in Byci skala cave (Moravian karst), covering the period 12.2 to 8.4 ky with 21 horizons and 4525 minimum number of individuals of 52 mammalian species, refined that information with robust data demonstrating early appearance of (i) elements promoting abrupt changes in community structure by the end of the Young Dryas followed by dramatic fluctuations in contribution of particular species and their phenotype dynamics suggesting serial colonization events in some species, and gradual increase in alpha diversity of mammalian community terminated with onset of Boreal dynamics (along 9.3-9.5 ky event) characterized by a decrease of alpha and increase of beta diversity. Moreover, it provides a robust evidence that a considerable part of the Holocene apochoric elements, expected to spread due to the post-Neolithic landscape changes, appeared in Central Europe already since early Preboreal, including those which latter disappeared from the region. In short, for the setting of the mid-European Holocene faunal development the Preboreal was the stage of essential significance.

# LIGHTNING AND THE THUNDER: INSULAR DWARFISM INFERRED FROM LONG BONE HISTOLOGY OF THE TITANOSAURIAN ATsinganosaurus velauciensis

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**Keywords:** *Atsinganosaurus velauciensis*, *insular dwarfism*, *titanosaur*, *long bone histology*

Titanosaurian sauropods include the largest land animals that ever walked on Earth. However, some of them evolved into dwarfed species, linked to their insular habitats. Here, we report on the long bone histology of several mature individuals of the small-sized titanosaur *Atsinganosaurus velauciensis* from the Upper Cretaceous of Velaux – La Bastide Neuve (Provence, South-Eastern France). The completely remodelled H bone tissue type in all specimens characterizes mature and fully grown individuals. Together with the extensive bone remodelling, the samples range from HOS (Histological Ontogenetic Stages) 14 and from RS (Remodeling Stages) 13 to 14. Considering the reduced size of the sampled femur and humeri, the remodelling process would have begun early in the ontogeny of this titanosaur compared to non-titanosaurian sauropods, at a rate that surpassed the apposition rate. Thus, size reduction of *A. velauciensis* has to be taken into account to explain the advanced state of its long bone histology. Insular dwarfism is a consistent hypothesis for this combination of features and has been proposed for a series of other titanosaurs from the European archipelago (e.g. the Romanian *Magyarosaurus dacus* and the Spanish *Lirainosaurus astibiae*) that show comparable long bone histology and inferred body size.

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# EVOLUTIONARY RELATIONSHIPS WITHIN TELEOSAUROIDEA (CROCODYLOMORPHA, THALATTOSUCHIA) AND IMPLICATIONS FOR MARINE ADAPTATIONS

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**Keywords:** *Crocodylomorpha*, *Teleosauroida*, *Thalattosuchia*, *Phylogeny*

Thalattosuchia was a unique group of marine crocodylomorphs that flourished during the Mesozoic Era, evolving an extensive range of feeding specializations and environmental adaptations. One of the two major groups within Thalattosuchia is Teleosauroida, a distinctive clade that superficially resembled modern gharials. They attained a near-global distribution, were morphofunctionally diverse and frequented shallow marine/brackish ecosystems throughout the Jurassic. Despite an increased understanding in their anatomy over the past ten years, the evolutionary relationships within Teleosauroida are still poorly understood and little studied. Here we present an in-depth phylogenetic analysis of Teleosauroida. Over 500 specimens from 12 countries were examined, creating the largest and most comprehensive teleosauroid dataset collected to date. We used parsimony methods with a dataset including 144 crocodylomorph taxa (twenty-two of which are teleosauroids). We find the basal-most teleosauroids (e.g. *Steneosaurus gracilirostris*) to share a common morphotype (i.e. longirostrine, laterally-facing orbits, small-bodied) with the basal-most metriorhynchoids (e.g. *Pelagosaurus typus*), and that these two clades were likely similar to one another in terms of shallow marine habitat and lifestyle. We then define two major subclades within Teleosauroida: 1) a Sub-Boreal northern European/Tethyan/Eastern Gondwanan '*Steneosaurus*' + *Machimosaurus* radiation, which represented the most successful lineage of teleosauroids in terms of species, morphofunctional diversity and feeding specializations, and 2) a second Laurasian radiation which include pholidosaurid-like, more terrestrial and bizarre-looking teleosauroids. However, both radiations are known from the Toarcian and continue on until the end of the Kimmeridgian. Our research signifies a diverse teleosauroid assemblage throughout the near-entirety of the Jurassic.



# BODY MASS RECONSTRUCTIONS OF LATE PLEISTOCENE SPOTTED HYAENAS (*CROCUTA CROCUTA*, ERXLEBEN 1777) FROM EUROPE

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**Keywords:** *Crocuta*, *hyaena*, *Pleistocene*, *body mass*

This study aims to develop a model for the reconstruction of spotted hyaena (*Crocuta crocuta*) body mass and to assess the variation in European *C. crocuta* body mass during the Late Pleistocene.

Reconstruction of body mass in an extinct species is generally done by regressing average body masses of multiple living species within a family against measurements of a skeletal or dental element, such as the first lower molar (m1). This element is generally well-preserved and abundant in the Pleistocene record, after obtaining the regression, measurements from Pleistocene individuals are introduced into the regression equation to calculate body mass predictions. This technique cannot, however, be used for the Hyaenidae as there are only four living species within the family, and therefore a small sample size. Moreover, body masses of present-day *C. crocuta* vary widely across Africa, so a single average mass would mask this diversity. A new method is proposed here, using a coalition of recent body masses and m1 lengths of *C. crocuta* from across Africa.

The statistical model reveals a strong correlation between body mass and m1 length, and it has good predictive ability.

In order to reconstruct body masses, the model is applied to material from various Late Pleistocene sites in Austria, Belgium, Britain, the Czech Republic, Ireland, Serbia and Spain, thus spanning much of *C. crocuta*'s former European range. There is overlap in size through the Late Pleistocene in Britain, and between sites across Europe, although *C. crocuta* from Ireland are on average smaller.

## PLEISTOCENE SMALL VERTEBRATE STUDIES IN SERBIA (BALKAN PENINSULA, SE EUROPE): STATE OF THE ART AND PERSPECTIVES

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**Keywords:** *Late Pleistocene, paleoenvironment, herpetofauna, rodents, Balkan Peninsula*

Fossil small vertebrate assemblages are commonly used as proxy for the reconstruction of Pleistocene terrestrial environments and climates. Serbia is located at the boundary between Balkan Peninsula and Central European plains. Geologically, Serbian terrain is favorable for the formation of limestone caves where small vertebrate remains have been recovered. Best preserved fossils occur in Baranica, Smolučka and Hadži Prodanova caves. Baranica is a composite cave, situated in Eastern Serbia (Balkan mountain range), while Smolučka and Hadži Prodanova caves are in Western Serbia (Dinarides mountain range).

Archaeological excavations revealed presence of small vertebrates in: tree layers in Baranica cave and four layers in Smolučka cave, documenting the last 40,000 years; and three layers in Hadži Prodanova cave with no clear chronological context within Late Pleistocene.

When compared with local present situation, the paleoecological and paleoclimatological reconstructions for these three caves suggest that climate was somewhat colder (presence in the sites of mountain species like *Chionomys nivalis*) and dryer (mainly because of the presence of *Coronella austriaca* and *Lacerta agilis*). The application of Taxonomical Habitat indexes to the different small vertebrate assemblages suggests that the associated environment was probably more open, however with the presence of forest species (*Clethrionomys glareolus* and *Apodemus* ex gr. *sylvaticus-flavicollis*), but never representing more than 10% of the total assemblage. In addition to these general conditions, a few stronger climate shifts can be put in evidence in Smolučka cave between the different layers.

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## SEMANTOR MACRURUS ORLOV, 1931 – NEW VIEW ON ITS MORPHOLOGY AND PALEOBIOLOGY

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**Keywords:** *Miocene, Pavlodar, Semantor, Mustelidae, morphology, adaptations*

*Semantor macrurus* was found in late Miocene deposits of Northern Kazakhstan (Pavlodar locality). J.A. Orlov, in 1933, attributed it to *Pinnipedia*. It was recognized as a representative of a particular specialization within semi-aquatic mammals, occupying an intermediate position between *Otharidae* and *Phocidae*.

The secondary water specialization of *S. macrurus* does not much exceed the level of specialization of extant *Enhydra lutris*. For *Semantor*, high mobility was determined in the hip, stifle and ankle joint. The amplitude for abduction-adduction of the femur in hip joint is 60°. The mobility of the femur in the hip joint by flexion-extension in the parasagittal plane is very high with 95°, which is close to the *Lutra* mobility and much higher than in *Zalophus* with 25° and *Phoca* with 30-32°. The limb mobility in the stifle joint is 90°, in contrast with all seals, whose mobility in the stifle joint is very small with 10° in *Zalophus* and 17° in *Phoca*. This is due to the pelvic limb of known modern and fossil seals is internal. The mobility of the pelvic limb in the joints indicates that the pelvic limb of *S. macrurus* was free. The flexion and extension of the ankle joint along the cranio-caudal axis is 95°, being very wide for an aquatic form in comparison with 35° in *Phocidae* and 75° in *Otharidae*. The peculiarity of the specialization of the pelvic limb of *Semantor* was a globular ankle joint. It was multi-axial and provided high mobility of the autopodium.

# MANUS EVOLUTION IN DINOSAURIA – PATTERNS OF DIGIT REDUCTION AND LOSS

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**Keywords:** *Dinosaur, Evolution, Ancestral Reconstruction, Manus, Digit*

Loss of manual digits and/or presence of vestigial metacarpals and phalanges are commonly observed through dinosaur evolutionary history, being defining character traits of many clades. From the plesiomorphic condition of early taxa, comprising five digits with up to four phalanges each, different dinosaur lineages developed independently a wide range of manual configurations linked to particular functions. But how and when these distinct morphologies were achieved remains poorly known, with existing studies focused on few taxa or very specific clades (e.g. transition from non-avian theropods to birds). Here we present a comprehensive assessment of the phylogenetic distribution of manual digit reduction and loss across all non-avian dinosaurs. Based on an extensive literature review, taxa were scored on presence/absence of digits, metacarpals and phalanges, together with diet, habitat and manus function (e.g. grasping or weight-bearing). These character sets were then mapped in a consensus tree to reconstruct ancestral states, calculate evolutionary rates and degrees of homoplasy and assess links between manus configuration and functionality. This study constitutes a first comprehensive overview of manual digit evolution in non-avian dinosaurs, elucidating character states, patterns of digit reduction and loss in Sauropodomorpha, Theropoda and Ornithischia, and association of manus morphology with function and ecology.

## THE SHOCK OF UNEXPECTED CONSERVATISM: A COUNTER-SIGNAL TO PACHYCORMID DIVERGENCE?

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**Keywords:** *Pachycormidae*, *Bonnerichthys*, *Protosphyraena*, *Leedsichthys*, *pectoral fin morphotypes*

Pachycormids occupy a key position within Actinopterygii, as part of the Holostei–Teleostei Transition. The larger the adult size of a pachycormid taxon, the more reduced the amount of its skeleton that ossifies. Large isolated pectoral and caudal fins were most commonly collected, however little work was done with them besides installing them as striking museum showpieces. Recent discoveries of new specimens and innovative preparation work have provided new insight into the three dimensional shape and arrangement of the pectoral fins in both the tusked and toothless tribes of pachycormids. The unusually long pectoral fins appear to have developed in conjunction with otherwise reduced skeletal ossification to counteract buoyancy problems in a group apparently lacking a gas bladder. Closer analysis also reveals adaptations of a primitive morphology to suit a suite of lifestyles from swift and agile carnivore to slow-cruising suspension feeder. Although a diversity of pectoral fin morphs can be recognized within a group where the pectoral was once simplistically dismissed as 'scythe-like', there is a surprisingly high degree of staticity in fin placement and mechanics across both the extremes of these diverse feeding strategies, and 100 million years of geological time.

Unsurprisingly, some of the observed pachycormid pectoral fin morphotypes mirror some of the most modern fuel-saving wingtip designs from today's aerodynamicists, converging on similar solutions to these enigmatic and fascinating fish. This new data allows us to apply these inferences to animals that, through a pronounced lack of skeletal ossification, would otherwise remain more mystery than organism.

# HIGH DIVERSITY OF SMALL DINOSAURS PRECEDING THE CRETACEOUS/PALEOGENE MASS EXTINCTION

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**Keywords:** *Dinosauria, extinction, Maastrichtian, palaeodiversity, North America*

Dinosaurs dominated terrestrial ecosystems for over 165 million years before disappearing at the Cretaceous-Paleogene (K/Pg) boundary. A gradual diversity declines near the end of the Cretaceous has been proposed to contribute to their extinction, and in particular, the late Maastrichtian fauna of western North America is thought to be low in diversity and dominated by large bodied species. However, biases in preservation, collection, and study may obscure the diversity of small dinosaurs. Here, a review of museum collections from the late Maastrichtian of North America shows that a highly diverse fauna of small ( $\leq 100$  kg) dinosaurs thrived alongside late Maastrichtian giants such as *Tyrannosaurus rex* and *Triceratops*, just prior to the K/Pg extinction. Fossils described here represent new taxa of Microraptorinae, Troodontidae, Caenagnathidae, Alvarezsauridae, Thescelosauridae, and Leptoceratopsidae. The Late Maastrichtian of western North America supported as many as 41 species, ranging from 2 to 50,000 kg, and occupying carnivorous, herbivorous, insectivorous and piscivorous trophic niches. A survey of functional diversity shows that Maastrichtian dinosaurs occupied a wider range of niches than previously thought, and that North American faunas experienced an increase in functional diversity just prior to the K/Pg extinction. These patterns suggest that a diverse, complex terrestrial ecosystem persisted until the end of the Maastrichtian, consistent with a sudden, catastrophic extinction at the end of the Cretaceous. The diversity of small dinosaurs, however, suggests that large size alone does not explain the extinction of non-avian dinosaurs.

**THREE NEW SPECIES OF MIDDLE TRIASSIC EOSEMIONOTUS STOLLEY, 1920  
(ACTINOPTERYGII: NEOPTERYGII) FROM MONTE SAN GIORGIO**

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**Keywords:** *Actinopterygii*, *Neopterygii*, *Eosemionotus*, *Monte San Giorgio*, *Ladinian*

Over 80 years, the Middle Triassic actinopterygian genus *Eosemionotus* has been known from a single species, *E. vogeli*, from the German Muschelkalk (Anisian). In 2004, one of us (TB) published a second species, *E. cerasiensis*, from the upper Besano Formation (earliest Ladinian) of Monte San Giorgio, Switzerland, and announced the presence of additional new species of this genus at this famous UNESCO World Heritage Site. New and excellently-preserved specimens recovered from the Cassina and Sceltrich beds of the Meride Limestone (Ladinian) of Monte San Giorgio have triggered a new study. The taxonomy of the genus has been revised and three new species have been established. Differential diagnoses are proposed for the five species, which differ in body proportions, relative position of the fins, shape and other features of several skull bones, squamation pattern, and some meristic characters, including the number of premaxillary and dentary teeth, and branchiostegal rays. The new material clearly shows the presence of anterior infraorbital bones and other features suggesting close phylogenetic relationships with the family Macrosemiidae (Ginglymodi), which are confirmed through a cladistic analysis. The stratigraphic distribution of the species along the Middle Triassic sequence of Monte San Giorgio indicates a replacement of the two oldest by the two newest species. This very speciose genus is so far restricted to the c. 10 Myr of the Middle Triassic, also having been reported from localities in Eastern Switzerland, Spain, Slovenia and China.

# NEW CLUES ABOUT THE LATE EARLY PLEISTOCENE PEOPLING OF WESTERN EUROPE: SMALL VERTEBRATES FROM THE BOIS-DE-RIQUET ARCHEO-PALEONTOLOGICAL SITE (LÉZIGNAN-LA-CÈBE, SOUTHERN FRANCE)

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**Keywords:** *small mammals, herpetofauna, biochronology, paleoenvironment, early Europeans*

Bois-de-Riquet is an archeo-paleontological site located in the Middle Hérault Valley (southern France), in a recently abandoned basalt quarry near the town of Lézignan-la-Cèbe. The site provides significant paleontological and archeological data about the first occupants of Western Europe. Microvertebrate remains were recovered from all sub-units of US2, which is an archeostratigraphical unit encased in a cavity within the basalt flowstone of unit US1. A few arvicoline remains have also been recovered from the contact area between US2 and US1 (on the floor of the cavity). The small vertebrate association from US2 is composed by *Epidalea calamita*, *Lacertidae* indet., *Vipera* sp., *Mimomys savini*, *Allophaiomys nutiensis*, *Castillomys crusafonti* and *Allocricetus bursae*; which suggest an age for this unit of around 1.1 and 1.2 Ma. This biochronological interpretation matches with the radiometric datation of 1.57 Ma obtained from the basalts (US1) encasing the later deposited US2. Regarding the paleoenvironment, *A. nutiensis* is typical of an open meadow habitat, while *M. savini* is dependent on the presence of water and indicates lacustrine or marshy areas near the site. *C. crusafonti* can be associated with forest habitats, but is more generally attributed to open meadow. *A. bursae* is associated with dry meadows and scrublands. Finally, although *E. calamita* is found in a wide variety of settings, it is mainly related with dry and open meadow landscapes. Therefore, we conclude that the dominant environment during the formation of the level US2 of the Bois-de-Riquet site was a dry open meadow near a lakeside or marshy area.

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## FOSSIL CROCODYLIANS FROM THE MIOCENE OF THE VALLÈS-PENEDÈS BASIN (NE IBERIAN PENINSULA)

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**Keywords:** *Crocodylia*, *Alligatoroidea*, *Diplocynodon*, *Paleoherpetology*, *paleoenvironment*

Although fossil crocodylians from the Miocene of the Vallès-Penedès Basin (Catalonia) have long been known, only the material of *Diplocynodon ratelii* from the early Miocene (MN4) of els Casots has been described in detail. Here we revise all the crocodylian remains from the Miocene of this basin including >200 remains from 13 fossil localities ranging in age from the early to the late Miocene. New remains of *D. ratelii* from els Casots are larger than those previously recorded there, in agreement with those from the type locality. *Diplocynodon* sp. is also recorded at the roughly coeval site of Can Canals (MN4), whereas the material from the remaining localities does not enable identification to even family rank, being assigned to *Crocodylia* indet. These localities include: Molí Calopa, Costablanca, Sant Andreu de la Barca and Turó de les Forques 1 (MN3); Torreta del Clos (MN3–MN4); Can Julià, Can Martí Vell 2 and 3, les Cases de la Valenciana 1 and Sant Mamet (MN4); Ca l'Almirall (MN6); and Can Feliu and Castell de Barberà (MN9). Our results show that crocodylian remains are much more abundant in early Miocene localities and become much rarer after the mid-Miocene Climatic Optimum. Crocodylians are indicative of water bodies and high temperatures, such that their decrease in abundance could be attributable to the progressive climatic 'deterioration' that took place throughout the middle and late Miocene—until they became locally extinct soon after the earliest Vallesian, roughly coinciding with the disappearance of forest-adapted taxa of (sub)tropical affinities.

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# THE FIRST RECORD OF THE GIANT TORTOISE FROM THE MIDDLE MIOCENE OF THE CZECH REPUBLIC

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**Keywords:** Titanochelon, Testudinidae, Brno-Královo Pole, Kostelní zmola, Lower Badenian

“Kostelní zmola” (Brno-Královo Pole district) locality, situated in the northern part of Brno city, represents a set of the lost sand-pits excavated in the middle Miocene deposits of equal age (Lower Badenian, MN 5). These deposits are developed in so called “Brno sands” which are typical by the cross-bedded sands and gravels corresponding to the fluvial environment preceding the Early Badenian marine transgression. As regards fossil vertebrates, this area is currently known only by the presence of selachids and teleostean fish fauna recovered from the marine clays (known as “Tegel”) deposited during the Early Badenian transgression. We present the tortoise remains uncovered from one of the former “Kostelní zmola” sand-pits. These remains are tentatively ascribed to one taxon stored at Moravian Museum collections. This large tortoise individual, formed by a partial shell and associated bones, is attributed to *Titanochelon* sp. which represent the first record of the genus *Titanochelon* s.s. in Czech Republic. Despite the remains fit well with the species *Titanochelon vitodurana* (MN6) only reported from Switzerland, the preservation state of the studied specimen prevents a precise species attribution. The presence of this giant thermophilic taxon indicates a dry environment with open steppe vegetation in Central Paratethys during the upper part of the MN5 Zone. The occurrence of *Titanochelon* sp. expands our poor knowledge on the Central European turtle assemblages during the middle Miocene.

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# RELATIVE SIZE VARIATIONS OF *MICROTUS ARVALIS* AND *MICROTUS AGRESTIS* AS CLIMATIC PROXY: THE CASE OF GROTTA FUMANE

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**Keywords:** *Common vole, Ficed vole, morphometrics, climate*

Fumane cave (350 m a.s.l.) is located in the Veneto Pre-Alps, north-eastern Italy. It presents one of the most important and well-dated Palaeolithic sequence of Late Pleistocene of the Italian Peninsula. Here we analysed the relative size variations of the first lower molar (m1) of *Microtus arvalis* and *Microtus agrestis* from Fumane cave during Marine Isotope Stages (MIS) 3-2, quantifying these variations with the  $L_{agr}/L_{arv}$  index,  $L_{agr}$  being the mean value of L (total length of m1) in *M. agrestis* and  $L_{arv}$  the mean value of L in *M. arvalis*.

We compared our results with previous studies of palaeoclimatic and palaeoenvironmental reconstructions based on small mammals, large mammals and birds to investigate the efficacy of the index as proxy for climatic oscillations through the sequence of the site. We observed that, while *Microtus arvalis* showed an increase in size during arid periods, *Microtus agrestis* became larger during humid pulses.

The  $L_{agr}/L_{arv}$  index proved to be an excellent indicator of the general level of humidity in the surrounding of Fumane cave (presence/absence of surface water resources, increase/decrease of open humid environment), although it is not directly correlated with the mean annual precipitation calculated for the site, but probably related with the annual distribution of rainfalls. Comparing the values of the  $L_{agr}/L_{arv}$  index of Fumane cave with those of other sites of the Italy, northern Spain, Croatia, Hungary and Belgium, we analysed the responses of the two species to the climatic oscillations of MIS 3-2 in different geographic and climatic areas.

# THE TAPIR FORELIMB AS A MORPHOFUNCTIONAL ANALOGUE FOR EOCENE EQUOID LOCOMOTION

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**Keywords:** *forelimb, locomotion, morphology, palaeothere, tapir*

Tapirs have historically been considered as ecologically analogous to extinct, four-toed relatives of modern perissodactyls (horses, tapirs and rhinos). In this study, we use a pre-existing dataset of forelimb bone shape to compare locomotor morphology and function between four modern tapir species and the putatively analogous endemic European perissodactyls - the palaeotheres (Hippomorpha: Equoidea). Forelimb bones from 15 species of Eocene and Oligocene European perissodactyls were laser scanned, with high sample sizes for long-bones (humerus, radius, ulna, metacarpals). Bone shape was quantified using 3D geometric morphometrics. Lever-arms were calculated for the shoulder and elbow joints, with high lever-arm ratios (LARs) indicating higher joint angular velocity. Long-bone ratios were calculated from humerus, radius and third metacarpal lengths. Landmark coordinates were Procrustes aligned, with resulting aligned coordinates and Euclidean distances between mean species values extracted for PCA and neighbour-joining tree calculation. PC1 described an axis of robusticity, with PC2 dividing groups based upon joint facet morphology. MANOVA and post-hoc testing show that the humerus of *T. pinchaque* most closely resembles that of extinct equoids *Plagiolophus* and *Propalaeotherium hasiacum*. Neighbour-joining trees suggest *Palaeotherium magnum* demonstrates the closest morphological and mechanical affinity to the *Tapirus* genus. *Lophiodon* and *P. magnum* resemble neotropical tapirs (including *T. pinchaque*) in humeral morphology and LARs. Finally, forelimb proportions suggest greatest locomotor similarities between modern tapirs and *Eurohippus*, *Lophiodon* and *Chasmodon*. From both morphological and functional analyses, we conclude that different extant tapir species may represent valid forelimb analogues for specific early European perissodactyls in this study.

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## NEW THEROPOD POSTCRANIAL REMAINS FROM THE UPPER BARREMIAN OF SPAIN AND ITS IMPLICATION FOR BARYONICHINE DIVERSITY

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**Keywords:** *Theropoda, Baryonychine, Lower Cretaceous, Morella, Spain*

Megalosauroid theropods are a relatively diverse clade of basal tetanurans with a worldwide distribution. The clade includes platnitkysaurids, megalosaurids and spinosaurids. The latter are especially well-represented in Cretaceous strata of Africa, South America, and Asia, but also in Europe, mainly in England, Portugal and Spain. Here, new postcranial remains of spinosaurid dinosaurs from the upper Barremian Arcillas de Morella Formation of Spain are described. These elements correspond to a posterior cervical vertebra, a right femur, a proximal fragment of a right femur, and a partial left tibia collected in three sites within the Mas de la Parreta Quarry at Morella (Castellón province, Spain). These remains present a combination of characters compatible with the clade of spinosaurids Baryonychinae, including the cervical vertebra with neural spine low and transversely thin and elongated zygapophyses and epipophyses. Comparison with elements assigned to *Baryonyx* indicates some differences between the remains from Morella and those of this genus described in the Lower Cretaceous of England, including the less ventral extension of the lateral femoral condyle relative to the medial one and the much less anteroposteriorly compressed femoral proximal end. Based on some identified differences, especially evident on the femora, the specimens from Morella can be confidently referred to a baryonychine distinct from *Baryonyx*. These new specimens support the previously proposed hypothesis on the presence of baryonychines in the eastern Spain and add information for the knowledge of the diversity and distribution of this clade in the Lower Cretaceous of the Iberian Peninsula.

**Acknowledgments:** We thank Morella municipality and Vega del Moll S.A. Company for collaboration.

# RAPID LOCOMOTION IN SAUROPODOMORPH DINOSAURS: RATHER WALKING INSTEAD OF RUNNING AS A MEANS TO DEAL WITH LARGE BODY MASS?

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**Keywords:** locomotion, sauropodomorpha, stride length, stride frequency, RATHER walking

The locomotion capability of an animal is directly tied to the material properties of its tissues and its size. Small animals can jump easily, bigger ones need special limb adaptations to achieve similar agility. Giant animals lose agility to the point where they cannot run, unable to employ an unsupported phase, as their limbs cannot be sturdy and powerful enough to lift the animal and absorb the resulting impact. Unravelling the underlying principles allowed Alexander to formulate his famous formula that allows calculating the speed at which a trackway was made if the maker's leg length is known. And for decades it has been used to calculate the walking speeds of dinosaurs, despite Alexander's own doubts and despite all the uncertainties involved in estimating limb length.

However, is terrestrial locomotion really that uniform? Can we extrapolate data from mammals to dinosaurs? The latter's limbs are built differently, with weak ankles and a focus on the caudofemoralis muscle as the main limb retractor. In contrast, mammals produce high torques in all joints of the limb.

Here, we present 3D volumetric muscle reconstructions of *Plateosaurus* and *Bos* that deliver muscle moment arms and forces. The comparison shows that *Plateosaurus*, and by extension sauropods, with high flexion and extension powers in the hip and a weak ankle, were adapted to short stride lengths and high stride frequencies (rapid, tiny steps = RATHER walking), whereas *Bos* follows the mammalian pattern linking stride length to frequency. Alexander's formula should therefore not be used on dinosaurs.

## WEAPONS-GRADE SAUROPODS OF THE BLACK HILLS: A RADIOACTIVE ASSEMBLAGE OF JURASSIC SKELETONS AWAITING DESCRIPTION

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**Keywords:** *sauropod, brachiosaur, Morrison, excavation*

Primarily excavated in the 1990s, the University of Kansas quarry in Weston County, Wyoming was originally discovered in the summer of 1941 by a field crew from the University of Nebraska, who noticed several large bones eroding from the outcrop. A preliminary excavation showed the presence of a large sauropod skeleton and plans were made to return to the site the following year. With the United States entry that winter into World War II, all field activities were cancelled for a number of years, and the bones laid exposed at the surface under simple plaster jackets. Due to mistakes in locality records made by the original field crew, the University of Nebraska was never able to relocate the quarry. The landowner, after seeing the degradation of the plaster, covered the site over again to protect it. In 1994, Larry Martin, a Nebraska alumnus and Curator at the University of Kansas, was able to finally relocate the quarry and led excavations to recover the 1941 specimen. As the quarry operations expanded, additional mostly articulated specimens were recovered, including four specimens of *Camarasaurus*, as well as specimens of Brachiosaurs, *Barosaurus*, *Dryosaurus*, *Othneilsaurus*, and a large theropod but oddly no large ornithischians. Disarticulated material is also abundant, and includes the largest sauropod pes ever recovered, which most likely to a brachiosaur. This specimen also happens to be the most radioactive fossil in the KUVF collections. The site is still being worked on, and hopefully more discoveries will be made in the coming years.

# EVOLUTIONARY RELATIONSHIPS AND BIOGEOGRAPHIC HISTORY OF EUSAUPOD DINOSAURS

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**Keywords:** *Biogeography, Cretaceous, Gondwana, Jurassic, Sauropods*

Eusauropod dinosaurs had a global distribution by the Middle Jurassic, with the first neosauropods known from the Late Jurassic. Significant progress has been made in the last decade in terms of the phylogenetic relationships of the neosauropod clades Diplodocoidea and Macronaria, via increasing taxon and character sampling, as well as revision of existing characters. However, focussing on these clades separately limits our ability to determine the placement of taxa that lie close to the base of Neosauropoda. Here we present a revised and expanded phylogenetic analysis, comprising 117 taxa, including most Late Jurassic to mid-Cretaceous eusauropods, scored for 542 characters. Our topology generally follows the main relationships recovered in recent analyses, but provides support for several novel or previously uncertain placements. *Haplocanthosaurus*, from the Late Jurassic Morrison Formation of the USA, has proven to be one of the most unstable eusauropod taxa: our results support its placement as a basal diplodocoid. The enigmatic *Tendaguria*, from the Late Jurassic Tendaguru Formation of Tanzania, is recovered as a non-neosauropod turiasaur, the first representative of Turiasauria recognised from Gondwana. A caudal vertebral sequence from the Tendaguru Formation displays several features that indicate a close relationship with Middle–Late Jurassic mamenchisaurids, otherwise thought to be endemic to East Asia. Analysis using the Maximum Likelihood R package BioGeoBEARS, incorporating palaeogeographic constraints, indicates that the biogeographic history of eusauropods is best explained by a combination of sympatry, early occurrences of widespread ancestral stocks followed by regional extinction, and founder-event speciation (i.e. long-distance geodispersal).



## RESPONSE SURFACE OPTIMIZATION METHODS TO INFER MUSCLE FORCES IN FOSSIL TAXA: EKEMBO AS AN EXAMPLE

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**Keywords:** *biomechanics, muscle forces, ekembo, primates, jaw*

Miocene primates *E. nyanzae* and *E. heseloni* appear to be closely related species, although, there are certain differences in the dentition. Both species have a molar morphology indicating a predominantly frugivorous diet. Specifically, *E. heseloni* from the Kenyan Rusinga Islands is thought to consume a general frugivorous diet similar to e.g. extant gibbons.

To study the morphological traits, Finite Element Analysis (FEA) models of the mandible of *E. nyanzae* and *E. heseloni* were created to gain biomechanical data that allow quantification of their chewing process. To allow for dietary trait allocation and comparative analysis, these mandibular FEA models were compared to those of extant great apes and gibbons.

Unfortunately, rather fragmentary fossil remains (KNM-RU 7290 and KNMU-RU 1674) represent the two *Ekembo* taxa. Both *Ekembo* mandibles can be satisfactorily reconstructed but only a highly distorted skull fragment renders reconstructions of chewing muscle attachments difficult. To solve this issue, the use of mathematical optimization methods was proposed to infer the direction of the muscle forces of the mandible in a biomechanical model that relies only on mandibles. Particularly, Response Surface Methodology (RSM) was used in combination with FEA to infer the muscle force directions of both fossil taxa to solve the FEA models.

The main conclusion of this work is that the results obtained for the FEA models of both *Ekembo* suggested that their biomechanical performance during chewing is closer to the gibbons than to the great apes.

## CLEANING PELECANIMIMUS (ORNITHOMIMOSAURIA, EARLY CRETACEOUS, SPAIN)

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**Keywords:** *Conservation, Restoration, Preparation, Transfer, Las Hoyas*

*Pelecanimimus polyodon* is a species of ornithomimosaur theropod described from a single articulated partial skeleton from the Upper Barremian (Lower Cretaceous) site of Las Hoyas (Cuenca, Spain). The holotype of *Pelecanimimus* is a unique and very relevant specimen for the knowledge of the evolutionary history of the ornithomimosaurs, and has a great museographic potential. In this sense, the specimen is currently under review, and has become part of the recently renovated permanent exhibition of the Museo de Paleontología de Castilla-La Mancha. Therefore, an intervention has been carried out on the specimen to assess its conservation status and ensure its future conservation.

The fossil was collected distributed in several fragments of lithographic limestone. Some of the fragments, particularly the skull, were prepared by the resin transfer method. The fragments were anchored to a polyester resin block, and formic acid was utilised to remove the calcareous matrix. The conservation state of the polyester resin that support the fossil, which can be unstable against light, temperature and humidity, has been evaluated. The cleaning of its surface and the restoration of some cracks was the next step. In the same way, part of the matrix still attached to the fossil was mechanically removed. The remains of altered consolidant and other wastes on the fossil were removed through the use of Japanese paper embedded in acetone. The fossils subjected to chemical technics can become very weakened, proceeding to a specimen's consolidation.

## REDISCOVERY OF THE LOCALITY OF MURS (OLIGOCENE, SOUTHEASTERN FRANCE): FIRST RESULTS OF THE NEW EXCAVATIONS

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**Keywords:** *Early Oligocene, Provence, reptiles, mammals*

The locality of Murs, dated to ca. 31Ma (MP23), is located in the Early Oligocene Apt-Forcalquier Basin in Southeastern France. It is known since the 1920's when local farmers found several fossil remains that they sent to H.G. Stehlin, curator of the Natural History Museum Basel, Switzerland. The interest in this locality remained limited until the 1960s, and most importantly in the 2000s when some of the mammalian fossils were published, including a preliminary faunal list. The latter publication described a new species of Perissodactyla, *Plagiolophus huerzeleri*, based on nicely preserved skulls on a block as well as on other bones. The presence of this sediment block rich in fossils and historical data found in the archives of the Museum in Basel raised our interest and we organised a new excavation of the site in October 2017. After finding the probable location of the original site again, we discovered 60 fossils including two other exquisitely preserved skulls, postcranial bones and some teeth of *Plagiolophus*. We also found new artiodactyl, rodent, turtle and crocodile material. To date, the mammalian fauna is composed of at least 3 perissodactyls (one *Plagiolophus*, two rhinocerotids), 4 artiodactyls (a cainothere, an anthracothere, a ruminant and possibly an entelodontid), a carnivore, and one rodent (a theridomorph). The list of material includes a total of nearly 200 specimens. New excavation will be taking place in 2018 with the hope of increasing the fossil sample and precisising the biogeographic and biodiversity context of the Early Oligocene of Southern France.

# LOCOMOTOR BEHAVIOR OF ADAPIS PARISIENSIS REVISITED: INSIGHTS FROM HUMERAL REMAINS OF HIGH MORPHOLOGICAL DIVERSITY

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**Keywords:** *Adapis*, *humeri*, *Quercy*, *locomotion*

Twenty primate humeral remains from Quercy (France) attributed to the adapiform primate *Adapis parisiensis* have been further analyzed after concluding that different morphotypes, possibly belonging to different species, may well be present in the sample.

The high morphological diversity of these humeri was quantified using Levene's tests and compared to extant primates of similar size. Our results show that some features of the distal articulation exceed the variance found in living species, confirming the idea that several species must be represented within the sample, as was suggested by previous authors. Moreover, our analyses show how humeral features previously thought to be not present in *Adapis*, such as the zona conoidea, are shown to be variable and present in some of the studied specimens. In fact, these features are those that present much less variance in extant species than in the *Adapis* sample, confirming the idea that we may be leading with different species.

The different features of each morphotype of *Adapis* suggest that these species probably presented different locomotor repertoires. *Adapis* has been traditionally described as analogous to extant lorises in locomotor behavior. However, the specimens studied do not overlap with living lorises in humeral head and distal articulation proportions. Instead, our analyses suggest a less specialized kind of quadrupedalism for *Adapis*. Proportions of the distal epiphyses overlap with many primate groups including omomyids, suggesting that telling apart distal humeral remains of strepsirrhines and haplorhines in early forms can be problematic.

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## A FOSSIL PREPARATION LABORATORY AS A PEDAGOGICAL FACILITY: THE DINOPARK LOURINHÃ (PORTUGAL)

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**Keywords:** *Dinoparque Lourinhã, Preparation Laboratory, Pedagogy*

Museum preparation laboratories visible to the public are a prime opportunity to showcase some of the backstage paleontological work, which precedes the mounting of an exhibition. Although known for several decades in the United States, they are uncommon in Europe and until the last few years nonexistent in Portugal. Coupled with related activities for children and guided tours, the laboratories are tools that allow to expand the outreach of Paleontology and Science in general, showing the unknown work to most visitors. This corresponds to their first contact with Paleontology, besides museum exhibitions.

The recently opened Dinosaur Park of Lourinhã, Portugal is here taken as an example, among other possible examples, for this system of science communication, being the second laboratory of this kind in the country. Another example is located at the Museum of Lourinhã. The Dinosaur Park laboratory has been used to show, to the general public, preparation methods and paleontological techniques, such as comparative anatomy. Other activities include, among others, searching for replicas or real invertebrates in artificial excavation blocks and fishes in the original matrix.

Taking in account that most of the prepared materials in the laboratory are from the Late Jurassic Lourinhã Formation, one of the most productive areas for vertebrates in Portugal, it can also be useful to raise awareness to local paleontological research examples.

## WILD-CAT SCATS: TAPHONOMIC ANALYSIS OF SMALL MAMMAL REMAINS

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**Keywords:** *Felis silvestris*, *taphonomy*, *micromammals*, *O Invernadeiro Natural Park (Galicia, Spain)*

Small mammals are important indicators of paleoecological, paleoclimatic and paleogeographic information. Small mammals constitute a considerable part of the diet of numerous predators and their skeletal remains record modifications that provide criteria to identify the predators involved in the fossil accumulations. The present study is focused on the taphonomic analysis of micromammal remains recovered from scats produced by European wildcats (*Felis silvestris*), collected in the O Invernadeiro Natural Park (Galicia, Spain). Three features were evaluated: anatomical representation, bone breakage and degrees of digestive corrosion. Results obtained from the skeletal representation indicate a high loss of elements, especially postcranial bones. A high fracture pattern has also been described. Most dental elements show a certain degree of digestion, reaching extreme grades of corrosion. All these results allow us to highlight the extreme modification caused by the European wildcat on bone remains. The scat contents provide a basic and general pattern of alterations caused by carnivorous mammals on the bones of their prey. Some differences between similar predator species wild cats from other regions and continents have been observed. This points out to the necessity of increasing taphonomic analyses to accurate the characteristic pattern of this group.

**Acknowledgments:** We thank Ana Piñeiro and Isabel Barja for supplying the scat sample to conduct this taphonomic study.

## YES, WE CAN HOMOLOGIZE SKULL (AND OTHER) BONES OF ACTINOPTERYGIANS AND TETRAPODS

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**Keywords:** *homology, Actinopterygii, Sarcopterygii, Tetrapoda, Osteichthyes*

It is difficult to homologize bones across Osteichthyes, even within Actinopterygii. For a long time, it seems, anatomists stopped trying; several sometimes contradictory nomenclatures were used in different decades for different taxa or by different authors. However, numerous recent discoveries are encouraging.

The tetrapod stem confirms that the actinopterygian “frontal”, “parietal”, “dermosphenotic”/“infraorbital 5”, “dermopterotic”/“intertemporal” and “supratemporal” are homologous to the tetrapod parietal, post-parietal, intertemporal (which participates in the orbit margin in some early tetrapods), supratemporal and tabular. Plesiomorphically, the bone dorsal of the (anterior) naris is not the nasal, but the “anterior tectal”; ventral to it is the “lateral rostral” (apparently the septomaxilla). Likely, therefore, the actinopterygian “nasal” and “antorbital” are their homologs. The squamosal of many sarcopterygians has a long contact with the maxilla and could be homologous to the (second) “supramaxilla”.

*Entelognathus* has shown that some homologies can be traced beyond Osteichthyes; I further propose that the unpaired “vomer” of various actinopterygians is the “prerostral” of “placoderms” and the Silurian osteichthyan *Guiyu*, the actual actinopterygian vomers being the “vomeric toothplates”.

The braincase remains underresearched; neomorphic bones seem common there. Still, the best candidates for actinopterygian homologs of the opisthotic are the “autopterotic” and/or perhaps the “epiotic”/“epioccipital”, not the “intercalary” sesamoid.

I propose further homologies throughout the skeleton based on ontogeny and the fossil record, and hope to start a discussion on this promising field. Confidently identified homologs would boost phylogenetics and evolutionary biology.

**Acknowledgments:** This work is a spinoff from a forthcoming paper with Michel Laurin and Océane Lapauze.

# EFFECTS OF POPULATION BOTTLENECKS ON PHENOTYPIC VARIATION IN EXTANT ARVICOLINE RODENTS: IMPLICATIONS FOR STUDIES OF THE QUATERNARY FOSSIL RECORD

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**Keywords:** *genetic drift, dental phenotype, evolution, small population size, isolation*

We here present the results of a project aimed to reveal phenotypic impacts of genetic bottlenecks, on extant populations of small mammals. Also, to identify general and species-specific phenotypic patterns that could be used to detect past bottlenecks, in the quaternary fossil record. The study was performed on the Subfamily Arvicolinae (Rodentia: Cricetidae), since its adaptive radiation and phenotypic evolution has been fairly well studied. To ensure compatibility of paleontological and neontological approaches, we focus this study on dental phenotypes. We investigate 1) populations of invasive species that have passed through recent bottlenecks (*Ondatra zibethicus*, *Microtus rossiaemeridionalis*), 2) populations of native North-Eurasian species showing periodic depressions and outbreaks (*Myopus schisticolor*, *Microtus (arvalis) obscurus*), and 3) skull collections of laboratory animals reared through 3-11 generations (*Dicrostonyx torquatus*, *M. (a.) obscurus*). Phenotypic shifts are common in populations passing through bottlenecks below 10-15 individuals, and the severity of changes depends on the previous history of a source population. The bottlenecks of > 200 individuals may be impossible to detect if the population expands without forming isolated groups. We identify species-specific dental morphs, which are extremely rare under usual conditions but tend to increase in small isolated groups, and reveal general patterns related to founder effects (incomplete sorting of primitive and advanced traits) or inbreeding (phenotypic distortions). We define three groups of dental characters for phenotypic screening of fossil arvicoline assemblages for bottleneck effects and provide examples from the fossil record.

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## HERPETOFAUNAL REMAINS FROM UPPER UNIT V FROM EL SALT (ALCOI, SPAIN): PRELIMINARY STUDY

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**Keywords:** *Reptiles, Amphibians, El Salt, palaeoecology, palaeoclimatology.*

The locality of El Salt (Alcoi, Spain) is a key site for the study of the processes of Neanderthal extinction and the disappearance of them before the arrival of modern humans to the region. Six teeth attributed to a *Homo neanderthalensis* were recovered from the base of Unit V, corresponding to one of the last neanderthal of this region in the Southeastern Iberian Peninsula. Most part of the unit upper V is archaeological sterile, however its uppermost part, dated at  $44.7 \pm 3.2$  Ka (MIS 3), some remains of human activity have been recovered without the possibility of ensuring its precise cultural attribution. The preliminary faunal list of herptiles recovered in this site is composed by 3 anurans (*Alytes obstetricans*, *Bufo bufo* s.l., and *Epidalea calamita*), 2 lizards (*Chalcides bedriagai* and Lacertidae indet.) and 5 taxons of snakes (Serpentes indet., Colubridae indet., cf. *Rhinechis scalaris*, *Coronella* cf. *C. girondica* and *Vipera* sp. “*V. aspis* group”). All of them show Mediterranean ecological preferences with a broad distribution area and wide ecological preferences range. Comparing this faunal list with those of the Unit Xb, an older stratigraphical unit of this same locality, a worsening of the paleoclimate conditions (to drier and colder) seems to have happened in this area. This is consistence with other the preliminary results of other proxies, such as sedimentology and small mammal fauna. The presence of some thermophilous taxa (such as cf. *Rhinechis scalaris*) could be indicating that El Salt was a refugee area during this period for warm-demanding species.

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**MICROVERTEBRATES (AMPHIBIA, SQUAMATA, LAGOMORPHA, RODENTIA AND INSECTIVORA) FROM STRATIGRAPHICAL UNIT XB OF EL SALT (MIDDLE PALAEOLITHIC; ALCOI, SPAIN)**

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**Keywords:** *Herptiles, small mammals, El Salt, palaeoecology, palaeoclimatology.*

Nearly 1000 small vertebrates' remains from Unit Xb of El Salt site (Middle Palaeolithic) have been studied in order to reconstruct the palaeoecological conditions during a phase of Neanderthal occupation in this locality at  $52.3 \pm 4.6$  ka. A total of 7 rodents, 4 insectivores, 1 lagomorph, 3 anurans, 1 blinid, 2 lizards and 1 snake have been identified. Applying the Mutual Ecogeographic Range (MER) method separately to small mammals and herptiles, a wide selected geographical area are obtained in both cases, resulting in wide distributions of values for each climatic parameter. Nevertheless, calculating jointly the MER of both types of faunas, it allows us to discriminate much more the distribution of values. Our preliminary results show a reduction of 98% of the geographical area selected for herptiles and 99% for small mammals. On the other hand, the palaeoclimatic parameters calculated in Unit Xb suggest a mean annual temperature (MAT) of  $11.84 \pm 0.54$  °C and a mean annual precipitation (MAP) of  $526.95 \pm 31.32$  mm. The new result for the MAP is lower than those obtained with herptiles and small mammals alone. The MAT shows a significantly lower value than those obtained with herptiles, whereas it is slightly higher than the results obtained in the small mammal study. Compared to the current climate in Alcoi, these results points to a colder climate and a similar rainfall. The surrounding area of El Salt would be dominated by bushland and forest, alternating with open areas.

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# THE FIRST FIND OF THE MAMMUTHUS TROGONThERII (POHLIG, 1885) SKELETON FROM THE PLEISTOCENE OF PERM REGION AND POLYTYPICAL MORPHOLOGY OF THE EURASIA STEPPE MAMMOTH

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**Keywords:** *Pleistocene, Mammuthus trogontherii, morphology, Russia*

The excavation of mammoth skeleton the Okhansk District of the Perm Region, Russia started in 2013. The site located at the right bank of Votkinsk reservoir of the Kama River (coordinates 57°34'479 N, 55°24'755 E). The skeleton lays in 0.65-m-thick riverbed and oxbow alluvial facies in co-occurrence with little amount of other mammal bones and numerous of macroplants remains. The alluvium interbedded between the terrace bedrock socle belongs to the Kazan stage of Upper Permian and Late Pleistocene loess-like sediments. The time of alluvium accumulation can be approximately estimated in the interval from the Late Middle to Early Late Pleistocene.

Morphology of m3 (mm): Length/width 273.0/99.5; Complete number of plates 19-20; Plate frequency (in 10 cm) 6.5; Enamel thickness 2.0. The parameters of m3 correspond the diagnosis in *Mammuthus trogontherii* (Pohlig, 1889). The epiphyses of long bones are fused. Transversal diameter of tusk (185 mm) and teeth replacement indicated that Okhansk mammoth is a male corresponding to a 50-52-years-old Asian Elephant. Comparative data on *M. trogontherii* with different regions of Eurasia indicates that in the size of limb bones of the Okhansk mammoth is medium-sized: humerus length 990, ulna 750 mm. In the Middle Pleistocene *M. trogontherii* was spread all over Holarctic. This determines polytypical morphology of *M. trogontherii* in different parts of Eurasia. Latest *M. trogontherii* has changes in morphology m3/M3 and body size decrease. Recent data from China and Yakutia may indicate that this species surviving until Late Pleistocene.

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## NEW INFORMATION ON THE DEEP-BODIED ACTINOPTERYGIAN DAPEDIUM FROM THE TRIASSIC-JURASSIC OF EUROPE

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**Keywords:** *Actinopterygii*, *Neopterygii*, *Dapedium*, *Opalinuston Formation*, *Aalenian*

*Dapedium* is a morphologically conservative genus of ganoid fish, best known from the Early Jurassic fossil lagerstätte of the UK and Germany. *Dapedium* decreased rapidly in relative and absolute abundance following the onset of the early Toarcian oceanic anoxic event, but remained diverse, with three contemporaneous species in the Southwest German Basin. No diagnostic remains have been recovered from late Toarcian sediments, but anecdotal reports suggest the persistence of *Dapedium* into the Middle Jurassic. Thus, the timing of extinction of *Dapedium* is poorly constrained, with the youngest confirmed material being Early Jurassic in age. Recently, a new, relatively complete fish, referable to *Dapedium*, has been recovered from the Middle Jurassic (earliest Aalenian) Opalinuston Formation of Baden-Württemberg, Germany. Referral is based on the shape and ornamentation of the cranial elements, number of branchiostegal rays, as well as the morphology of the scales, and definitively extends the stratigraphic range of *Dapedium* into the Middle Jurassic. The Aalenian material represents a distinct large-bodied species, differing from Early Jurassic species in a unique combination of characters pertaining to the shape of the dermal skull elements, pectoral fin position, and scale shape and ornamentation. However, the new specimen exhibits no autapomorphies with which to distinguish it from the Toarcian species. This mosaic trait evolution and absence of morphological novelty typifies all named species of *Dapedium*, creating problems for species recognition. Understanding character convergence and morphological evolution in these fishes awaits a generic revision and a robust hypothesis of relationships at the species level.

## TRACKING EARLY SAUROPODOMORPHS

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**Keywords:** *Dinosaur tracks, Prosauropods, Sauropods, Late Triassic, Pangaea*

Two sauropodomorph trackways are known from Late Norian–Early Rhaetian lake deposits of the Fleming Fjord Formation in Greenland. One (*Evazoum*) is referable to a prosauropod, and the other (*Eosauropus*) to a basal sauropod.

Tidal flat sediments of the Eastern Swiss Alps have yielded trackways of prosauropods attributed to *Tetrasauropus*, despite their large size. Footprints with the morphology of advanced sauropods have been found in the Hauptdolomit and Kössen Formation (Late Norian/ Early Rhaetian).

Prosauropod tracks attributed to *Evazoum* occur in Late Carnian marginal marine deposits in the Dolomites (Travenanzes Fm, NE Italy) and in fluvial sediments at Lerici (Montemarcello Fm, NW Italy). Other possible prosauropod tracks come from the Norian tidal flats of the Dolomia Principale Formation (NE Italy).

The Molteno/Lower Elliot formations of southern Africa contain trackways in fluvio-lacustrine sediments assigned to *Pseudotetrasauropus* and *Tetrasauropus* that probably represent sauropodomorphs, such as plateosaurids and/or basal sauropods.

*Evazoum* from the Late Triassic (Italy) was later identified elsewhere, particularly in the North American Chinle Group. *Eosauropus*, possibly the footprint of a sauropod, is known from fluvial and lacustrine deposits of the western USA, Greenland, ?China, Wales, and Italy (Middle to Late Norian, ? Rhaetian).

Overall, we can conclude that the track record of Pangaea provides evidence of the coeval presence of prosauropods and more derived sauropods as early as the Norian. This is consistent with an earlier (Carnian or older) origin of sauropodomorphs and also fits ideas of a relatively cosmopolitan tetrapod fauna across much of Late Triassic Pangaea.

# ONTOGENETIC CHANGES IN THE BRAINCASE OF STENOPTERYGIUS

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**Keywords:** *Ichthyosauria*, *Stenopterygius*, *braincase*, *ontogeny*

The ichthyosaur *Stenopterygius* is the most common reptile from the Early Jurassic Posidonienschiefer Formation of southern Germany. The genus is known from a large number of specimens of all ontogenetic stages. Unlike their Cretaceous relatives, the braincases of Early Jurassic ichthyosaurs are not often the specific subject of study, but nonetheless an important source of characters in phylogenetic analyses. Better documentation of the ontogeny of these animals will substantially increase our understanding of intra- and interspecific variability. Here we qualitatively assess ontogenetic changes within braincase elements of *Stenopterygius*. This was analysed by comparing the numerous specimens assigned to this genus in the Stuttgart collection and other collections containing Posidonia Shale material. We observed several characters that changed over ontogeny. In the basioccipital, the size of the notochordal pit decreases and the extracondylar area and basioccipital peg increase in relative size over ontogeny. Moreover, the facets on the basioccipital ossify in a staggered pattern, whereby the basisphenoid facet obtains a smooth surface last. Likewise there are ontogenetic changes in the relative size of the carotid foramen within the parabasisphenoid, as well as the elongation of the paraoccipital process of the opisthotic. Previously, juvenile specimens of *Stenopterygius* were mainly defined by their absolute cranial length and relative stages of limb ossification. With these new observations, we have a better definition of the juvenile stages of *Stenopterygius*. This may ultimately lead us to define juvenile specimens on the basis of qualitative cranial characters rather than relative measurements.

# A NEW SPANISH PLACODONT THAT PROVIDES NEW INFORMATION ON THE EVOLUTION OF THE BIZARRE HENODONTIDAE

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**Keywords:** *Henodus chelyops*, *Cyamodontoidea*, *Central Spain*, *El Atance*, *Upper Triassic*

*Henodus chelyops*, from the Carnian (Upper Triassic) of Tübingen (Germany), is a highly derived cyamodontoid placodont, showing an extremely modified skull compared with other representatives of Cyamodontoidea. Based on this, trophic adaptations very different from those of other placodonts have been proposed. Whereas the other taxa are durophagous animals, herbivory and filter feeding has been suggested for *H. chelyops*. The phylogenetic position of this taxon within Cyamodontoidea could not be, until now, well established.

We present a partial skull of a cyamodontoid recently found in El Atance fossil site (Upper Triassic, Guadalajara, Spain), MUPA-ATZ0104. MUPA-ATZ0104 corresponds to a new taxon. Its inclusion in a cladistic analysis shows it is the sister taxon of *H. chelyops*. Both taxa are identified as members of the clade Henodontidae, hitherto considered as monotypic. Several character states previously recognized as exclusive of *H. chelyops* are synapomorphies of Henodontidae, including: maxillae without teeth; a single palatine tooth; upper temporal fenestrae reduced to absent; broad parietals; palatines separated by pterygoids. Based on this information, the diagnosis of Henodontidae is emended. This clade is recognized as belonging to Cyamodontida.

In addition to the presence of several character states hitherto considered as autapomorphies of *H. chelyops*, MUPA-ATZ0104 shares other character states with some less derived cyamodontoid placodonts, including: skull narrowed anteriorly; upper temporal fossae opened; larger palatine teeth. The discovery of this new form provides important information on both the acquisition of the highly specialized cranial morphology of *H. chelyops* and the evolutionary history of the clade Henodontidae.

# ON THE DISPERSAL OF THE AFRICAN RODENT MYOCRICETODON INTO EUROPE AT THE END OF THE MESSINIAN

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**Keywords:** *Gerbillidae, Miocene, Iberian Peninsula, Messinian Salinity Crisis*

The Messinian Salinity Crisis consisted in the nearly complete desiccation of the Mediterranean at the end of the Miocene, as a consequence of the closure of the connections with the Atlantic Ocean. This event allowed faunal exchanges between northern Africa and the Iberian Peninsula. The gerbil *Myocricetodon*, mainly known from the Miocene of Africa and Asia, has been also identified in some European sites: Salobreña, Negratín-1, Pino Mojón (Southern Spain), Almenara-M (Eastern Spain) and Castelnou-3 (Southern France). Nevertheless, only the population from Negratín-1 has been attributed to the African species *Myocricetodon jaegeri*, while the rest have still not been determined at the specific level. We have studied in detail these European populations of *Myocricetodon*, concluding that all of them belong to the same species. Their presence in Europe can be explained by a single migratory event from Africa in the context of the Messinian Salinity Crisis. As other gerbils, *Myocricetodon* is considered an indicator of warm and arid conditions. Its distribution in Europe is restricted to southern and eastern Spain and the southeastermost extreme of France, being absent in other Iberian areas, such as the Granada, Cabriel and Teruel basins, which would have more humid conditions during the latest Miocene. Moreover, the presence of *Myocricetodon* in Europe was limited to a short interval close to the Miocene-Pliocene boundary. We interpret that *Myocricetodon* was extremely sensitive to environmental factors and its occurrence in Europe was limited to a moment of particularly arid conditions.

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# REVISION OF THE PRIMATE MATERIAL FROM ROC DE SANTA (LATE EOCENE, NE SPAIN)

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**Keywords:** *Omomyidae*, *Paleogene*, *Microchoerus*, *Iberian Peninsula*, *Pyrenees*

The locality of Roc de Santa (central Pyrenees, Lleida Province, NE Spain) is one of the most relevant late Eocene (Headonian, MP17) fossil sites from the Iberian Peninsula, together with the neighboring site of Sossís. First documented in 1975, this locality yielded a rather diverse mammal assemblage that included rodents, perissodactyls, artiodactyls, creodonts, carnivorans and primates. According to the original description of the fauna, the scarce primate material from Roc de Santa consisted of a mandibular fragment with  $P_3$ - $M_2$  and a maxillary fragment with  $P^3$ - $M^3$  assigned to *Adapis magnus* (later transferred to the genus *Leptadapis*), and an isolated  $M_3$  attributed to *Necrolemur antiquus*. Nevertheless, these specimens were never described in detail. We have thoroughly studied these specimens for the first time, with the exception of the mandibular fragment, which was lost. The maxillary fragment is much smaller than *L. magnus* and shows clear morphological differences with that species, fitting better the size and morphology of the genus *Microchoerus*. Similarly, the isolated  $M_3$  resembles the specimens of *Microchoerus* already described from Sossís. Apart from these specimens, we have found in the collections from Roc de Santa a typical microchoerine upper incisor never reported previously, which can be also allocated to *Microchoerus*. Therefore, we interpret that the previous taxonomic determinations were mistaken and all the available primate specimens from Roc de Santa can be confidently assigned to the genus *Microchoerus*, previously described in the same-aged locality of Sossís. Further study will allow for sure a specific determination of this material.

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# RECENT DISCOVERIES OF MICROCHOERINAE (PRIMATES) FROM THE EOCENE OF WESTERN AND CENTRAL EUROPE SHED NEW LIGHT ON THE EARLY EVOLUTION OF HAPLORHINES

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**Keywords:** Necrolemur, Microchoerus, *Omomyidae*, Iberian Peninsula, Switzerland

The recent study of the Microchoerinae (Omomyiformes) from several localities in the Pyrenees (NE Spain) has allowed the erection of different species. Among them, *Necrolemur anadoni* from Sant Jaume de Frontanyà (middle Eocene) and *Microchoerus hookeri* from Sossís (late Eocene) deserve particular attention, since their description has led to the proposal of the lineage *Nannopithecus filholi-Necrolemur anadoni-Necrolemur antiquus-Microchoerus hookeri-Microchoerus erinaceus*. In this line, an increase of size and several morphological changes can be observed (enlargement of hypoconulids and mesoconids, reduction of the paraconid and widening of the trigonid in the lower molars; enlargement of the hypocone and the conules and acquisition of a mesostyle in the upper molars). The identification of these species or closely related forms in Switzerland (*M. hookeri* from Eclépens B and *N. aff. anadoni* from Verrerie de Roches) demonstrates that this lineage had a wide geographical range, extending from Spain to Central Europe.

In this lineage, the progressive development of a mesostyle is evidenced from *N. antiquus* (without mesostyle) to *M. hookeri* (mesostyle absent or very weak), *M. cf. erinaceus* from Euzet and Perrière (generally large mesostyle) and *M. erinaceus* (very large mesostyle). The existence of older samples (such as those from Creechbarrow and Grisolles) with a well-developed mesostyle implies a different, earlier divergence from *Necrolemur* and the independent acquisition of this tubercle. Therefore, the genus *Microchoerus*, as currently construed, would be paraphyletic. An exhaustive description of several unpublished samples (Grisolles, Perrière, Robiac) is necessary to clarify the phylogenetic relationships among this diverse microchoerine group.

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# DIPLODOCINES OF THE GNATALIE QUARRY, A NEW BONE-BED ACCUMULATION FROM SOUTHERN UTAH (MORRISON FM., USA)

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**Keywords:** *Sauropoda, Phylogeny, Late Jurassic, Diplodocinae, Diplodocus*

A new Morrison bone-bed (Brushy Basin Member) from San Juan County yields abundant remains of sauropods as well as more fragmentary fossils of theropods, ornithopods, and thyreophorans. The 'Gnatalie quarry' (locality LACM 7683; Natural History Museum of Los Angeles County) contains the remains of at least two sauropod clades: Diplodocinae and Macronaria. Previous works have suggested for the presence of two diplodocine taxa. This fossil-site has produced several partially complete diplodocine individuals in articulation or in association, and many isolated sauropod bones. Five diplodocine sets that might correspond to three or four individuals are described and briefly discussed herein. The performed phylogenetic analyses place all these sets within the clade *Barosaurus+Diplodocus*, sharing the presence of a double posterior centroparapophyseal lamina on posterior dorsal vertebrae, straight ventral surface with projected chevrons facets in mid-caudal vertebrae, or high twisted humeral shaft (>40°). The presence of pneumatic foramina until the 16th caudal vertebra (and perhaps beyond), deep ventral hollow in anterior- and middle-caudal vertebrae, or hook-like ambiens process, all support the inclusion of these specimens within *Diplodocus*. The recovered phylogenetic hypothesis and the detailed comparative analyses support a close relationship of the Gnatalie diplodocines with *Diplodocus hallorum*. However, the most complete specimen presents an exclusive combination of characters, with some possible reversals to the plesiomorphic condition in *Galeamopus*+derived diplodocines. For the moment, the Gnatalie assemblage appears to comprise only one diplodocine form, corresponding to the most southwestern occurrence of *Diplodocus* in the Morrison Formation, west to the paleo-Lake T'oo'dichi'.

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## NEW INFORMATION ABOUT THE APPENDICULAR SKELETON OF SPINOPHOROSAURUS NIGERENSIS (MIDDLE JURASSIC, NIGER)

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**Keywords:** *Eusauropoda, Systematics, Middle Jurassic, Gondwana, Sauropoda*

*Spinophorosaurus* is a non-neosauropod from the Middle Jurassic of Niger (Africa) represented by at least two individuals, one with an almost complete axial skeleton, and both specimens with associated skull and appendicular bones. The full preparation and detailed study of the appendicular material is revealing new and important systematic and morpho-functional information about this taxon. Both holotype and paratype comprise elements from pectoral and pelvic girdle (scapula, coracoids, clavicles -previously interpreted as tail spikes-, interclavicle, ilium, pubis, ischium) and fore and hind limbs (humerus, femur, tibia, fibula, astragalus, metapodials) being one of the most complete non-neosauropod sauropod found to date. *Spinophorosaurus* presents a plesiomorphic appendicular skeleton within Sauropoda (e.g. transversely compressed proximal end of the tibia; pubis shorter than ischium, non-coplanar ischial distal end). However, several eusauropod apomorphies are also present such as a scapular blade with a D-shaped cross-section, coracoid dorsal margin lies below the level of the scapular proximal expansion, pubic distal and proximal end in the same parasagittal plan, astragalus is wedge-shaped and the ascending process extends to the posterior edge. *Spinophorosaurus* presents a specialized and unique scapular girdle (e.g. markedly curved scapular blade, fan-shaped distal expansion) and shares some features with the members of Mamenchisauridae (pronounced posterior flange in the ventral edge of the scapula, fourth trochanter at midline of the femoral posterior face). The systematic analysis of the appendicular skeleton combined with the skull and axial remains indicates that *Spinophorosaurus* is a member of Eusauropoda more derived than *Barapasaurus* and *Shunosaurus* rather than a non-eusauropod.

**Acknowledgments:** We acknowledge members of Project PALDES and Museo Paleontológico de Elche for allowing access to *Spinophorosaurus* specimens; and Haaga Family Postdoctoral Fellow (PM)

## LATE JURASSIC SAUROPODS OF PORTUGAL: WHERE ARE WE NOW?

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**Keywords:** *Phylogeny, Upper Jurassic, Neosauropoda, Macronaria, Lusitanian Basin*

The Late Jurassic sauropods of Portugal have been focus of several recent studies centred on the review and description of known and unpublished specimens, including many new occurrences found in the Turcifal (e.g. Torres Vedras) and Bombarral (e.g. Lourinhã). The application of an extensive dataset of morphological characters is improving the phylogenetic positions and testing the validity of the Portuguese taxa. The Late Jurassic sauropod fauna of Portugal comprises turiasaurs, diplodocines and macronarians. The present analysis concludes: (1) *Zby atlanticus* needs a new diagnosis and is a member of Turiasauria closely related with *Turiasaurus*; (2) two diplodocines are identified - a possible member of the genus *Diplodocus* found in Praia de Valmitão; and *Dinheirosaurus lourinhanensis*, with an uncertain position within Diplodocinae and exhibiting apomorphies absent in *Supersaurus*; (3) *Lourinhasaurus* is a member of Camarasauridae sharing several features with *Camarasaurus* (future analyses might include *Lourinhasaurus alenquerensis* within *Camarasaurus* genus); (4) *Lusotitan* is recovered as a member of Brachiosauridae and (5) a new specimen found in Praia de Valmitão might represent a more derived titanosauriform than Brachiosauridae, and the oldest occurrence of Somphospodyli in the fossil record. The present analysis supports a closer relationship between Portuguese and North-American sauropods than with Gondwanan forms. This can be explained by a more recent common evolutionary history with the North American territory. The Iberian sauropod fauna also seems to present a wide niche partition for sauropods that might explain the presence of a high taxonomic diversity in this territory, especially for Macronaria clade.

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# THE MORPHOLOGICAL VARIABILITY ON TITANOSAUR CAUDAL SERIES FROM LO HUECO: TAXONOMIC DIVERSITY, INTRA-SPECIFIC VARIABILITY OR BOTH?

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**Keywords:** *Late Cretaceous, Sauropoda, Lithostrotia, Systematics, Caudal vertebrae*

Lo Hueco (Cuenca, Spain) represents a Campanian-Maastrichtian multitaxic bonebed, with several partial titanosaurian skeletons, mostly articulated or with low dispersion. This accumulation is key for the comprehension of the titanosaur evolutionary history in the European territory. Preliminary studies suggested for the presence of two different taxa (including *Lohuecotitan pandafilandi*), but recent works on axial remains are suggesting a higher diversity. The detailed morphological description of the abundant caudal vertebral remains of Lo Hueco is necessary to assess this hypothesis. Four distinct caudal morphotypes are recognized: morphotype I) biconvex first caudal, anterodorsally projected neural spines, and long prezygapophyses; morphotype II) neural spine posterodorsally directed and transversely expanded, and postzygapophyses overhanging the centrum posteriorly; morphotype III) transversely compressed, short and vertically oriented neural spines with a distal anteroposterior expansion; and morphotype IV) slightly posteriorly oriented neural spine, with lateral and medial *spol* and *spri*. Morphotype II is possibly represented by two caudal series in different ontogenetic stages showing a substantial variability in the laminae pattern. Morphotype II and *Lohuecotitan* share a similar morphology on the caudal vertebrae, and the absence of some *Lohuecotitan* autapomorphies in elements of the morphotype II might be related with intraspecific variability. Morphotype I and III are markedly distinct from the remaining two morphotypes, which seems to support the presence of at least two or three different taxa in Lo Hueco. The phylogenetic relationships of the Ibero-Armorican titanosaurs is debated and this study reveals for the first time, the presence of features traditionally considered as synapomorphies of aeolosaurines.

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# ON THE WAY TO ISLANDS: ASSESSING THE DISPERSAL WAYS USED BY INSULAR EXTINCT RODENTS TO SETTLE IN MEDITERRANEAN ISLANDS (PLIO-QUATERNARY)

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**Keywords:** *rodent order, glirids, land bridges, over sea, permanence*

The Messinian Salinity Crisis (MSC, 5.96-5.3 Mya) was a key event in order to explain the Plio-Quaternary biodiversity of terrestrial mammals of Western and Central Mediterranean Islands. The desiccation of the sea allowed the connection by land bridges to the surrounding mainlands, although continental species could arrive by sweepstake later. On the other hand, the Eastern Mediterranean Islands were not connected to the mainland during MSC neither Plio-Quaternary period, so their faunas are only consequence of over sea dispersal. Although many of the insular rodents of Mediterranean Islands have been described several years ago, new findings in specific sites have enlarged their known biodiversity. Here, we have made a compilation of the fauna of rodents presented in the main Mediterranean Islands from Pliocene to human arrival. We categorized the species by their dispersal mode (over sea or over land), permanence (short- or long-term) and family. The results show that there are no differences among the dispersal ways of rodents ( $\chi^2$  test,  $p>0.05$ ). However, when evaluating long-term species, it is observed that glirids are the better colonizers over land, while murids and cricetids are settled when they used an over sea dispersal ( $\chi^2$  test,  $p<0.05$ ). The MSC allowed the entrance of several families of rodents (glirids, murids, cricetids and ctenodactylids), but glirids were the most successful. Their biology and life history should be considered to give answer to this trend.

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# FIRST RECORD OF A PALEOPATHOLOGY IN A TIBIA OF A LAGOMORPH (MIDDLE MIOCENE, GERMANY)

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**Keywords:** *micromammal, infection, ankylosis, Goldberg site, MN6*

Observing pathologies in the fossil record is unusual, but it may be most helpful to the gain of insights into the biology of extinct species. Up to date, some paleopathologies have been described in large vertebrates (dinosaurs, rhinoceros, deer, horses, carnivores, primates, among others) including, *inter alia*, fractures, infections or tumors. However, paleopathological reports in microvertebrates are rare. Here we present the first paleopathology recorded from a lagomorph bone from the Middle Miocene site of Goldberg (Germany, MN6). Located at the proximal epiphysis of a right tibia (total length *ca.* 36 mm), it shows clear signs of bone necrosis (the epiphysis has been destroyed and the medullary cavity is exposed) and pathological reactive bone growth (osteophytes and bone remodelling). A complete strong ankylosis of the proximal tibiofibular joint is observed. These macroscopic changes could be related with two infectious conditions: osteomyelitis (infection of the bone) and septic arthritis (infection of the joint). Both pathologies occur in extant lagomorphs in several body parts, especially in the mandible and in the foot (ulcerative pododermatitis). A CT-scan of the bone will provide valuable information about the microstructural changes and the inner structure, thus giving additional data to better understand the nature of this pathological condition and its cause.

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## ARCTIC HABITAT AND CLIMATE CHANGE: MORPHOLOGICAL VARIATION IN EXTANT AND FOSSIL DICROSTONYX SPECIES

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**Keywords** : *morphology, extant, fossil, lemmings, climate*

Arctic habitats are characterized by extreme conditions with strong seasonality or resource restrictions. Most of animals living in such conditions exhibit different strategies as migration or hibernation. Rodents usually continue to maintain their activity and they represent key-species in arctic ecosystems, as they are the main resources for numerous predators. The genus *Dicrostonyx* (collared lemming) is one of the small mammals well adapted to these conditions. This genus has also been considered as one of the climate indicator in past cold faunas, being described in numerous European Pleistocene localities. The habitats have long been subject to climate changes leading to constraints on animals. The purpose is here to estimate the impact of climatic pressure changes on key-species and to quantify the morphological variations induced.

Very few studies have been done on the skull morphology of this complex of species. In order to compare fossil and extant specimens, tooth shape variation is here quantified along the present geographical distribution (Canada, Greenland and Siberia) and for several European fossil localities. The morphological differentiation is compared to the genetic differentiation, which shows several lineages indicating the occurrence of multiple refuge zones during the Last Glacial Maximum. The fossil tooth shape will allow identifying the morphological state of the past extreme distribution of the genus. Preliminary results show both a great intra and inter-specific morphological differentiation between extant populations and a distinctive morphology for the fossil specimens. This differentiation suggests isolation in restricted areas with only little connectivity between populations.

# SHAPE DESCRIPTORS AND STATISTICAL CLASSIFICATION OF MORPHOLOGICALLY CLOSE SPECIES: THE CASE OF TWO MICROTINES (RODENTIA) AND PALEOBIOGEOGRAPHICAL IMPLICATIONS

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**Keywords** : *morphology, voles, taxonomy, paleobiogeography*

The common vole *Microtus arvalis* (Pallas, 1778) and the field vole *Microtus agrestis* (Linnaeus, 1761) are commonly found in Middle and Late Pleistocene palaeontological and archaeological sites of Western Europe. The first lower molars ( $M_1$ ) are classically used to identify voles, even if they present a large intra- and interspecific morphological variability that can potentially lead to confound these two species. So, in the case of these morphologically close species, decision making of taxonomic attribution is not always obvious and can be subjective. It is now necessary and important to take into account this variability. Indeed, depending on populations, some individuals present the clear characteristics of the species (such as, in *M. agrestis*, a strong tooth asymmetry or the presence of a new supplementary triangle at the anterior loop on  $M_1$ ), while others will be less typical.

Based on extant populations, this study will present a morphological approach to statistically differentiate these species and will then be applied on fossil populations. The method is based on the analysis of tooth outline, landmarks and semi-landmarks describing the most variable parts of the teeth (anterior loop, asymmetry). Learning extant and fossil populations will be included as a test of accuracy and robustness of the morphological descriptors. One of the objectives is to propose a simple and statistical tool for the attribution of species. Beyond the importance of this correct attribution, the goal is also to help a better understanding of the paleobiogeographical expansion of these two key species in Quaternary faunas.

# DIGITAL RECONSTRUCTION OF THE SKULL OF TWO EARLY PLEISTOCENE SHREWS

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**Keywords:** *Soricidae*, *MicroCT*, *reconstruction*, *Early Pleistocene*, *paleobiology*

*Beremendia fissidens* and *Dolinasorex glyphodon* are red-toothed shrews (Soricidae, Mammalia) present in the Early Pleistocene levels of Sima del Elefante and Gran Dolina sites (Sierra de Atapuerca, Burgos, Spain). They are relevant in biostratigraphy and paleoecology.

The fossil remains are fragmented and concreted, being difficult to study them in a paleobiological way focusing in the whole skull. To do it two 3D digital models have been generated, one for each species. Fragments of skull have been selected: one complete mandible for each species, three fragments of maxilla of *Beremendia*, and two of *Dolinasorex*. Additionally a skull of *Blarina*, an extant shrew with similar characteristics in its skull was chosen to reconstruct the complete crania. The samples were scanned with a MicroCT and reconstructed in 3D, scaled and combined to form the virtual skulls.

Although the reconstructions are not real individuals or mean models of the fossil species, they allow comparing the two species. We conclude that *Beremendia* has sharper and more opened and horizontally oriented mandibles with a tighter coronoid process and a wider and higher skull in the posterior part in *Dolinasorex*. The latter has a closer articulation to the teeth-row and higher teeth.

As conclusion, the skull morphology relates both fossil species with a fossorial life. On the other hand *Dolinasorex* seems to be adapted to a more abrasive diet than *Beremendia* because their molars are more massive.

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# TREASURES FROM THE DEPTHS: FIRST RECORD OF *TUSCIZIPHIUS* (FOSSIL BEAKED WHALE) FROM THE AZORES ISLANDS DEEP WATERS AND THE IMPORTANCE OF LOCAL COMMUNITIES TO SCIENCE

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**Keywords:** *Ziphiidae*, *beaked whale*, *Tusciziphius*, *Azores*

Ziphiids or beaked whales, are deep-diving, echolocation-user odontocetes. They are the second most species-rich modern cetacean family with a diverse fossil record, with around fifty skulls recovered from Portuguese and Spanish (Asturias and Galicia) coastal waters. The mid-Atlantic Portuguese Archipelago of Azores is well-renowned for its rich fauna of living cetaceans. However, the occurrence of Late Neogene fossils of whales in the Azores was previously restricted to fragmentary material referred to as *Mesoplodon* sp. from marine sedimentary rocks from Santa Maria island.

A new specimen of fossil beaked whale from OMA (Observatório do Mar dos Açores), was recently recovered from deep waters surrounding the Azores by the fishing vessel *Manuel de Arriaga*. It is a well preserved rostrum (around 630 mm in length), with distinctive prominent medial rostral hook/sail-like structure formed by the fused premaxillae, which is believed to be related to sexual dimorphism. It also exhibits almost complete filling of the right premaxillary sac fossa by compact bone forming a semicircular shelf and rostral maxillary eminences on both sides of the rostrum. Because of these traits, it is assigned as *Tusciziphius atlanticus* Bianucci et al., 2013.

This specimen is the first fossil ziphiid attributed to *Tusciziphius* for this locality, increasing its previous distribution in about 1500 km (932 miles) to the west of the continental platform of Portugal.

Since most of these fossils are not collected by scientists but involuntarily in fishing activities, the collaboration and willingness of the fisherman to donate the specimens is crucial for their study.

# ARCHOSAUMORPH LOCOMOTION IN THE EARLY-MIDDLE TRIASSIC: AN APPROACH BASED ON TRACKS AND TRACKWAYS FROM THE CATALAN PYRENEES (NE IBERIAN PENINSULA)

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**Keywords:** *Tetrapod ichnology, locomotion, fluvial palaeoenvironment, Buntsandstein*

Tetrapod ichnites are essential to untangle trackmakers locomotion and behaviour, as they are *in situ* and *in vivo* evidences of the trackmaker. They also provide information on the palaeoenvironmental affinities of the trackmakers. All these features can be studied in detail in the Early–Middle Triassic Buntsandstein fluvial successions from the Catalan Pyrenees (NE Iberian Peninsula). Such successions yield a rich and diverse tetrapod ichnological record, representing some of the earliest vertebrate evidence after the end-Permian mass extinction from Western Tethys. Of special interest, the Tossal de Pollerini locality (western Catalan Pyrenees) preserves hundreds of footprints attributed to archosauromorphs. Ichnites are found in uppermost surfaces of several fine-grained sandstone strata corresponding to meandering channels, small ponds and crevasse splay deposits. Sandstones, embedded in floodplain mudstones, are laterally extended from 2-3 to tens of meters and ~50 cm thick. Trackways correspond to alternated manus-pes sets, sometimes preserving sinuous tail traces. Both manus and pes tracks are pentadactyl and mesaxonic, similar in shape, though pes are much larger and shallower than manus tracks. Most footprints are oriented in the same direction, being highly abundant, thus indicating potential gregarious behaviour. Some trackways are asymmetrical, denoting inclination of the substrate. Some ichnites correspond to digit trailing marks (scratches), indicating swimming capabilities, and most of surfaces are mud-cracked, indicating desiccation. Preliminary results show high locomotion variety of archosauromorphs, occupying all fluvial environments. Such locomotor capabilities may prompted archosauromorph advantage and dominance among other groups during vertebrate ecosystems recovery, occupying a wide range of ecological niches.

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## SUBTROPICAL STEPPE IN THE LATE PLEISTOCENE OF EASTERN MIDDLE EUROPE

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**Keywords** *Crocuta, Late Pleistocene, Middle Europe*

Investigations in cave hyena caves during the last decade allow a re-interpretation of the Middle Würmian ecology through new chronological and genetic data. Caves from the Alpine area (Teufelslucke, Mehlwurmhöhle, Winden, Griffen) as well as the general proximity (Grotta Pocala, Pestera Igrita, Szeleta, Vypustek) were investigated regarding their Radiocarbon age and the genetic values of the cave hyena. Based on this knowledge the associated fauna remains from the same layers have been assigned to the same age.

Upper Pleistocene hyena fauna remains in Europe consists of remains of the hyenas as well as of megaherbivore bones. Some of them carry characteristic gnawing marks from hyenas. Furthermore teeth and bones were recovered from other predators such as lions, leopards and brown bears, that have occasionally used caves as shelters. These hyena fauna additionally includes rare elements such as onagers, porcupines and blind mole-rats, whose closest relatives now inhabit tropical to subtropical steppe areas. Datings of cave hyena remains from the investigated caves have yielded values covering the MIS 3 period of approximately 41,000 to 50,000 years (calBP). This allows a distinction between the cave bear area and the hyena area in the Alps; the latter ending earlier before the Last Glacial Maximum.

**SYSTEMATICS OF ALLODAPOSUCHID CROCODYLIFORMS FROM THE MAASTRICHTIAN  
(LATE CRETACEOUS) OF ROMANIA AND THE STATUS OF ALLODAPOSUCHUS  
PRECEDENS NOPCSA 1928**

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**Keywords:** *Crocodyliformes*, *Eusuchia*, *Allodaposuchidae*, *Upper Cretaceous*, *Allodaposuchus*

*Allodaposuchus precedens* is a basal member of Eusuchia, established almost a century ago by Ferenc Nopcsa on a set of cranial and postcranial remains from the Maastrichtian of Vălioara (Romania). It was the first described member of the recently defined clade Allodaposuchidae, one of the closest outgroups to Crocodylia.

Attribution of the original material studied by Nopcsa to a single individual cannot be confirmed. Thus, subsequent papers considered only a fragmentary skull table as the lectotype of the species. This lectotype is no longer sufficient to support the diagnosis of a distinct species and it cannot be distinguished from most of the better-known allodaposuchids. Based on the type series alone, *A. precedens* is a *nomen dubium*.

A nearly complete skull from the Maastrichtian of Oarda de Jos (Romania), referred to *A. precedens*, could form the basis for a new species. Alternatively, given the widespread historical use of the name, nomenclatural stability might be better served by designating a neotype for *A. precedens*. The authors have chosen this avenue; applying to the ICZN asking to set aside all previous type fixations and designate the Oarda de Jos skull as the neotype for *A. precedens*. This specimen presents several autapomorphies and an exclusive combination of characters within Allodaposuchidae, allowing an emended diagnosis for *A. precedens*.

The neotype designation is of utmost importance for the objective identification of this species, recognized as the type species of Allodaposuchidae. This proposal is necessary for future phylogenetic analyses and assessments of the Upper Cretaceous crocodyliform diversity.

## AN UPDATE ON THE CROCODYLIFORM FAUNA FROM THE CENOMANIAN SITE OF ALGORA (GUADALAJARA, SPAIN)

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**Keywords:** *Crocodyliformes, Eusuchia, Upper Cretaceous, Cenomanian*

The information regarding the crocodyliform faunas from the Lower and the uppermost Cretaceous of Europe is relatively abundant. Different clades integrated the continental faunas of crocodyliforms in both periods. Lower Cretaceous faunas were mainly composed by non-eusuchian members of Neosuchia, whereas the uppermost Cretaceous faunas were represented by non-crocodylian representatives of Eusuchia. The information relative to the European crocodyliforms present during the lower part of the Upper Cretaceous is remarkably limited. Therefore, the discovery of new material assignable to Crocodyliformes is essential in order to shed light on this faunal turnover.

In this context, the Spanish uppermost middle-lowermost upper Cenomanian site of Algora (Guadajara, Central Spain) provides relevant information regarding this issue. This site has yielded numerous material assigned to Crocodyliformes, especially as a result of the latest fieldworks. These new remains comprise well-preserved and complete isolated cranial (e.g., ectopterygoid, exoccipital) and postcranial (e.g., rib, vertebrae) remains, including a dorsal vertebra, attributable to a member of Eusuchia. The detailed analysis of the crocodyliforms remains from Algora allows increasing the knowledge on the faunal association from this relevant Cenomanian fossil site.



## THEROPOD GREGARIOUSNESS: POSSIBLE EVIDENCES IN TRACKSITES FROM LA RIOJA, SPAIN

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**Keywords:** *Dinosaurs, theropods, gregariousness, tracksites, La Rioja*

The southern part of La Rioja (Spain) has revealed as one of the richest areas of the Iberian Peninsula in terms of ichnological record. Around 150 outcrops containing footprints of dinosaurs and other vertebrates have been recognized in the area. The materials of this hilly region were deposited in the Cameros basin, where thousands of meters of fluvial, lacustrine and coastal sediments were deposited between Tithonian (Upper Jurassic) and lower Albian (Lower Cretaceous). Since Ostrom's revolutionary proposal of some predatory dinosaurs being able to hunt in packs, many fossil evidences have been proposed to support that idea. Except for some extraordinary bonebed accumulations where multiple individuals appear fossilized together, dinosaur tracksites reveal themselves as a nice way to approach theropod gregariousness issue. Tracks are generated by interaction of organisms and substrate, allowing interpretation of some behaviour aspects by carrying out careful and systematic investigations. One of the most accepted evidences of dinosaur gregariousness are parallel trackways, but many times the problem of identifying time lapses between tracks arises. The analysis of as many factors of the track as possible can lead to determine high probability of gregarious behaviour in dinosaurs.

Evidences of theropod gregarious behaviour have been identified in 12 tracksites of La Rioja, including: parallel trackways and accumulations of footprints where parallel trackways can be inferred among them. These trackways are usually made by small- to medium-sized theropods, but even footprints longer than 30 cm can bear such evidences.

## BEAR TRACKS IN THE PLEISTOCENE AT NORTH OF PRAIA DO CAVALO, ODEMIRA (PORTUGAL)

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**Keywords:** *Eolianite, tracks, Ursichnus, SW Alentejo, Portugal*

The Pleistocene coastal eolianite formations in Portugal have provided an unexpected ichnological record of moderate diversity and circumscribed abundance related with mammals and birds, particularly in SW Alentejo. Several tracks attributed to the ichnogenus *Ursichnus* were recently been found in a small inlet at north of Praia do Cavalo, not far from Longueira (Odemira), at Medo Tojeiro/Almograve Eolinite which is tentatively dated from OIS3-2? (upper Pleistocene). They are organized in a single quadrupedal trackway composed of 10-13 tracks; tracks are not well preserved since they show different undertrack preservational variants, in coarse-grained sandstones. The strong variation of track length, the wide range of footprint length/width ratio, and the seldom impression of the heel are possibly related with an animal walking up a dune slope; the speed estimation of 2,4 km/hour contributes for this interpretation. Some of the tracks show five digit prints and the inward rotation of the foot typical from bears. The toe prints are generally packed together which is a characteristic of brow bears. These are the first bear tracks described in the Portuguese paleontological record and the first ever recorded in eolianite facies.

**Acknowledgments:** The author thanks to José Pombal for finding the tracks at Praia do Cavalo and contact him through Vanda Santos, Museum of Natural History and Science – University of Lisbon.

# GEOMETRY MORPHOMETRIC APPLIED ON THE OCCLUSAL SURFACE OF THE UPPER MOLARS OF *YINDIRTEMYS DEFLEXUS* (CTENODACTYLIDAE, RODENTIA, MAMMALIA)

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**Keywords:** *Small mammal, Ctenodactylidae, Geometric Morphometric, Fourier Analysis*

We applied Fourier analysis on the upper molars of *Yindirtemys deflexus* (N=52). There were no differences in the outlines of the molars, when applying on the three molars together. However, we saw tendencies when we applied principal component analyses for the data on the geometric morphometric analysis of first, second and third molars independently.

M1 showed a strong variation along the PC1 (73,249%). The values of this component are related to the development of the hypocone. Positive values are correlated with strong protruding and development of this cusp.

M2 showed uniformity around positive values of PC1 (60,774%), it could be explained by a major development of the anteroloph and a major worn of the posteroloph. As the tooth is more worn, the contact between teeth is higher, wearing the facets of contact. Positive values of PC1 are related with worn specimens where the posteroloph (the contact facet with the M3) is much worn, whereas, negative values are related with less worn posteroloph and more protuberant.

Finally, M3 are distributed for PC1 (56,574%) and PC2 (10,253%). We related PC1 with swollen and bulky molars. Negative values with pointy anteroloph and protruding anterocone, and positive values with more rounded anteroloph. PC2 are related to more straight teeth, negative values with rounded metacone with less developed anteroloph.

The results enable us to describe molars outline using continuous variables. Geometric morphometric of rodent molar outline showed as an important tool to quantify changes in molar shapes and to evaluate tendencies on each molar piece.

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## A NEW TRIASSIC (LADINIAN/CARNIAN) VERTEBRATE LOCALITY FROM VILLÁNY, SOUTHERN HUNGARY

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**Keywords:** *Ladinian/Carnian, fishes, sauropterygians, Tanystropheus, Hungary*

Triassic vertebrate fossils in Villány (Villány Hills, southern Hungary) come from two neighbouring, systematically-collected sites: a road-cut at Templom Hill and an abandoned construction site. Whereas the lower, most probably latest-Ladinian beds of these outcrops are predominantly composed of dolomarl and dolomite, and rich in vertebrate micro- and macrofossils, the upper, more clastic layers of Carnian age have produced a rich microfossil assemblage.

The ca. 3000 recovered vertebrate fossils are dominated by marine forms, but some semi-aquatic taxa also occur. Fishes are abundant microfossils referred to both chondrichthyan (e.g. *Palaeobates*, *Hybodus*) and osteichthyan (e.g. *Gyrolepis*) taxa. The most frequent macrofossils are from eosauropterygians belonging to at least two different nothosauroids and cyamodontoid placodontians. Nothosaurs are represented by skull and mandibular remains, hundreds of vertebrae, and appendicular elements, including one associated specimen. Placodont fossil remains consist of massive bean-shaped teeth, cranial bones with teeth and armor blocks. Continental vertebrate fossils are cranial and axial remains of *Tanystropheus*, and various conical, non-serrated teeth representing some other, small-sized archosauromorph taxa.

These fossil sites are of great importance since the three-dimensionally preserved remains are quite abundant in some horizons. The fauna shows a great similarity with the typical Lettenkeuper vertebrate associations of the German Triassic. The mostly isolated but unabraded fossils suggest that specimens were subject to little transportation, and terrigenous influence, including bones and teeth of semi-aquatic to terrestrial forms, might have been more significant higher in the section.

**Acknowledgments:** This project was supported by NKFIH K 116665 and the ELTE Dinosaur Research Group.

# SEASONAL PATTERNS AND ECOLOGY OF *TARBOSAURUS BATAAR* (NEMEGT FORMATION, MONGOLIA) INFERRED FROM STABLE OXYGEN AND CARBON ISOTOPES IN TOOTH ENAMEL

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**Keywords:** *Tyrannosaurid, carbon and oxygen isotopes, tooth enamel, ecology, Mongolia*

Patterns of isotopic variation in tooth enamel from five individuals of *Tarbosaurus* tyrannosaurid from early Maastrichtian, Nemegt Formation, Mongolia, were recognized by measurements of carbon and oxygen stable isotopes (serial sampling) along the growth axis. Additional bulk samples of dentine, bone and surrounding sediment were taken to exclude diagenetic alteration of the isotopic record. Enamel and bone samples of potential prey species were also analysed for dietary studies. Sampled teeth usually record between 2/3 and full annual cycles in case of largest specimens.

Fluctuations in  $\delta^{18}\text{O}$  values (up to 3.5 ‰) in tyrannosaurid teeth suggest strong seasonality (high annual temperature range with distinct precipitation/humidity maxima during summer months). The seasonal pattern shows similarities to modern day Shijiazhuang GNIP station (Global Network of Isotopes in Precipitation), Northern China, and suggests that the Nemegt biota in early Maastrichtian flourished in a context under cool temperate monsoon climate. Carbon isotopes ( $\delta^{13}\text{C}$ ) values from tooth enamel of three sympatric herbivorous dinosaurs imply the presence of the woodland ecosystem dominated by coniferous trees such as Araucariaceae. This study shows that large theropod teeth can serve as valuable archives for paleoenvironmental studies.

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# PUTATIVE ONTOGENIC AND INDIVIDUAL NICHE SPECIALIZATION OF *TARBOSAURUS* BATAAR (NEMEGT FORMATION, MONGOLIA) INFERRED FROM STABLE CARBON ISOTOPES

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**Keywords:** *Tyrannosaurid, Mongolia, carbon isotopes, diet, sauropod*

Predators generally select their prey according to their body size, with their profitability correlated with their prey size. However habitat type may affect predation rates with one type of prey taken significantly more frequently than expected (based on its availability). Moreover some types of “high-risk” prey can be deliberately avoided. Large apex predator could roam widely and inhabit multiple ecosystems with different types of prey communities. Individual niche specialization (INS) can be driven by habitat heterogeneity and diversity of available prey types. The use of different foraging tactics may lead to reduced intraspecific competition and may change across different ontogenetic stages. Multiple studies have documented the presence of INS in recent apex predators but there were no such attempts regarding extinct taxa.

Inter-individual differences in  $\delta^{13}\text{C}$  signatures can indicate long term differences in feeding behaviour. Intrapopulation variability of  $\delta^{13}\text{C}$  in consumers critically depends on the isotopic range and distribution of food sources. If consumer's food sources have unique/distinct  $\delta^{13}\text{C}$  signatures, then the intrapopulation variation in  $^{13}\text{C}$  may be used for quantifying diet variation and detecting of individual specialization. The preliminary results on tooth enamel and bone show that herbivorous hadrosaurids, sauropods and (herbivorous/omnivorous) ornithomimids have distinct isotopic signatures. Results from the tooth enamel of sympatric tyrannosaurids support the hypothesis of Hurum and Sabath (2003) that the more rigid skull of *Tarbosaurus* (compared to North American *Tyrannosaurus*) was an adaptation to hunting the massive titanosaurid sauropods found in the Nemegt Formation and suggest changes in dietary niches during tyrannosaurid ontogeny.

**Acknowledgment:** This work was supported by National Science Center grant number UMO-2012/07/N/ST10/03355.

# INTRA-INDIVIDUAL VARIABILITY AND STRONTIUM ISOTOPE MEASUREMENTS IN TARBOSAURUS BATAAR (LATE CRETACEOUS, MONGOLIA)

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**Keywords:** *Tyrannosaurid, Mongolia, strontium isotopes, oxygen isotope, mobility*

Measurement of  $^{87}\text{Sr}/^{86}\text{Sr}$  relative abundance ratios in tooth enamel is a primary method to determine animals paleomobility, and a growing number of studies now uses these measurements to also reconstruct individual life histories and geographical origins.

In this pilot study, dual-element isotopic profiles were created from incrementally developed dental tissues of five individuals of tyrannosaurid *Tarbosaurus bataar* selected from Nemegt Formation (Late Cretaceous, Mongolia). Here we test the utility and validity of this method for reconstructing individual life histories of Mesozoic apex predator.

Enamel from dinosaur teeth was sequentially sampled in order to reconstruct time-series isotopic profiles. Variation in the strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) and oxygen ( $\delta^{18}\text{O}_{\text{CARB}}$ ) isotope ratios of sequentially sampled enamel were compared to local geological and environmental conditions preserved in the surrounding sediment and diagenetic mineral filling of tooth pulp cavity.

Four individuals displayed the same general trends, although absolute isotopic values varied. One individual displays a very different trend and may represent a behavioural outlier or an immigrant from geologically distinct region.

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## EARLY MIOCENE SNAKES FROM THE LOCALITY OF WINTERSHOF-WEST (GERMANY)

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**Keywords:** Boidae, Colubridae, Elapidae, Viperidae, palaeogeography, early Miocene, climate

The late early Miocene snake assemblages are well-documented from Central European localities of the MN 4 and MN 5 Zones. However, diversified snake fauna is still poorly known from MN 1 to MN 3 Zones. German Wintershof-West locality (MN3b) provided both abundant fauna with a relatively diversified snake assemblage including Boidae: *Bavarioboa* sp., *Bavarioboa* sp. 1 (probably new species), *Falseryx petersbuchi*, Boidae gen. et sp. indet.; Colubridae: *Coluber hungaricus*, *Coluber* aff. *hungaricus*, Colubrinae gen. et sp. indet., „*Neonatrix*“ aff. *europaea*, „*Neonatrix*“ sp.; Elapidae: *Micrurus gallicus*, *Micrurus* sp. and Viperidae: *Vipera* sp. ('Oriental vipers'), *Vipera* sp. (*V. aspis* complex). Although Boidae still represents an important group within the assemblage, the colubroid snakes, mostly of Asiatic origin, are dominant which coincides with recent studies from Amöneburg, Germany, MN 2. Several snake taxa from Wintershof-West display their first distinct appearance (*C. hungaricus*, *Micrurus gallicus*, and the genus „*Neonatrix*“). The presence of 'Oriental vipers' which are documented by numerous large vertebrae (centrum length 5.24–6.21 mm) indicates that these vipers were widespread in Central Europe earlier than expected. The snake assemblage composition documents that the late MN 3 climate was favorable for distribution of rather thermophilous taxa (*Bavarioboa*, *Falseryx*) in southern Germany. Therefore, we can assume a relatively rapid increase in temperatures in western part of Central Europe during the early Burdigalian stage.

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## NEW MAMMALIAN TRACKS FROM A PALEOGENE (EOCENE-OLIGOCENE) LOCALITY OF PUEBLA, CENTRAL MEXICO

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**Keywords:** *Trackway, Artiodactyla, Coatzingo Formation, Puebla, Mexico*

Among fossil track record in Mexico, the best represented belong to dinosaurs, while mammalian tracks are scarce and only reported in Coahuila, Jalisco, and Puebla. Here we report the presence of poor-preserved mammal tracks discovered in Santiago Mimiapan town, southeastern Puebla. The tracks occur on a sequence composed of tuffaceous sandstone and pale-green mudstones with saccaroid texture, interpreted as a low-energy lacustrine basin, which belongs to the Coatzingo Formation (Eocene-Oligocene). We detected at least three well-differentiated trackways. The spatial distribution of two of them suggests that the animals moved in normal walking progression, whereas the third trackway would be associated with an individual faster progression. This “main trackway” is composed of 16 footprints with a predominant trajectory of S-SE. They all take place as a concave epirelief with an outline rounded to sub oval. The ichnites show the impression of two elliptical hooves divided by a central ridge; the outer edges of the finger impressions are convex, while the inner edges are diffuse. Their length is greater than their width. According to these attributes, the ichnites are similar to those produced by even-toed mammals (Artiodactyla). The precise identity of the producer organism, the locomotion speed, and the ontogenetic stage will be evaluated in subsequent studies.

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# MODULARITY IN THE TITANOSAURIAN APPENDICULAR SKELETON: INSIGHTS FROM LO HUECO FOSSIL SITE

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**Keywords:** *Titanosauria, Lo Hueco, Appendicular Skeleton, Modularity, Geometric Morphometrics*

Wide-gauge stance acquisition is considered one of the most relevant innovations in the titanosauriform sauropods. Recent studies highlight the adjustment of key structures involving the humeral head position and deltopectoral crest rotation as well as the medial deflection of the femur. These characters are related with several trade-offs in the morphofunctional reconfiguration of the limbs. Lo Hueco (Upper Cretaceous, Cuenca, Spain) have yielded an abundant sample of appendicular bones of titanosaurs. They show a greater variability in femur and humerus than in the distal portion of the limbs. In this study, the implications of a more cohesive module in the distal part of both limbs is explored. Lo Hueco specimens and other titanosaurs are analysed with 3D geometric morphometric techniques. Covariation of the pair humerus-ulna and femur-tibia are compared against the ulna-radius and tibia-fibula pairs. The common method of two block Partial Least Squares (2B-PLS) employed to assess the modularity in the skeleton requires the comparison among elements of the same individuals and this impedes the analysis of some taxa. Here we present different methods and comparisons with the sample from Lo Hueco, *Altasaurus* and *Neuquensaurus* as examples of bone-bed specimen inclusion.

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# INTRASPECIFIC VARIABILITY IN AND ITS EFFECTS ON SYSTEMATIC ASSESSMENT OF THE TITANOSAURS FROM LO HUECO (LATE CRETACEOUS, CUENCA, SPAIN)

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**Keywords:** *Late Cretaceous, Sauropoda, Systematics, Variability, Character coding*

Recent studies in the sauropod systematics highlight the importance of specimen coding instead of relying in operational taxonomic units (OTUs) based in multiple specimens of the same species. A sample of titanosaurian hindlimbs and forelimbs from Lo Hueco fossil site (Campanian-Maastrichtian, Cuenca, Spain) are studied to test the impact of its morphological variability in character coding. A series of discrete characters used in previous cladistics studies of Sauropoda were coded for appendicular bones. A sample of 15 or more specimens for each bone was coded. Instead of phylogenetical analysis, we explore the presence of distinct morphotypes via hierarchical clustering with Gower distances of dissimilarity between the discrete characters. For hypothesis testing, partition around medioids was employed. This analysis clusters the data with an *a priori* assumption of number of clusters. The partitions tested range between two morphotypes up to four morphotypes of titanosaur from Lo Hueco. Two morphotypes as suggested in previous studies of teeth, braincase and appendicular bones. Four morphotypes identified on the caudal series. Two main morphotypes are recovered for all the elements as the most probable clusters. Even in the extreme case of four morphotypes, all distributions show character coding variation within the same cluster in all bones. Humeri are the more variable elements, followed by femora, while the pairs ulna-radius and tibia-fibula show less variation for the explored characters. This suggest that: i) it is necessary to code each individual when possible, and ii) OUTs might help to include specimens with difficult association and polymorphic character.

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# FACTORS AFFECTING THE INCIDENCE OF PALAEOPATHOLOGY IN EARLY JURASSIC ICHTHYOSAURS

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**Keywords:** *palaeopathology, ichthyosaurs, Posidonienschiefer Formation, palaeoecology, injury.*

Pathological studies in palaeontology represent a useful tool for understanding the behavior and interactions between species or individuals as the possible causes of injuries. Such studies, however, are not common in fossil vertebrates. We considered ichthyosaur fauna from the Posidonienschiefer Formation (Early Jurassic: Toarcian) from Southwestern Germany to determine if taxonomy, adult body size, ontogeny or stratigraphy influences the presence of osteopathologies in ichthyosaurs.

We surveyed 238 specimens of ichthyosaurs from the Posidonienschiefer Formation referable to five genera: *Temnodontosaurus*, *Eurhinosaurus*, *Suevoleviathan*, *Hauffiopteryx* and *Stenopterygius*. We classified the presence and absence of pathologies according to five variables (genus, anatomical region, size, ontogeny, stratigraphy) and analyzed the data using logistic regression.

The model indicated that the incidence of pathologies was dependent on both taxon and anatomical region, but the interaction term was not significant. Large genera do not show a significantly higher incidence of pathology than small genera, suggesting that body size alone is not a factor directly related to the frequency of pathologies in ichthyosaurs. For the ontogenetic and stratigraphic analyses, we considered only *Stenopterygius* for reasons of sample size. There were significantly more pathologies in the largest adults than in neonates, juveniles, and small adults, and significantly fewer pathologies in mid-sized adults than in all other size classes. Stratigraphic horizon did not influence the frequency of pathologies in *Stenopterygius* in the Posidonienschiefer Formation.

Our study represents the first comprehensive analysis of palaeopathologies in a palaeocological context in marine reptiles and will serve as a model for future work on palaeopathologies.

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**A NEW SPECIMEN OF «ARCHAEOTHERIUM» CLAVUM (ARTIODACTYLA, ENTELODONTIDAE) AND A PHYLOGENETIC PROPOSAL FOR THE ENTELODONTIDAE**

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**Keywords:** *Entelodontidae*, «*Archaeotherium*» *clavum*, *Artiodactyla*, *phylogeny*, *Palaeogene*

Entelodontids are artiodactyls restricted to the Eocene-Miocene of Eurasia and North America. They are well represented in the fossil record, with at least 28 species. Still, a large gap in the study of this diverse group concerns the lack of any phylogenetic proposal. Here, we report a new specimen of «*Archaeotherium*» *clavum* and present the first phylogenetic proposal for the group based on an original dataset (28 entelodontid species, 2 outgroups and 35 characters). The specimen's provenance is still uncertain –it was apparently collected by Llewellyn Price in South Dakota between 1951-52. It comprises the pre-maxillae, incomplete maxillae and incomplete mandible. Preserved teeth consist of I1-P2 and i1-m1. In the upper jaw, the incisors long axes point straightly downwards. They are closely spaced and there is a diastema with a re-entrancy between I3 and C. The canine and P1 are closely spaced. The alveolus for P1 is oblique, similarly to *Cyprotherium*, *Archaeotherium* and *Daeodon* and unlike other genera. The diastemata between P1 and P2 exhibit a re-entrancy, similar to *Archaeotherium* and *Daeodon*. In the mandible, all teeth are closely spaced, different from any species of *Archaeotherium* or *Daeodon*. Only diminutive spaces exist between c-p1 and p1-p2. The alveoli of the lower canines are not lateralized, differently from any species of *Archaeotherium*. Based on our phylogenetic analysis, we agree that *Cyprotherium coarctatum* falls outside of *Archaeotherium* and further recognise that «*Archaeotherium*» *clavum* represents a distinct lineage, sister-group to *Archaeotherium* plus *Daeodon*. This taxon would thus require a new generic name.

# NEW DATA ON THE BOTHREMYDID TURTLES FROM THE SPANISH UPPER CRETACEOUS SITE OF LO HUECO

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**Keywords:** *Pleurodira*, *Bothremydidae*, *Iberian record*, *paleobiogeography*, *Foxemys mechinorum*

Bothremydidae is the best represented group of turtles in the coastal and freshwater Upper Cretaceous sites of southwestern Europe. Several members of Bothremydini have been identified in the Campanian-Maastrichtian record of this area. *Rosasia soutoi* is only known in the Portuguese record. Several taxa so far restricted to the French record were described: *Polysternon provinciale*, *Elochelys perfecta* and *Foxemys mechinorum*. *Polysternon atlanticum* was defined in the Spanish upper Campanian site of Laño (Burgos), being unknown outside of this locality. The only species recognized in more than one country is *Iberoccitanemys convenarum*. It was defined by a shell from the upper Maastrichtian of Haute-Garonne (France), having been subsequently recognized in Central Spain by several well-preserved complete and partial shells from the upper Campanian-lower Maastrichtian site of Lo Hueco (Cuenca), and by isolated remains from the upper Campanian site of Armuña (Segovia).

Besides the fossils attributed to *Iberoccitanemys convenarum*, a plastron of a second bothremydid was found in Lo Hueco, this site being the only one in Europe where the synchronous and sympatric coexistence of two bothremydids is currently recognized. However, the limited information so far available only allowed its preliminary identification as an indeterminate member of Foxemydina.

Several unpublished remains from Lo Hueco, attributable to that second form, are presented here. This study allows its accurate systematic attribution, being recognized as *Foxemys mechinorum*, and, therefore, expanding both the knowledge about the diversity of Bothremydidae in the Spanish record and the paleobiogeographical distribution of this taxon so far exclusively recognized in France.

## IDENTIFICATION OF THE EUROPEAN CENOMANIAN BOTHREMYDID TURTLE ALGORACHELUS IN MIDDLE EAST AND NORTH AMERICA

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**Keywords:** *Pleurodira*, *Bothremydidae*, *Algora*, *paleobiogeography*

Several Gondwana lineages of the crown Pleurodira reached Europe through diachronic Mesozoic and Cenozoic dispersion events. The oldest pleurodiran turtle known in Laurasia is the Bothremydid *Algorachelus peregrinus*. It was defined in the uppermost middle-lowermost upper Cenomanian site of Algora (Guadalajara, Central Spain), having subsequently been recognized in the middle Cenomanian locality of Nazaré (Central Portugal).

The first systematic excavation of relatively long duration carried out in Algora has recently been performed. As a consequence, abundant material of *Algorachelus peregrinus* was found. The new material analyzed here corresponds to several complete or almost complete and very well-preserved shells, including the most complete, as well as abundant articulated remains of both the carapace and the plastron. The abundance of remains allows the analysis of the general disarticulation patterns experienced by the shells of this littoral form. This study also allows the identification and characterization of several pathologies. In addition, it also improves the knowledge about the anatomy and intraspecific variability of this form.

This new information allows the evaluation of the validity of other Cenomanian bothremydids, both from Middle East and from North America. Thus, *Algorachelus* is identified in these regions, being represented in both the early or middle Cenomanian of Palestine, and in the uppermost Cenomanian of Utah. A different species is identified in each of the three continents where the genus *Algorachelus* is identified. Therefore, close biogeographical relationships are recognized, evidencing a relative fast dispersal event, corresponding to the oldest identified for a Gondwanic lineage of Pleurodira in Laurasia.

## NEW INFORMATION ABOUT THE EARLY EOCENE BOTHREMYDID REMAINS FROM THE BRITISH RECORD

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**Keywords:** *Pleurodira, Bothremydidae, Ypresian, London Clay*

The British record of Pleurodira is very limited, contrasting with that of Cryptodira. It is restricted to a few poorly known and poorly represented taxa from the lower Eocene record. Two successful lineages of Pleurodira are identified in the Eocene levels of Europe: Bothremydidae and Podocnemididae. Both clades have been identified in the lower Eocene British record.

A single specimen attributable to Podocnemididae is recognized in the British record, through a partial shell, from Bracklesham Bay (Sussex). It was attributed to the recently described littoral genus *Eocenochelus*. Several almost complete or partial shells of coastal bothremydid turtles have been found, since the 19th century, in the London Clay of the Isle of Sheppey. Four different species were defined in the 19th century but subsequent authors indicated that all of them could represent a single form. No detailed review of these specimens has been made after the 1950s, and no photographs of any of these classic specimens had been, until now, published. The detailed study of those classic specimens is performed, and photographs and schematic drawings of all of them (except for the missing holotype) are presented here for the first time. In addition, several shells subsequently found, are also analyzed to improve the knowledge about both the shell anatomy and variability of this potential single species. Thus, the diversity of Bothremydidae in the British record is evaluated, as well as the precise systematic position of the recognized form or forms.



# THE ARARIPEMYDID TURTLES FROM THE AFRICAN APTIAN LOCALITY OF GADOUFAOUA (NIGER): AN UPDATE

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**Keywords:** *Pleurodira, Araripemydidae, Early Cretaceous, Africa*

The most abundant and diverse collection of Pleurodira from the Lower Cretaceous record of Africa comes from the Aptian levels of Gadoufaoua. Gadoufaoua is located in the Illumedden Basin of the Ténéré Desert, in central Niger. The first African araripemydid, *Taquetochelys decorata*, was defined based on several remains from this locality. It is the first described araripemydid is the Brazilian Aptian-Albian *Araripemys barreto*. Therefore, the finding of this lineage of freshwater forms in Africa was relevant, because it represents a group of freshwater turtles distributed in both South America and Africa during the Early Cretaceous.

The type series of *Taquetochelys decorata* was composed of several isolated plates. The identification of other specimens attributable to the same form was notified. However, they remained as unpublished. Considering the limited information available, subsequent authors indicated that the attribution of this African form to Araripemydidae should be confirmed by the finding of more complete remains. Fortunately, one of the most complete Lower Cretaceous skeletons of Pleurodira was recently identified in Gadoufaoua. This specimen corresponds to an unquestionable member of Araripemydidae. However, it was attributed to a new taxon, *Lagaremys tenerensis*.

The type series of *Taquetochelys decorata* is here revised, and other unpublished specimens are studied. The detailed comparison between *Lagaremys tenerensis* and *Taquetochelys decorata* is carried out. For this purpose, the intraspecific variability of several pleurodires, including the araripemydid *Araripemys barreto*, is analyzed. Considering all this information, the hypothesis about the identification of *Taquetochelys decorata* and *Lagaremys tenerensis* as two different forms is evaluated.

# THE HINDLIMB MUSCULATURE OF THE TRIASSIC DINOSAURIFORM *SILESIAURUS OPOLENSIS*

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**Keywords:** *Dinosauromorpha*, *Silesauridae*, *muscles*, *locomotion*

The dominant trend in the Triassic evolution of the dinosaur lineage is the improvement of bipedal locomotion. This is reflected by the morphology of pelvis and hindlimb of these reptiles, as well as in the trace fossils record from that time. Later, some ornithischian dinosaurs and ancestors of sauropods reverted this evolutionary process and adapted to quadrupedal locomotion. However, the first known example of such departure from the bipedal stance is exemplified by members of family Silesauridae. Among them, *Silesaurus opolensis* is best represented by hundreds of partially articulated, well preserved bones. We examined muscle scars on the pelvis and hindlimbs in order to reconstruct the locomotor musculature of this animal. We observed attachment sites for the m. iliotibialis, m. ambiens, m. femorotibialis, and m. iliofibularis expanded in respect to other archosaurs. These muscles flex and extend the knee. This, together with evidence from the axial skeleton and foot osteology, suggests a capability to efficient bipedal locomotion despite elongated forelimb.

The attachments of m. caudofemoralis longus and brevis preserved primitive condition, as elongated and strong tail presumably provided a counterbalance for the body in front of the pelvis. The scars on ilium suggest a shift of the origin of m. puboischiofemoralis internus from vertebrae to this bone. The diminishing of the obturator plate indicates reduction of the m. puboischiotibialis externus. The latter two muscles already approached the bird-like condition in Silesauridae.

**Acknowledgments:** this study was funded by the Polish National Science Centre, decision number: DEC-2013/11/N/NZ8/03262.

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

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

This research documents the distribution of the Pleistocene mammoth *Mammuthus trogontherii* on the territory of Oltenia, Romania. My intention is to shed light on all the occurrences of *M. trogontherii* 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. trogontherii* have been discovered in rock formations from the Pleistocene age. The material under scrutiny comes 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 expert literature. On the territory of Oltenia, *M. trogontherii* occurs isolated, and is rarely associated with other species of mammals, but this is due to previous research not being in-depth and thorough. Beside the molars, there have been discovered parts of the postcranial skeleton. For example, several teeth remains (tusk fragments, cheekteeth) and post-cranial bones (humerus, cubitus, radius, femoris fragments) belonging to *M. trogontherii* were discovered in 1969 in Batoti (dep. Mehedinti).

# FRILL ONTOGENY, MODULARITY AND HETEROCHRONY IN NEOCERATOPSIAN DINOSAURS

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**Keywords:** *ontogeny, dinosaur, Ceratopsia, evolution, morphometrics*

Neoceratopsian dinosaurs have a parietosquamosal frill extending caudodorsally from the skull overhanging the neck. Frills vary in size, shape, presence and composition of epiparietal and episquamosal structures. Functional and display/sexual selection functions have been proposed for the frill, with heterochrony being invoked to explain the variation in size and shape between species. Yet, quantitative analyses to test this have been lacking or very limited. We analyze frill size and shape variation for addressing fundamental questions on the biological and evolutionary significance of this structure, using Procrustes superimposition and Square Root Velocity Function techniques. Modularity was evaluated using the covariance ratio and comparison of ontogenetic trajectories for various taxa allowed evaluation of frill heterochrony. We sampled 25 species spanning ceratopsian evolution.

Most variation consisted of caudal and caudolateral expansion of the frill; within ceratopsids, it concentrated along the caudolateral border in chasmosaurines and laterally in centrosaurines. Changes in frill were independent of size during much of development. The frill constituted a module in ceratopsian evolution, but modularity is weakly supported ontogenetically. Muscle scars, modularity and increasing disparity during evolution may indicate a release from an early feeding-related functional constraint, allowing the caudal skull to be exapted for functions such as display in derived species. Results support a mosaic heterochrony case, combining local peramorphic and paedomorphic processes at different stages of ceratopsian evolution and affecting different frill components. Modularity and heterochrony led to the evolution of disparate frill morphologies, likely promoting diversification and niche partitioning among neoceratopsians or with other contemporary herbivores.

## A FOSSIL MORID COD (MORIDAE) FROM OLIGOCENE DEPOSITS OF MORAVIA (CZECH REPUBLIC)

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**Keywords:** *Teleostei, Gadiformes, Moridae, Oligocene*

Moridae is a relatively small family with about 108 extant species, classified within 18 genera. The group is diagnosed by contact between anteriorly enlarged horns of the gas bladder, the horizontal septum of the gas bladder, characteristic morphology of the otoliths and unique architecture of the caudal skeleton. Definitive articulated fossils of this group have been described from the Oligocene, Miocene and Pliocene deposits of different parts of the World, including the region of Paratethys. A new articulated skeleton from the Oligocene Menilitic Formation has been discovered in the Kelč-Strážné locality (Moravia; Subsilurian Unit; Western Carpathians). The fossil is only partially complete, lacking most of the postcranial part of the body. A comparison between fossil and extant gadiform taxa revealed a suite of features that clearly support its attribution to the family Moridae. Unfortunately, due to the incompleteness of the fossil, it is not possible to classify it to the generic and species level. However, the morphology of pterotic, general architecture of skull and shape of postcleithrum suggests that the fossil under consideration represents a member of the “*Pseudophycis*” group related to the genus *Lotella*.

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# A NEW 3D PRESERVED ARTICULATED PARTIAL SKELETON OF NEOSUCHIA FROM THE UPPER JURASSIC OF PORTUGAL

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**Keywords:** *Crocodylomorpha, osteoderms, biomechanics, Lourinhã Formation*

Neosuchians are a worldwide-distributed clade of crocodylomorphs very abundant in most semi-aquatic ecosystems, being Atoposauridae and Goniopholididae one of the most common taxa during the Jurassic–Late Cretaceous of Laurasia. Here, we describe an anatomically associated and 3D preserved partial skeleton of a small neosuchian Crocodylomorph from the Upper Jurassic of Porto das Barcas (Portugal). This new specimen represents one of the scarce 3D articulated skeletons of Neosuchia recovered in the fossil record from this time interval.

The skeleton consists of twelve dorsal osteoderms, three indeterminate osteoderms, five dorsal vertebrae, four thoracic ribs, the distal part of the left femur and proximal parts of the left tibia and fibula. The dermal armour is the best-preserved element. It consists of two rows of paired osteoderms, being rectangular in outline and up to twice as wide in a mediolateral direction as they are long. Each osteoderm presents its lateral margin ventrally tilted and an anterior process laterally placed for a peg-and-groove articulation. All these features are present in crocodylomorphs with closed paravertebral armour bracing system, such as some protosuchians, spheosuchians, notosuchians, goniopholidids and atoposaurids. Most of the characters observed in this specimen are congruent with *Theriosuchus* or a related form, nevertheless, its belonging to a juvenile goniopholidid cannot be ruled out. A further CT scan of this specimen will allow us a better taxonomic assignment and the possibility to perform biomechanical analyses to test previous hypotheses related with the axial bracing mechanisms and locomotion of this group of crocodylomorphs.

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# AN ALLOSAUROID FROM THE EARLY-MIDDLE JURASSIC OF PATAGONIA AND PHYLOGENETIC UNCERTAINTY AT THE BASE OF TETANURAE

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**Keywords:** *Pliensbachian-Toarcian extinction, Tetanuran phylogeny, radiation, homoplasy*

A new basal tetanuran theropod dinosaur from the Cañadón Asfalto Formation (late Toarcian-Bajocian) of Chubut, Argentina, represents one of the most complete basal tetanurans known, being represented by an almost complete skull, presacral vertebral column, complete forelimbs and parts of the hindlimbs. The new taxon presents a unique character combination, combining characters hitherto considered as megalosauroid synapomorphies with allosauroid synapomorphies and characters that are plesiomorphic for Tetanurae in general. Phylogenetic analysis places the new taxon close to the base of Allosauroidae in a monophyletic Carnosauria uniting Megalosauroidae and Allosauroidae to the exclusion of Coelurosauria, but also highlights the great phylogenetic uncertainty at the base of Tetanurae, as the unusual character combination shown by this taxon makes the placement of many fragmentarily known taxa ambiguous. The calibrated phylogeny indicates an explosive radiation of tetanurans following the Pliensbachian-Toarcian extinction event in the latest Early and Middle Jurassic. An analysis of the distribution of homoplasy in basal tetanuran phylogeny shows very high levels of homoplasy at that time and especially in nodes close to the origin of Tetanurae, whereas rates of morphological evolution do not seem to be significantly elevated. This pattern of distribution of homoplasy explains the phylogenetic uncertainty at the base of Tetanurae and might be explained by a rapid radiation under relaxed selection and possible evolutionary constraints following an extinction event. This seems to be a common pattern in the rapid radiation of major clades.

# A REASSESSMENT OF THE PHYLOGENY OF BASAL SAUROPODOMORPHS THROUGH COMPARATIVE CLADISTICS AND THE SUPER-MATRIX APPROACH

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**Keywords:** *Comparative cladistics, Basal sauropodomorpha, Phylogenetic analyses*

Basal Sauropodomorphs have been thoroughly studied in recent years. Several hypotheses on the interrelationships within this group have been proposed, ranging from a complete paraphyly, where the group represents a grade from Basal Saurischia to Sauropoda, to a group on its own. The grade-like hypothesis is the most accepted, however the relationships between the different taxa are not consistent amongst the proposed scenarios. These inconsistencies have been attributed to missing data and unstable (i.e., poorly preserved) taxa, nevertheless, an extensive comparative cladistic analysis has found that these inconsistencies come from the character coding and character selection, plus the strategies on merging data sets. This analysis also produced the largest and most comprehensive matrix after the reassessment and operationalisation of every character applied to this group far. Furthermore, partition analyses performed on this data set have found consistencies in the interrelationships within Basal Sauropodomorpha and has cast doubt on the validity of several clades and taxa, such as Massospondylidae, *Massospondylus*, *Yunnanosaurus*, and *Coloradisaurus*. The results of these studies also highlight a different scenario on how quadrupedality evolved, independently originating twice within the group, and provide a better framework to understand the palaeo-biogeography and diversification rate of the first herbivore radiation of dinosaurs.

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# THE DENTITION OF THE LATE JURASSIC DWARF SAUROPOD EUROPASAURUS HOLGERI FROM NORTHERN GERMANY: ONTOGENY AND FUNCTION

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**Keywords:** *Europasaurus*, *dentition*, *morphology*, *soft-part preservation*

Remains of the dwarf macronarian sauropod *Europasaurus* are only known from the Kimmeridgian (Upper Jurassic) Langenberg locality near Oker, Germany. Ever since the 1970's, dinosaur remains including small sauropod teeth had been found in this quarry, however, they were not always described as such. Most of the skeleton of *Europasaurus* is known in detail, including the skull, based on numerous individuals represented by partial disarticulated skeletons and isolated bones. Here we provide a detailed description of the dentition and morphology of the teeth which are known from partial dentitions in jaw bones, isolated tooth rows, and isolated teeth.

*Europasaurus* teeth are slender and spatulate, and are curved lingually and mesiodistally. The dental formula (PM4 + m12 / d13-14) matches that of *Giraffatitan brancai*, and the two species share similar tooth morphologies, supporting close relationships of *Europasaurus* and the Brachiosauridae. This similarity is helpful in reconstructing the dentition and, together with the teeth from jaws and the isolated tooth rows, allows the assignment of isolated teeth to an exact position in the jaw.

The wrinkled enamel on the crown of *Europasaurus* and other sauropod teeth and the preservation of isolated tooth rows may indicate an extensive cover of the crowns by gingival connective tissue, or possibly by a keratinous beak. This tissue or a beak would have held the teeth in place and provided stability to teeth in which root resorption had progressed severely, ensuring a complete dental row at all times.

## SMALL VERTEBRATE ASSEMBLAGE FROM THE LATE PLEISTOCENE OF KALDAR CAVE (KHORRAMABAD VALLEY, IRAN)

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**Keywords:** *rodents, herpetofauna, taxonomy, taphonomy, Iran*

Kaldar Cave is located in the Central Zagros (Khorramabad Valley, Iran), the site was occupied from the Pleistocene (with lithic tools from Middle and Upper Paleolithic) to the Holocene (with Neolithic archaeological remains). Small vertebrates come from Layer 4, attributed to the Upper Paleolithic, and Layer 5 (sub-layers 7 and 7II), attributed to the Middle Paleolithic. The <sup>14</sup>C dates from Layer 4 (sub-layers 5 and 5II) produced results in the ranges of 38,650–36,750 cal. BP, 44,200–42,350 cal. BP and 54,400–46,050 cal. BP, respectively.

The small-vertebrates assemblage is composed of five Arvicolinae, three Cricetinae, two Gliridae, two Gerbillinae, two Murinae taxa, a toad, an agamid lizard, a gecko, a skink, a lacertid, a glass lizard, a sand boa and possibly six types of colubrine snakes.

Late Pleistocene sub-layers 5II and Layer 7II have enough remains for the paleoclimatic inferences. A preliminary taphonomic analysis showed an important number of digested elements. A Category 3 predator could primarily be assumed, such as the tawny owl (*Strix aluco*) or the Eurasian eagle owl (*Bubo bubo*).

The rodent assemblage indicates an environment surrounding the cave mainly composed of open dry steppes, indicated by the most abundant taxa, *Microtus* gr. *socialis* and *Meriones* spp. Together with these taxa, Murinae species indicate the presence of a certain vegetation cover. Also, most of the herpetofauna identified specimens (Agamidae, *Eryx* sp. and Elapidae) live in savannahs, steppes and deserts, with a way of life always linked with warm arid areas in rocky or sandy environments.

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# FOSSIL VERTEBRATES IN THE PALEONTOLOGICAL COLLECTIONS OF THE SCIENCE MUSEUM (UNIVERSITY OF COIMBRA, PORTUGAL)

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**Keywords:** *Science Museum, University of Coimbra, paleontological collections, fossil vertebrates, taxonomical revision*

The fossil vertebrate collection in the Science Museum (University of Coimbra) is a valuable miscellany of specimens. It was acquired during the late XIX and XX centuries, from several European *comptoirs*, together with donations of private collectors, and the fieldwork materials assembled by teachers, researchers and students. The objective of this study was the taxonomical revise and inventorying these vertebrate fossils. The methodology included collecting data from the original labels, compiling the taxonomy, age, collecting site, stratigraphic context, and three-dimensional measurements, and updating this information, into a database.

For several years, chosen specimens of this collection also have been used for practical classes of Natural Sciences. Due to this, some of the original specimens have already been destroyed, worn out or lost. The taxonomic diversity of the collection spans all the main macrofossil vertebrate groups, comprising 74 specimens, with approximately 30 different taxa, ranging from the Triassic to the Quaternary. Their geographical distribution extends from Europe (Portugal, Germany, Italy, Belgium and France) to North America (E.U.A.), Africa (Morocco, Lebanon and Angola), and Asia (Japan). We highlight two specimens: a carapace and plastron of the bothremydid turtle, *Rosasia soutoi*, from the Maastrichtian of Aveiro (Portugal) and an unstudied nearly complete Actinopterygii from the Albian of Porto Amboim (Angola).

Most specimens are presently conserved in galleries and storage rooms, and not accessible to the general public, awaiting a redefinition of the present day museological strategies. However, they are fully available to members of the scientific community.

## VALIDATED 3D RECONSTRUCTIONS OF THE HOMININ AXIAL SKELETON: THE THORACIC SPINE

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**Keywords:** *Thoracic spine, 3DGM, kyphosis, anatomy*

The evolutionary morphology of the hominin vertebral column is of interest in paleoanthropology for its functional implication in the transition from quadrupedal locomotion to habitual bipedalism. In humans four curvatures (cervical and lumbar lordosis; thoracic and sacral kyphosis) are present, yet their evolutionary origin is unclear because, for taphonomic reasons, the few available fossil vertebral columns are anatomically disconnected. Here we present preliminary results of ongoing work on virtual reconstructions of human thoracic spines from individual vertebrae. Entire vertebral columns were obtained by computed tomography of patients and segmented virtually into individual vertebrae. These isolated bones were then virtually reconnected following several standardized methods. The resulting virtual reconstructions of the spines were finally compared with the original spines using 3D geometric morphometrics. Our preliminary results suggest that the method the maximum overlap between the lower articular facets of each vertebra and the upper articular facets of the following vertebra led to reconstructions which were morphometrically closest to the original spines. This method ignores the vertebral body position and the intervertebral discs. However, our results also show that the thoracic kyphosis, while closest to the original, is systematically underestimated in the reconstructions. This is important because some studies, based on virtual reconstructions, have proposed that in Neandertals the spinal curvatures were less pronounced than in modern humans. Our method provides criteria for a critical re-assessment of previous work and quantitative information to improve future reconstructions on spines of other hominin species.

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## FOSSIL LAND TORTOISES OF THE CANARY ISLANDS

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**Keywords:** *Tortoise, Canary Islands, Geochelone.*

During recent decades, the Canaries have become a source of terrestrial tortoise fossils, both osteological material from Tenerife and Gran Canaria islands, or fossil eggs from Lanzarote and Fuerteventura islands. These remains led to the description of two extinct tortoise species: *Geochelone burchardi* Ahl, 1926 from Tenerife and *Geochelone vulcanica* López-Jurado and Mateo, 1993 from Gran Canaria.

The collection of the Museo de Ciencias Naturales (MCN, Tenerife) contains remains from three of the four islands where they were found, including the neotype of *G. burchardi* (a femur, MCN), eggs and nests of *Geochelone* sp. 1 (MCN, Lanzarote) and *Geochelone* sp. 2 (MCN, Fuerteventura). Additionally, the holotype of *Geochelone vulcanica* (a femur) and some fossil eggs are part of the Museo Canario collection (Gran Canaria).

Here, we present the results of examining material from the Museo de Ciencias Naturales collection in order to organize the present knowledge of the Canary tortoise fossil record. This study contributes to its preservation and will be used for research purposes, cultural displays, and educational activities to enhance scientific culture in the teaching field. Given that these species are already extinct in the Canaries and the palaeobiodiversity of the islands is notably on the increase, we consider it necessary to preserve at least one paleontological site on each island with fossil tortoises.

## DRYOSAURID ORNITHOPODS FROM THE LATE JURASSIC OF PORTUGAL: AN OVERVIEW

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The Late Jurassic beds of the Lourinhã Formation have yielded a diverse vertebrate fauna, including fishes, squamates, mammals, turtles, crocodyliforms, plesiosaurs, pterosaurs and dinosaurs. Ornithopod dinosaurs are represented by the camposaurid *Draconyx loureroi* and the dryosaurid *Euosdryosaurus nanohallucis*. Despite the paucity of species recognized so far, isolated material belonging to Ornithopoda has been recovered from the Lourinhã Formation, especially from the Praia Azul Member. Most of this material is ascribed to Dryosauridae, a highly successful family of ornithopods, ranging from the Middle Jurassic to the Early Cretaceous.

Here we report undescribed material from the Museu da Lourinhã collection. Most remarkably we report the first dryosaurid cranial material to date from Portugal, including a fragment of a right dentary with erupting teeth (ML 768), and a small parietal (ML 1851), probably belonging to an immature individual. Isolated dentary teeth are tentatively identified as dryosaurids on the basis of the arrangement of the main ridges.

Furthermore, we report isolated limb-bones, such as an associated tibia and femur (ML 2055), an isolated tibia (ML 505), and an isolated femur (ML 563). We suggest ontogenetic variation is the main responsible for the high degree of variation present in the sample, based on the intraspecific variability observed in other dryosaurids, such as *Dryosaurus* and *Dysalotosaurus*. Two isolated cervical neural arches and an isolated centrum are the only dryosaurid axial skeleton elements in the collection. The new material, although fragmentary, improves our knowledge of the osteology of Portuguese dryosaurids, including the previously unknown cranial anatomy.

## ASSESSING THE MESOZOIC RECORD OF IBERIAN THEROPODA

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**Keywords:** *Jurassic, Cretaceous, Dinosauria, Completeness, Taxonomic diversity*

The Iberian theropod fossil record is evaluated to get an estimation on its quality and representativeness and to explore its congruence with the global record. The overall stratigraphic fit of the Iberian taxa phylogenetic relationships has been found to be close to the general vertebrate Mesozoic record when measured through SCI (Stratigraphic Congruence Index, 0.54) and GER (Gap Excess Ratio, 0.70) indexes at the family level. Therefore, the clade appearance succession in the Iberian record is as stratigraphically congruent as the currently known worldwide Theropoda record. When calculated at the genus level, a higher GER (0.86) and a negative RCI (Relative Completeness Index, -1.92) highlight the stratigraphic concentration of known genera due to *Largesttäten* effect (Kimmeridgian-Tithonian and Barremian). Their low values reflect poorly represented time intervals (Berriasian-Hauterivian and Albian-Santonian) that might be affected by sampling and taphonomic biases, mostly due to the lack of non-marine sedimentary environments. On the other hand, the affinities of Iberian theropods suggest that the Peninsula would have acted as a bridge between major landmasses (corresponding to present Eurasia, Africa and North America). Additionally, the presence of both novel and relict taxa indicate that it might also acted as a centre of endemism and as a refugee. This paleobiogeographical scenario, with Iberia acting as a continental island with intermittent connections to other landmasses (at least around the Jurassic/Cretaceous boundary and the middle of the Early Cretaceous), suggest that the Peninsula may had a relevant role in Mesozoic dispersal, speciation and extinction dynamics.

## A REAPPRAISAL OF THE BIOCHRONOLOGY OF THE VILLAGRANCHIAN FAUNAL ASSEMBLAGE OF COLLEPARDO (CENTRAL ITALY)

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**Keywords:** *Pliocene, mammals, biochronology, taxonomy*

The age of the Colleparado Faunal Assemblage, found in 1980 on the SW flank of the Ernici mountains range (southern Latium, central Italy), is here discussed after the finding of new fossil material in 2016, during a geological survey of the area, that led to the identification and “rediscovery” of the Colleparado site.

The abundant fossil vertebrate remains occur within a complex sequence of travertines and breccias that has never been described before.

The faunal assemblage has been cited and studied, and the Colleparado Local Fauna was defined and referred to the middle Villafranchian (Pliocene in literature, since 2009 Early Pleistocene). A detailed geological survey, coupled with palaeomagnetic and isotope analyses, and a revision of the vertebrate fauna has led to a more detailed chronological definition of the Faunal assemblage. The faunal list provided in literature includes *Stephanorhinus* cf. *S. jeanvireti*, *Sus* sp. (small size), *Pseudodama lyra*, *Hemitragus stehlini*, *Nyctereutes megamastoides*, *Megantereon* sp., Felidae and Ursidae. A revision of the fossils collected in 1980 has started and it appeared clear that the taxonomical position of some of the fossils needs to be reconsidered. Moreover, the study of new material is in progress also through modern non-invasive methods such as CT scanning analysis.

Among the new fossil remains, the occurrence of a large sized short-faced ursid is documented together with another ursid, suids, and cervids. The study of the fossils, with the geological and stratigraphical analyses of the deposit, suggests an attribution of the assemblage to the Pliocene (Early Villafranchian).



## THE PLEISTOCENE VERTEBRATES FROM GROTTA ROMANELLI (APULIA, SOUTHERN ITALY)

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**Keywords:** *Late Pleistocene, mammals, biochronology, geo-archaeology*

Grotta Romanelli, (Apulia, Southern Italy), is considered a key site for the Mediterranean Pleistocene for its archaeological and palaeontological contents. In 1914, G.A. Blanc led a pioneering excavation campaign. He studied the in-filling deposits and distinguished: the upper complex, the “terre brune” (layers A-E) bearing upper Palaeolithic tools and a vertebrate fauna including *Pinguinus impennis* (= *Alca impennis*); the stalagmitic layer F; and the lower complex (G-K), bearing a diversified vertebrate fauna (including *Palaeoloxodon antiquus*, *Hippopotamus amphibius*, *Canis lupus* and other taxa), and Mousterian limestone artefacts. The deposit lays on a Cretaceous limestone that was shaped during MIS5, constraining the age of the deposit to the Late Pleistocene. In 2015, a new excavation campaign began, led by a team from Sapienza Università di Roma in collaboration with IGAG CNR and other research institutions. The vertebrate fauna from the “terre brune” has been studied by the team of archaeozoologist of “Museo Preistorico ed Etnografico Luigi Pigorini” (Rome), who considered in particular the huge and diversified avifauna. The large mammals from the “terre rosse” complex is are under revision and the study of the material coming from 2015-2017 field activities is in progress. The study of the canid skull remains allowed a detailed analysis of the fossils and an attribution to *Canis lupus*. The occurrence of a “light” true wolf is in accordance with a late Middle to Late Pleistocene age for the lower complex, therefore a combination of palaeontological data and radiometric and stratigraphic analyses is crucial to clarify its age.

## DO DIFFERENT METHODS OF MEASURING MORPHOLOGICAL DISPARITY SHOW SIMILAR SIGNALS? A STUDY OF THE THEROPOD MANDIBLE

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**Keywords:** *Morphological Disparity, Discrete Characters, Geometric Morphometrics, Theropod*

For years, palaeobiologists have studied the broad patterns of evolution, focusing on taxonomic diversity. Recent decades have witnessed an increase in the number of studies utilising rich data about morphological novelties and their role in evolution. The diversity of organismal form and function, known as disparity, is studied in many ways using many methods. Disparity studies have become common, but few comparisons have been made between the different disparity metrics – do they all show the same trends? Here we provide a large-scale test for congruence between three methods of capturing morphological disparity, discrete characters, morphometric outlines and geometric morphometric landmarks, using coelurosaurian theropod mandibles as our case study. Preliminary data shows that all three methods have a significant correlation with each other, based on pairwise morphological distances. The correlation is particularly strong between the two morphometric methods, but much weaker between the morphometric methods and the discrete characters. Therefore, a similar overall view of coelurosaurian theropod mandibular disparity is revealed by each method. However, there are some notable differences in morphospace occupation, when more detailed disparity analyses are performed. For example, we highlight the potential importance of geometrically extreme forms, such as the Oviraptorosauria, and the influence of clades where discrete characters may be relatively oversampled.

## RECENT DEVELOPMENTS AND CURRENT QUESTIONS IN QUATERNARY MICROVERTEBRATE STUDIES

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**Keywords:** *Microvertebrates, Quaternary, palaeoenvironments, Lateglacial, mammals*

The study of microvertebrates has demonstrated enormous potential to enhance our understanding of the impacts of long-term and abrupt climatic change on biological communities during the Quaternary. Small vertebrate assemblages are often key to the interpretation of complex taphonomic and depositional environments, as well as permitting the elaboration of highly-detailed palaeoenvironmental and palaeoclimatic reconstructions, frequently as the backdrop for hominin occupation. Such advances have been facilitated by rapid technological developments in the fields of, for example, ancient DNA, stable isotopes, geometric morphometrics and climate-based training sets, allowing a previously unattainable level of precision to be achieved.

This paper reviews some key developments and proposes some future research questions, using the Last Glacial-Interglacial transition as test case for study. This period produced a major re-ordering of the small vertebrate faunas of NW Europe, resulting in aggregations of extinct and extant taxa that are not sympatric today. However, problems of poor resolution and chronology have often hampered our understanding of: (i) the mode and tempo of faunal movement; (ii) potential leads and lags between different parts of Europe; and (iii) regional extinction chronologies in this complex period. Using new data from British cave sequences, this presentation will examine the capacity of small mammals to cope with abrupt climate change during the Lateglacial, evaluate the source-sink dynamic of species dispersal from south to northern Europe and examine the role of cryptic northern (micro)refugia at the very margins of the North Atlantic.

## THALATTOSUCHIAN CROCODYLOMORPHS - A MAJOR EVOLUTIONARY TRANSITION FROM LAND TO WATER

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**Keywords:** *neuroanatomy, Crocodylomorphs, Thalattosuchia, sensory evolution*

Thalattosuchians are extinct clade of crocodylomorphs that underwent a major evolutionary transition from terrestrial to aquatic environments during the Jurassic. Not only did they achieve a wide geographical distribution, they evolved from gharial-like, semi-aquatic forms into pelagic cetacean-like species (the Metriorhynchidae). While the osteological underpinning of the metriorhynchids' success is well understood (evolving a hypocercal tail, hydrofoil-like forelimbs, loss of osteoderm cover), their neuroanatomical and physiological adaptations to an aquatic environment are still poorly understood and about to be investigated (with only the evolution of enlarged cranial exocrine glands known).

Non-invasive  $\mu$ CT scans of three basal thalattosuchians (the gharial-like species *Pelagosaurus typus*, *Steneosaurus cf. gracilirostris* and *Steneosaurus bollensis*) were digitally segmented to reveal the internal anatomy. These were then compared with the extant gharial, a habitual aquatic living species.

Early findings reveal basal thalattosuchians are unique in having a reduced and poorly differentiated pharyngotympanic sinus system, hypertrophy of the transverse dural venous sinuses, and hypertrophied orbital and internal carotid arteries. Moreover, basal Thalattosuchia have bony labyrinths in which the anterior and posterior semicircular canals form an 'M' shape in lateral view and generally show a reduced curvature. The extant gharials possess a curved canal shape. This suggest an early specialisation for an aquatic lifestyle in thalattosuchian, occurring prior to the teleosauroid-metriorhynchoid split.

# A NEW NOTOSUCHIAN CROCODYLOMORPH FROM THE EARLY MAASTRICHTIAN OF NORTHEASTERN IBERIAN PENINSULA

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**Keywords:** *Notosuchia*, *Doratodon*, *postcranial skeleton*, *Late Cretaceous*

Notosuchians were a peculiar group of terrestrial crocodylomorphs that proliferated during the Late Cretaceous, and persisted till the Miocene. Although they were abundant and diverse in Gondwana regions, only sebecosuchians reached Europe. Their Late Cretaceous record in Europe is limited to several fragmentary specimens of the genus *Doratodon* and scattered dental elements with uncertain affinity.

Here, we report the discovery of a tiny skeleton of a new notosuchian from the early Maastrichtian of the Coll de Nargó area (Northeastern Iberian Peninsula). From a taphonomic viewpoint, the specimen was discovered in a nearly articulated disposition, surrounded by large dinosaur eggshell fragments, and few meters apart from titanosaur clutches. Evidences suggest minimum transport of the skeletal elements, indicating that it died in the same place where fossilized. The specimen is represented by cranial and postcranial elements. The skull shows a short, deep, and laterally compressed rostrum; a reduction of the dentition; and the premaxilla-maxilla suture occurring within a notch for the reception of a hypertrophied mandibular ziphodont tooth. The axial skeleton includes almost all the dorsal series, the sacral region, and the most anterior caudal vertebrae. The appendicular bones of both forelimbs and hindlimbs are straight, elongated and slender, as typically observed in cursorial crocodylomorphs. However, the plaster jacket was stolen during fieldworks and, although it was finally recovered, it was returned in very bad conditions, with several broken bones and hindering many anatomical comparisons. Nevertheless, cranial and postcranial features exhibited by the newly discovered specimen suggest sebecosuchian affinities.

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# **“NEW” OLD ICHTHYOSAURS FROM THE VERONA MUSEUM: THREE RE-DISCOVERED MARINE REPTILES FROM THE UPPER JURASSIC OF VENETO REGION (NORTHERN ITALY)**

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**Keywords:** *Ophthalmosauridae, Rosso Ammonitico Veronese, Oxfordian, Kimmeridgian, Tithonian.*

In 2016, two fossil marine reptiles (V7101 and V7102) were re-discovered in the Verona Natural History Museum's collections. Both, never mentioned in the literature, were found in 1904 in the middle member of Rosso Ammonitico Veronese (RAV) at Monte Interrotto, near Asiago (Vicenza province).

V7101 is a semi-articulated vertebral column (anterodorsal to mid-dorsal region) with ribs. It is an ichthyosaur with the left part of the ribcage still intact and in anatomical position. Calcareous nannofossils from the matrix allowed us to ascribe V7101 to the early-middle Oxfordian (NJT13a subzone). Lacking clear diagnostic elements, we can only state it is a parvipelvian ichthyosaur, most likely belonging to Ophthalmosauridae based on stratigraphic occurrence.

V7102 is part of a vertebral column, with displaced ribs partially merged together above the centra. The poor preservation prevents a clear identification of the individual elements; however, we provisionally attribute it to an ichthyosaur as well. The calcareous nannofossils indicate a late Oxfordian-?basal Kimmeridgian age (top NJT13-?base NJT14).

A third specimen (V7158), found in 1881 and shortly after cited by De Zigno and De Stefani, is still undescribed. V7158, re-discovered by one of us (G.R.) in the nineties, is the tip of an ichthyosaur rostrum with some broken teeth, coming from the uppermost RAV in Campo Retratto, near Erbezzo (Verona province). Calcareous nannofossils allow it to be ascribed to the early Tithonian (NJT15a). The shape of the anteriormost rostrum and the relatively robust teeth with coarsely ridged enamel suggest V7158 was a generalist predator similar to *Aegirosaurus*.

**Acknowledgments:** We would like to acknowledge Dr. Roberto Zorzin (Verona) for allowing us to study the fossils hosted in Verona, and Luca Borghi (Modena) who wrote a BSc thesis on V7158.

# THE FIRST RECORD OF DORMOUSE (GLIRIDAE, RODENTIA) IN THE PLEISTOCENE OF NORTH-WESTERN ALTAI (RUSSIA)

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**Keywords:** *Late Pleistocene, Altai, Strashnaya cave, Dryomys*

Dormice (Gliridae Thomas, 1897) are a small systematic group including seven contemporary and 30 fossil species. Within the contemporary Russian fauna, there are four genera of dormice. Three of them also inhabit Europe, Northern Africa and Asia Minor, but only one, *Dryomys*, inhabits an area stretching more to the east, up to Mongolian Altai. Gliridae is one of most ancient families of rodents, with the earliest dormice dated from the Eocene. The distribution peak of this group corresponds to the Miocene, when the first findings of *Dryomys* are known. However, fossils of dormice dating to Pleistocene in Altai (South Siberia) were previously unknown.

During 2017, the Institute of Archaeology and Ethnography has been conducting multidisciplinary research over the sediments in the Strashnaya cave. The Strashnaya cave is a well-known Paleolithic site in North-Western Altai. The cave deposits include 13 layers. In the 6.1 layer, a right upper molar (M2) of Gliridae was found. Detailed morphological analysis of the tooth revealed typical features of the forest dormouse *Dryomys*. M2 has simple structure with main transverse ridges (anteroloph, protoloph, metaloph and posteroloph) plus anterior centroloph and endoloph.

The forest dormouse habitat is typically linked to dense bush and deciduous forest, which require uniform precipitation and relatively high average annual temperatures. The finding of *Dryomys* in the 6.1 layer provides an indicator that such conditions were likely at the time of the accumulation of the sixth layers. At the same time, the radiocarbon dates for sixth layers correlate with warm stage MIS 3.

**NEUROANATOMY OF LOHUECOSUCHUS MEGADONTOS (EUSUCHIA,  
ALLODAPOSUCHIDAE) FROM THE CAMPANIAN-MAASTRICHTIAN (LATE CRETACEOUS)  
OF SPAIN**

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**Keywords:** *Neuroanatomy, Lohuecosuchus, Cretaceous*

The Campanian-Maastrichtian fossil site of Lo Hueco (Cuenca, Spain) has yielded abundant remains of eusuchian crocodylomorphs. Two species have been recently defined on the basis of specimens found at Lo Hueco: *Agaresuchus fontisensis* and *Lohuecosuchus megadontos*. They are members of the clade Allodaposuchidae, which comprises exclusively European species and represents one of the closest outgroups to Crocodylia.

The holotype of *Lohuecosuchus megadontos* is a nearly complete skull. We CT scanned it and reconstructed all its inner cavities in three dimensions. Although the specimen has undergone some deformation during diagenesis, its endocranial anatomy was amenable to digital reconstruction.

The brain and inner ear cavities, the nervous and vascular canals, as well as the morphology of the tympanic and pharyngotympanic systems and of the paranasal sinuses were compared to those of extinct and extant eusuchians, most of them belonging to the three main lineages of Crocodylia. The presence of several plesiomorphic character-states for Eusuchia, such as a flat caudodorsal surface of the cerebrum, huge lateral expansions of the intertympanic recess and a long medial pharyngeal recess, is consistent with *Lohuecosuchus megadontos* being an early-branching eusuchian.

The inner skull cavities of *Lohuecosuchus megadontos* were also quantified and analyzed to evaluate its sensory and cognitive capabilities. Our work suggests that *Lohuecosuchus megadontos* had neuro-sensorial capabilities similar to those of extant crocodylians, such as an acute sense of olfaction and a hearing most sensitive to low frequencies.



## BETTER PHYLOGENIES FROM MORPHOLOGY: DATA FROM EXTANT CROCODYLIANS

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**Keywords:** *archosaurs, phylogeny, morphology, crocodilians*

DNA phylogenies for extant taxa are increasingly reliable, with larger datasets and improved analytical techniques. However, for fossils, phylogenies must remain based on morphology. Often results based on morphology conflict with those based on DNA for extant taxa, and thus phylogenies inferred for fossils may be inaccurate. To begin addressing this problem, data from modern crocodilian taxa were assessed. The homoplasy of morphological characters from the morphological matrix of Narváez et al. (2015, PLoS ONE) was assessed against a composite DNA-based tree. Individual characters were examined, and different groups of characters were compared statistically against one another. Cranial characters were significantly less homoplastic than postcranial characters using a Mann-Whitney U test on retention, consistency, and rescaled consistency indices ( $p=0.05$ ). Characters considered robust – i.e. matching matrix scoring completely, and where within-state homology was plausible – after first hand observation and documentation were significantly less homoplastic than non-robust characters ( $p=0.01$ ). Multistate characters were significantly less homoplastic than binary characters. Other comparisons were not significant. A maximum parsimony phylogeny created from robust characters only showed similar results to that using all characters, with placement of the gharial and false gharial as the progressively closer sister taxa to the crown, and the black caiman (*Melanosuchus*) within *Caiman*. A neighbor-joining network based phylogeny demonstrated that gharial and false gharial are morphologically closer to the crocodile than alligator line, and that their basal position using parsimony may be due to lack of an appropriate outgroup. Further work examining different methods and taxonomic groups is required.

**BISON REMAINS FROM THE LATEST EARLY PLEISTOCENE OF VALLPARADÍS SECTION (VALLÈS-PENEDÈS BASIN, IBERIAN PENINSULA) AND COMPARISON WITH THE BOVID SAMPLE FROM ELLERA DI CORCIANO (ITALY)**

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**Keywords:** *Bison*, *Bovinae*, *Iberian Peninsula*, *Italy*, *Pleistocene*

The genus *Bison* includes two of the largest species of land mammals living on Earth, the American bison (*Bison bison*) and the wisent (*Bison bonasus*), whose evolutionary history is probably rooted in the Early Pleistocene. Bison fossils from Vallparadís Section (Vallès-Penedès Basin, Iberian Peninsula) allow to shed new light on the evolution of this group of bovines. The Vallparadís Section (sites of Cal Guardiola and Vallparadís Estació; ca. 1.2–0.6 Ma) yielded more than 160 specimens attributable to the genus *Bison*. Some cranial and postcranial remains of a medium-sized bovid referred to the genus *Bison* were discovered at the site of Ellera di Corciano (Italy), whose age roughly corresponds to that of the Vallparadís Section.

In this study, the fossils (especially metapodials and astragali) from the two analyzed samples are compared with those from other Pleistocene Eurasian sites. The size and proportions of the specimens from Vallparadís Section fit those of *Bison schoetensacki* from the latest Early Pleistocene site of Le Vallonnet (France), also recorded in several early Middle Pleistocene European sites. The Vallparadís Section and Vallonnet remains represent the first occurrence of this large-sized species in Europe. The smaller size and bulky proportions of the specimens from Ellera di Corciano support instead an attribution to the scarcely known *Bison* (*Eobison*) *degiulii*. Further analyses are needed to clarify the relationships between the studied specimens and the more primitive *Bison* sp. forms recorded in the Mediterranean area during the Late Villafranchian.

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## A REVIEW OF ICHTHYOSAURIA FROM PORTUGAL

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**Keywords:** *Ichthyosaurus*, *Stenopterygius*, *Jurassic*, *Lusitanian basin*, *I. larkini*

The ichthyosaur fossil record of Portugal is composed of specimens from the localities of S. Pedro de Moel, Alhadas, Cadima, Murte, Casal do Combo, Condeixa, Alvaiázere and Tomar, within the confines of the Lusitanian Basin, ranging in age from the Sinemurian to the Aalenian. Historical classifications by Zbyszewski, Moitinho de Almeida and Veiga Ferreira have identified the specimens as belonging to the genera *Ichthyosaurus* and *Stenopterygius*, and in the cases a species could be determined, *I. intermedius* and *S. uniter*. However, over half a century has passed since these specimens have first been documented, and new developments in Ichthyosaur phylogeny and taxonomy have rendered these classifications invalid.

In this study, we've reviewed the specimens, providing a more detailed description, after which a phylogenetic analysis was performed to elucidate their taxonomic affinities. The fragmented condition, and in some cases poor preservation, of most specimens resulted in largely inconclusive analysis, with very low resolution of the consensus trees recovered. Only one specimen, labelled MDT-IST 85 and housed in the collections of Museu Decio Thadeu in Instituto Superior Técnico de Lisboa, was unambiguously assigned to the recently described species *I. larkini*. Further studies and new developments in ichthyosaur research are required for a more accurate classification of these historical Portuguese specimens.

## EGGSHELL OF EARLY JURASSIC BASAL SAUROPODOMORPH DINOSAURS

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**Keywords:** *eggshell, amniote, early dinosaurs, Sinemurian, reproduction*

One of the most puzzling features of the fossil record is the absence of preserved eggs or eggshell during the first third of the known 315-million-year history of amniote evolution. Our meager understanding of the origin and evolution of calcareous eggshell and amniotic eggs in general, has been largely based on Middle Jurassic to Late Cretaceous fossils, and the primitive condition was hypothesized through parsimony arguments. For dinosaurs, the most parsimonious inference yields a thick shelled egg (300-500  $\mu\text{m}$ ), so richly represented in the Late Cretaceous fossil record. Here we show that the oldest known amniote eggs, belonging to three coeval Sinemurian (195-192 Ma) basal sauropodomorph dinosaurs, had a thin calcareous layer ( $\leq 100 \mu\text{m}$ ) with interlocking units of radiating crystals (mamillae) and a thick shell membrane, in strong contrast to the considerably thicker calcareous shells of more derived dinosaurs. Phylogenetically informed analyses and their great age indicate that the thin eggshell of basal sauropodomorphs represents a major evolutionary innovation at the base of Dinosauria and that the much thicker eggshell of sauropods, theropods, and ornithischian dinosaurs evolved independently. Fossil evidence indicates that these mineralizations occurred not earlier than Middle Jurassic corresponding with a global trend of atmospheric oxygen increase.

# STATE OF THE ART ON QUATERNARY MICROVERTEBRATES FROM NORTHWESTERN AFRICA

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**Keywords:** *Micromammals, Herpetofauna, Maghreb, integrative approach.*

Studies on North African microvertebrates have considerably developed in recent years. These studies no longer simply provide palaeontological descriptions of the species found in the assemblages, but they also aim to better understand the evolution of faunal communities in relation to Quaternary climate changes and to reconstruct the palaeoenvironmental background of prehistoric human occupations, in well-established taphonomic and chronological contexts. These studies are also increasingly adopting an integrative approach, combining archaeology, palaeontology, taphonomy and palaeoecology, using "modern" methods such as geometric morphometrics, genetics and isotopes. The present paper aims to bring an overview of these recent studies on Quaternary microvertebrates in northwestern Africa, allowing new interpretations of their evolution over time, their relations with current populations, changes in their geographical and ecological ranges, all connected with climate changes and increasing human pressure on the environment.

# BONE MICROSTRUCTURE OF *OSMOLSKINA CZATKOWICENSIS*, AN EARLY TRIASSIC ARCHOSAURIFORM FROM POLAND

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**Keywords:** *Osmolskina*, *bone histology*, *growth dynamics*

The Czatkowice (Southern Poland) bone-bearing karst deposits, dated at early Triassic (Olenkian), are a unique locality yielding abundant small reptile fauna. *Osmolskina czatkowicensis*, a basal archosauriform, is one of the most abundant form found in this locality (hundreds of bones are known). We studied the bone microstructure of the long bones of *Osmolskina* in order to test hypotheses about the growth dynamics and palaeobiology of this animal. A considerable sample of bones (14 humeri, 14 femora, 10 tibiae, and four fibulae) representing different age classes (from 30% to 80% of the mature individual size) were sectioned in the mid-shaft to study the bone tissue. The thin sections show that all *Osmolskina* long bones are composed of fibrolamellar bone. Only larger individuals (more than 60% of the maximum size) have a parallel-fibered tissue in the external cortex and display up to two lines of arrested growth (LAGs). All analyzed bones are relatively highly vascularized. In contrast to the geologically younger archosauriform *Euparkeria capensis*, *Osmolskina* does not show any secondary osteons. However, in general, the long bone microstructure of both species is similar. This newly studied histological material fills a large gap in our knowledge of the early archosauriforms growth patterns and dynamics, allowing us for implying about ancestral adaptations.

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# HOW MESOZOIC PALAEOGEOGRAPHY AFFECTS THE PRESENT DISTRIBUTION OF SQUAMATES

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**Keywords:** biogeography, Squamata, Amphisbaenia, dispersal, vicariance

Re-examination of well-preserved fossils of Mesozoic lizards sheds some light on the timing and spatial co-ordinates of the squamate phylogeny. *Ardeosaurus brevipes* from the Late Jurassic Solnhofen archipelago may represent the oldest known stem-Scincidae. This would mean that the Scincoidea (Scincidae (Xantusiidae+Cordyliformes)) clade was already established in the Late Jurassic, which is congruent with molecular calibrations. Furthermore, this fits well the timing of the final split of Pangea into Laurasia and Gondwana. Putting all this together, the vicariance resulting from fragmentation of Pangea seems to be the best explanation for the diversification of Scincoidea: among them the Cordyliformes evolved in Gondwana, Xantusiidae in North America, and Scincidae in Eurasia. The same probably applies to other coeval clades of lizards.

The oldest crown Lacertoidea (Teiidae (Lacertidae+Amphisbaenia)) are younger and known exclusively from former Laurasian continents. The Cretaceous stem-Teiidae comes from North America, while the Mesozoic record of Lacertidae is yet to be recognized in the available fossil material. Surprisingly, the Cretaceous stem-amphisbaenians (*Slavoia darevskii*) come from Asia. This contradicts previous hypotheses, which located their origin in North America. Modern Lacertidae are typical Old-world clade of lizard and its last common ancestor with Amphisbaenia probably lived in Eurasia. The amphisbaenians expanded together with associated groups of vertebrates to North America from Asia at least twice: just after the Cretaceous/Paleocene boundary and near the Paleocene/Eocene boundary when both continents were connected. Prehistoric land connections between continents offer better explanation of the present lizard distribution than transoceanic dispersals.

# A NEW FINDING OF A PERINATE BALEEN WHALE (MAMMALIA: CETACEA) FROM LOCALITY FORTEP'YANKA 2 (REPUBLIQUE ADYGEA, RUSSIA)

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**Keywords:** Cetotherium, Miocene, neonatal, squamosal, morphology

In 2003, K.K. Tarasenko found several localities of fossil vertebrates in sections cropping out at the Fortep'yanka River. Of these locations, the whales of the *Kurdalagonus* genus are known. At the beginning of the fieldwork in 2018, the new small skull was found in the Fortep'yanka 2 locality. The samples (collection PIN №5462/64,65) show the following features: the anterior margin of the superior occipital bone is enlarged and slightly rounded; posterolateral skull walls relatively flat and dorsomedial. The suture surface (the suture between the squamosal, posterior occipital bone and the supraoccipital bone) has very deep caverns. In this place there was a cartilaginous tissue. Samples of PIN № 5462 / 64,65 were found in association. Considering the underdevelopment of the superior occipital bone (5462/62) and the squamosal bone (5462/65), it must be concluded that the skull belonged to the newborn whale, with the suture of the cranium still not formed. This was partly confirmed by measurements using samples belonging to perinate and adult whale, as well as by comparison with the materials of the zoological museum of Moscow State University (S - 113797). Morphology of the squamosal, features of the posterior edge of the squamosal bone in the region of the squamosal-occipital suture and the area of attachment of the mastoid process allows us to define this whale as belonging to the genus *Kurdalagonus*.

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## TO BE OR NOT TO BE (HEAVIER) – PRELIMINARY DELIBERATIONS ON THE FUNCTION OF THE THICK DERMAL SKELETON OF METOPOSAURUS

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**Keywords:** dermal bones, *Metoposaurus*, Krasiejów, Late Triassic

Metoposaurids are well known for their extremely thick dermal bones, which are considered to be the strongest argument supporting the bottom-dweller mode of life. According to this model, thick dermal bones allow to control buoyancy (i.e., helping the animal to stay close to the bottom). A common measure for solidity is the Bone Mass Index (BMI), which is defined by two factors: size/thickness ratio of the bone and its compactness. The latter factor is crucial since a thick bone is not necessarily heavy, due to possibly high porosity. The increase of bone thickness could thus be necessary to maintain optimal bio-mechanical properties while porosity increases. To confirm that the *Metoposaurus* dermal bones are not only thick but also heavy and therefore play a role in the static buoyancy control, the BMI has to be estimated for a representative amount of temnospondyl samples. The study of plagiosaurids, cyclotosaurid and chigutisaurid dermal bones thin-sections showed that plagiosaurid and especially cyclotosaurid have very porous bones with a relatively similar thickness as metoposaurid. Especially, in the case of *Cyclotosaurus* the porosity is even higher than 70 %. The preliminary results show that in metoposaurids, the dermal bones indeed served as ballast function according to their high bone mass achieved mostly by their compactness and not by thickness. Moreover, it was proposed that a key function of the dermal bone sculpture, which is associated with strong vascularization, was to buffer CO<sub>2</sub>-induced acidosis and perhaps also lactic acidosis induced by periods of anaerobic activity.

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## CHOOSING THE RIGHT METRIC: A COMPARISON OF MOLAR RELIEF ESTIMATES USED IN DENTAL TOPOGRAPHY

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**Keywords:** 3D dental topography, diet, RFI, slope

Dental topography is now commonly used to investigate tooth form and function in extinct species. As a growing number of dental topographic variables and applications are made available to paleontologists, choosing the right metric might become increasingly challenging. Furthermore, the risk of combining variables that could be correlated raises concern about collinearity. A comparison of the existing metrics is therefore required.

This work focuses on the dental relief of primates i.e., the variation of their dental surface elevation. Dental relief, especially molar relief, can be used to infer the diet of extant and extinct primates in terms of physical properties. Tough food eaters, such as insectivorous and folivorous primates, are expected to have higher dental relief than frugivorous primates. Here a selection of dental relief estimates (slope, relief index, logarithmic relief index and elevation) are compared across a sample of upper second molars from extant primates. In addition to average tooth-scale values, the distribution of every metric over the molar surface is characterized using topographic maps.

We found that slope and relief indexes are strongly correlated. This can be explained mathematically, as slope and relief index were found to be linked by a mathematical relation. In contrast, all metrics were independent from elevation *per se*. The strong correlation between slope and relief indexes implies they should not be combined in multivariate analysis to avoid collinearity. Still, both metrics show different arithmetic and graphical properties, meaning that paleontologists might prefer one over the other depending on the question investigated.

## **“RHABDODON-LAND”: NEW DISCOVERIES OF RHABDODON FROM THE CAMPANIAN OF THE NATIONAL NATURAL RESERVE OF SAINTE-VICTOIRE (SOUTHERN FRANCE)**

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**Keywords:** *Rhabdodon*, *Dinosauria*, *Upper Campanian*, *Provence*, *variability*

The present study is the continuation of previous works started in 2015 on the historical “eggs” locality of Grand-Creux, in the national natural reserve of Sainte-Victoire (RNSV), Southern France, by the RNSV/MHNA team. We report the discovery of new partial skeletons and isolated elements belonging to the ornithomimid *Rhabdodon* and to other dinosaurs (dromaeosaurids, abelisaurids and titanosaurs) and tortoises (*Solemys*). On the locality, *Rhabdodon* are now represented by, at least, eight fragmentary small to medium-sized individuals.

These discoveries include new caudal vertebrae for the biggest individual, new limb bones and caudal vertebrae for the second most complete individual and the first cranial elements (jugal, quadrate). New elements confirm the morphological disparity observed between the two most complete individuals. The femora, the ischia and the caudal vertebrae display differences despite of the same general size. This supports the consideration of the sexual dimorphism in *Rhabdodon*.

These new discoveries confirm the presence of a complex combination of features among specimens from the Provence: La Nerthe Tunnel (Bouches-du-Rhône), Trets (Bouches-du-Rhône), Velaux (Bouches-du-Rhône), Vitrolles-Couperigne (Bouches-du-Rhône), Fox-Amphoux (Var), Pourrières (Var), the Saint-Chinian area (Hérault). As such, they establish the basis for the recognition of the different types of dimorphism (interspecific, ontogenetic and, now, sexual) in order to better define the genus *Rhabdodon*, better estimate the French rhabdodontid diversity and improve understanding of the paleobiodiversity on the Ibero-Armorican island during the Late Cretaceous.

## UPPER LUTETIAN-LOWER BARTONIAN FISH FROM THE TRANSYLVANIAN BASIN, ROMANIA. PRELIMINARY RESULTS

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**Keywords:** sharks, bony fish, Eocene, Căpuş Fm., Cluj-Napoca

Recent survey in the middle Eocene deposits of Luna de Sus locality (Gilău sedimentary area) revealed a rich occurrence of fish teeth, dermal spines, caudal spines and vertebrae belonging to the Căpuş Formation.

This locality is situated in the north western side of the Paleogene Transylvanian basin, in the central part of Romania, about 10 km west from the city of Cluj-Napoca. This locality is a new one for fossil fish remains.

The Căpuş Formation is a middle Eocene formation exposed in the NW side of the basin. Its sedimentology indicates a paleoenvironment of inner shelf of an open sea, with tidal regime. The latest study shows that the age of the formation is Lutetian-Bartonian. Only its lowest portion includes Lutetian, the remaining being Bartonian. The analysis of the local sedimentologic log shows that the outcrop exposes rocks, which age is very close to the lowermost Bartonian, just above the Lutetian/Bartonian boundary.

The collected fauna includes the following taxa: *Heterodontus* sp., *Rhizoprionodon ganntourensis*, *Galeocerdo* cf. *eaglesomei*, *Physogaleus secundus*, *Abdounia* sp., *Macrorhizodus precursor*, *Striatolamia macrota*, *Otodus* (*Carcharocles*) sp., *Jaekelotodus robustus*, *Hypotodus verticalis*, cf. *Myliobatis* sp., cf. *Aetobatus* sp., *Dasyatis* sp., *Rhinobatos* cf. *steurbauti*, *Pristis* sp., cf. Rajiformes, Batomorphii indet., Phacodus cf. punctatus, Labridae indet.

The fauna with some new species for Romania, indicates a mixture of reef fish (Pycnodontiformes, Perciformes), littoral (Carcharhiniformes), demersal (Myliobatiformes), and pelagic (Lamniformes) ones. The specific taphonomy indicates that the fish teeth are in majority autochthonous, devoid of transport marks, few being parautochthonous.

# A NEW MARINE SNAKE (PALAEOPHIIDAE) FROM THE EARLY PALEOGENE OF MOROCCO, A SIGNAL OF EARLY CENOZOIC DIVERSIFICATION

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**Keywords:** *Palaeophiidae*, *Ypresian*, *Diversification*

The early Cenozoic phosphates of Morocco have yielded a diverse marine vertebrate fauna. Among these are the Palaeophiidae, a diverse taxon of marine snakes. Previously, all *Palaeophis* from Morocco have been identified as *P. maghrebianus*. We describe a new palaeophiid from the Ypresian (Lower Eocene) of the Oulad Abdoun basin, and describe a previously unknown species from Morocco, *Palaeophis toliapicus*. The new specimen consists of disarticulated vertebrae and ribs, and is referred to the family Palaeophiidae based on the horizontal axis of the cotyle-condyle, the low position of the synapophyses, the long and slightly curved ribs, and lateral compression of the vertebrae. It differs from primitive palaeophiid snakes and resembles *Pterosphenus* in exhibiting a hypertrophied neural spine, which extends to twice the length of the centrum on trunk vertebrae, and in the pterapophysis protruding slightly over the dorsal height of the zygosphenon at a low angle. Parsimony analyses based on 54 characters, including 29 novel quantitative characters and 26 fossil snake taxa suggests a relatively derived form of *Palaeophis*. The specimen illustrates the extreme adaptations to the aquatic environment of this clade, the phylogeny suggests that Palaeophiidae underwent a major radiation in the Paleocene and early Eocene in response to the extinction of Cretaceous marine reptiles and Paleocene-Eocene global warming.

# THE LARGE MAMMALS ASSEMBLAGE FROM BUDA (EASTERN ROMANIA) AND ITS IMPLICATIONS ON PALAEOOLITHIC HUNTING BEHAVIOUR

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**Keywords:** *late Pleistocene, Bovidae, Palaeolithic hunters*

Located on the terraces of Bistriţa River, the open-air Palaeolithic site from Buda (Bacău County, Eastern Romania) is well known to archaeologists for the Gravettian flint tools found there. A high amount of large mammal remains were also found at the site, yet they remained less studied. Consisting almost exclusively of fragmentary postcranial elements, the large bovid remains, dominant in the faunal assemblage, were previously assigned to an indeterminate specie, either *Bos primigenius* or *Bison priscus*.

A thorough morphological study of 1044 bovid specimens, based on comparison to the morphologies of extant bison and cattle, revealed that virtually all of them can be assigned to the steppe bison. Many of the specimens bear signs of human activity: butchering marks and frequent signs of bone breakage for marrow extraction, charred bone is also present, and carnivore bite marks are absent. The bone accumulation is dominated by fragments of the appendicular skeleton, indicating the remains are the result of a secondary butchering site. The higher ratio of adult female bison can result from different hunting strategies, including seasonal selection of fatter females during autumn, or from herd organization under predator pressure.

Reindeer remains are far less numerous, and are not restricted to the appendicular skeleton, the much lighter cervids being easier to transport without need for butchering. The presence of adult reindeer suggests they were also hunted at the beginning of or during the cold season, and signs of antler collecting and processing into tools took place at the site.

## THE MICROVERTEBRATE FOSSIL ASSEMBLAGE FROM ABRI 122 MIDDLE PALAEOLITHIC SITE IN THE VÂRghiŞ GORGES (ROMANIA)

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**Keywords:** *small vertebrates, Middle Palaeolithic, late Pleistocene*

With more than 100 caves, the Vârghiş Gorges represent the most important karst system of Perşani Mountains. One of several archaeologically important sites, the Abri 122 rock shelter stands out for yielding various lithic elements belonging to the Middle Palaeolithic. Large mammal remains are also abundant at the site, and include fragmentary bones assigned to large bovids (aurochs or bison), medium-sized ruminants (ibex, and possibly roe deer), and carnivores (cave bear and wolf). Cut marks and bone processing for tool making were also identified, representing clear evidence of animal exploitation by humans.

The presence of microvertebrates at the site was tested by screen-washing around 50 kg of sediment, from two depth intervals around the cultural layer where most lithic elements were found. This led to the discovery of a diverse microvertebrate assemblage, including indeterminate fishes, amphibians (*Rana* sp., *Pelophylax* sp., *Hyla* sp.), snakes (*Natrix* sp., and an indeterminate colubrine), a lacertid lizard, rodents (*Microtus arvalis*, *M. gregalis*, *Clethrionomys glareolus*, *Chionomys nivalis*, *Lagurus lagurus*, *Arvicola amphibius*, *Cricetulus migratorius*, *Cricetus cricetus*), and one insectivore (*Sorex araneus*).

The microvertebrate assemblage (albeit preliminarily assessed), includes taxa that show affinities to cold rocky habitats (*Chionomys nivalis*), grasslands (*Lacerta agilis*, *Microtus arvalis*, *Lagurus lagurus*, *Cricetus cricetus*), shrubberies, and forests (e.g. *Clethrionomys glareolus*, *Sorex araneus*), in the close vicinity of permanent streams (*A. amphibius*, *Pelophylax* sp.). The relative age indicated by the values of the Schmelzband-Differenzierung-Quotient calculated for *A. amphibius* correlate to some of the absolute dates obtained for the Middle Palaeolithic layer.

## VARIABILITY OF CERVICAL INTERVERTEBRAL SPACE, POSTURE AND RANGE OF MOTION: COMPARING SAUROPOD AND GIRAFFE ONTOGENY

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**Keywords:** *Sauropoda, Functional Anatomy, Cervical vertebrae, Ontogeny, Giraffe*

Articular soft tissue is key when studying extinct vertebrate functional anatomy. Intervertebral tissue and its thickness in particular is central on the lively debate on sauropod neck posture. Previous studies on extant giraffes have shown notable changes on neck posture and extreme shrinkage of the proportion of soft tissue contributing to the actual length of the neck from younger to older individuals. To test whether the same could happen to sauropods, we have articulated 3D virtual models from two complete cervical series of a juvenile and a nearly full-grown subadult of the Middle Jurassic sauropod *Spinophorosaurus nigerensis*. To test whether digital mounts can replicate the *in vivo* measurements, 3D virtual models of two cervical series from a calf and adult *Giraffa camelopardalis* were articulated as well. The results from the giraffe skeletons reveal that the virtual mounts can predict an accurate intervertebral space, posture and range of motion, within the ranges measured from fresh carcasses and alive specimens. Just as it happens *in vivo*, the virtual giraffe calf has more than four times the intervertebral space, a lower neck in neutral posture and smaller range of motion than the adult. The situation for *Spinophorosaurus* is similar: the virtual neck of the juvenile has more intervertebral space, a lower neutral posture and smaller range of motion than the adult. This suggests that the ossification pattern of the cervical centra of *Spinophorosaurus* might have emulated that of giraffes, so neutral posture would shift and range of motion would increase during ontogeny.

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## THE REDISCOVERY OF THE ORCAU DINOSAUR: FOLLOWING THE STEPS OF WALTER GEORG KÜHNE IN THE TREMP BASIN (CATALONIA)

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**Keywords:** *W.G. Kühne, Orcau, sauropod, Tremp basin*

In the summer of 1953, the renowned paleontologist Walter Georg Kühne (1911-1991) arrived to Catalonia to perform geological expeditions in the southern Pyrenees. A year later, he was commissioned by the Instituto Lucas Mallada to find fossils of Cretaceous mammals in the coal-bearing deposits of the Tremp and Vallcebre basins. Unexpectedly, and during the fieldwork near the Suterranya coal mines, he discovered the first Pyrenean fossil locality with a nearly-articulated sauropod dinosaur. The fossils collected at Orcau locality in the 1954-1955 expeditions were sent to the Lucas Mallada Institute in Madrid and since then they remained unstudied and absolutely forgotten by the science.

In recent years, the history of the Kühne expeditions in the Tremp basin and the whereabouts of the collected bones have been reappraised. By means of interviews with locals, personal letters, historical images, unpublished scientific reports, and original Kühne's field notes, we got a unique information about the fieldwork procedures as well as unrevealed details on the taphonomy of the site and the number and nature of the collected specimens. The historical research proves not only that the German "mammal hunter" was the first to formally excavate a sauropod dinosaur in the Pyrenees, but it reveals that he kept records of what, when, and how he collected the specimens. All this information has been merged with that from recent (2012-2014) excavations and ultimately, after the collection of the remaining skeleton, has been useful for identifying old specimens and to complete the taphonomy of the quarry.

## NEW TITANOSAURIAN FINDINGS FROM HISTORICAL LOCALITIES OF THE TREMP BASIN (MAASTRICHTIAN, PYRENEES)

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**Keywords:** *titanosaurians, late Cretaceous, Tremp basin, SW Europe*

In South-western Europe, titanosaurian sauropods have a continuous record from the middle-Campanian to the very end of the Maastrichtian with several types of evidence, including bones, tracks, eggshells and clutches, and even skin impressions. The titanosaurian taxa described are *Ampelosaurus atacis*, *Lirainosaurus astibiae*, *Atsinganosaurus velaucencis*, *Lohuecotitan pandafilandi* as well as other new titanosaurian species pending description.

In the southern Pyrenees, excavations conducted in recent years in the Tremp basin have produced new findings of Titanosauria in two of the main historical localities, of early Maastrichtian age (C31r). In the Els Nerets site, cranial and postcranial elements have been recovered, including most of the snout, dentary and several skull roof elements, alongside appendicular bones and distalmost caudal vertebrae. In the Orcau-1 site, new excavations and the reappraisal of the historical fieldwork conducted by W.G. Kühne in 1954 and 1955, have produced new and nearly-articulated material including axial and appendicular elements such as dorsal vertebra and ribs, a partially-preserved and articulated neck, scapular girdle, and various fore- and hind-limb bones. Due to the scarcity of titanosaurian record in the Maastrichtian deposits of the Pyrenees, the finding of new material that may represent new taxa is significant in terms of systematics and diversity. In addition, the cranial material represents the second evidence for this clade in south-western Europe and will involve further phylogenetic implications for the European titanosaurians.

# PRELIMINARY REPORT ON THE AMPHIBIANS AND REPTILES FROM THE LOWER PALAEOLITHIC PALAEOANTHROPOLOGICAL SITE OF VISOGLIANO (NE ITALY)

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**Keywords:** *Middle Pleistocene, herpetofauna, Apennine Peninsula*

The Visogliano shelter has been defined as an important Middle Pleistocene site where human remains were found together with an archaic lithic industry. Besides the human remains, stone tools, sediments, pollen and faunal remains have been already the subject of specific analyses indicating that the fossil bearing layers were deposited in one interglacial and one or two glacial phases (dated to a 500-350 kyr time span). However, among the non-human vertebrates, only mammals were studied so far. Here we report, for the first time, on the amphibians and reptiles collected thanks to the wet sieving screening of the sediments from the shelter. The analysis is preliminary since only the remains recovered between 1992 and 2000 have been studied so far, but overall 1305 fossils were identified.

The herpetofauna consists of at least four amphibians (an undetermined caudate, *Bufotes viridis*, *Pelophylax* sp., *Rana* sp.) and at least seven reptiles (*Testudo hermanni*, *Anguis* gr. *A. fragilis*, a large- and a small-sized lacertids, undetermined “Colubridae”, *Natrix* sp., *Vipera* gr. *V. aspis*). Interestingly, all the taxa recognised so far are still represented in NE Italy, supporting the previously reported hypothesis of a modern herpetofauna that was already setting up in the area since the beginning of the Pleistocene. Notable is the apparent absence of *Pseudopus*, which is known in other Middle (and even Late) Pleistocene sites of this part of the country (e.g., in Veneto).

**CONSERVATION-RESTORATION STRATEGIES IN HARD SEDIMENTS. THE CASE OF A BEAR MANDIBLE FROM THE MIDDLE PLEISTOCENE SITE POSTES CAVE, (EXTREMADURA, SPAIN)**

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**Keywords:** *conservation, restoration, Middle Pleistocene, mammal fossils*

The site of Postes Cave Extremadura, Spain has yielded many fossils from a middle Pleistocene deposit. But, it presents many difficulties derived from the filling karst sediment made of speleothem and hard clays. The aim of this study is to present the conservation-restoration tasks applied to the fossils in situ and in the laboratory.

The biggest bones are partially covered by speleothems, so the field work requires the use of chisels and hammers to remove the bones. During the process, we followed the principle of minimum intervention but, at times, the vibrations might generate fractures and fissures. After years of experience in this site, we have observed that long bones and fossils with thin cortical, like vertebrae or scapula, were the most vulnerable. In those situations, it was necessary to carry out in situ interventions that prevented future damages and consisted in partial gauzes and consolidations. Paraloid B-72 in different concentrations of acetone were used. In most cases, bones are removed with sediment and speleothem, which helped to minimize the damage. We bring here an example of a complete bear mandible partially adhered to the speleothem. The main treatments consisted in a mechanical cleaning with a pneumatic engraving pen. As a result, we have recovered all the fossils and preserve enough anatomical elements to allow us to carry out scientific studies.

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# AN ARBOREAL AVIFAUNA FROM THE EARLY–MIDDLE MIOCENE BOUNDARY OF EASTERN SIBERIA

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**Keywords:** *Central Asia, early-middle Miocene, clade of Land birds, arboreal avifauna*

Tagay is one of the most important localities with Neogene bird remains in Central Asia. It is located on Olkhon Island of Baikal Lake and is dated to the boundary of the early and middle Miocene. In contrast to Europe, bird remains from this time interval are extremely rare in Asia. In this locality, a representative sample of arboreal birds was found along with waterfowl and groundbirds. Some of the most impressive specimens of arboreal bird from Tagay locality have been recently described. They are the first Siberian parrot and *Kischinskiniya scandens* Volkova, Zelenkov, 2018, a tree-climbing passerine bird from the clade Certhioidea. In addition to them, remains of various other bird groups, which are very rare in the early Miocene of Asia, were found in this locality. Among them there are several other passerine birds, two species of owls (Strigiformes), and the first piciform bird found in the Miocene of Asia.

Such taxonomic composition is similar to that of the late early Miocene and early middle Miocene (MN 3–MN 5) of Europe. Some waterbirds from Tagay also support affinities between the Siberian and Western European avifaunas during the discussed time interval. The fauna of ectothermic snakes from Tagay is also similar to the contemporary faunas from Europe. These facts indicate relatively close environmental conditions in the Baikal region and Western Europe at that time.

**Acknowledgments:** I am grateful to all participants of the field work at the Tagay locality. The study was supported by a grant RFBR №18-34-00680.

# NEW DATA ON THE TAXONOMIC DIVERSITY OF THE MAASTRICHTIAN MULTITUBERCULATE MAMMALS FROM TRANSYLVANIA BASED ON POSTCRANIAL ELEMENTS

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**Keywords:** *Maastrichtian, Hațeg Basin, multituberculate mammals, postcrania*

In the uppermost Cretaceous continental deposits of Transylvania, at least four partial skeletons of kogaionid multituberculates are known. These fossils preserve associated cranio-dental remains and postcranial elements, particularly limb bones. Three of them, LPB M. 1635, LPB M. 1698 and LPB M. 1700 (all in the Laboratory of Paleontology, Faculty of Geology and Geophysics, University of Bucharest collections), were recovered from the Bărbat River outcrop succession near Pui, in the eastern Hațeg Basin. To date, all published multituberculate fossils recovered from this site (exclusively cranio-dental material) were referred to a single species, the red-toothed multituberculate *Barbatodon transylvanicus*. Although earlier observations documented quite remarkable morpho-dimensional differences, these were interpreted as falling in the range of intraspecific/individual variations. Partial skeletons now allow a more detailed comparison between the different individuals using postcranial features as well. Our aim is to interpret the results obtained from the morphological and morpho-functional analysis of the femora of two specimens from Pui (LPB M. 1635 referred to *B. transylvanicus*, and LPB M. 1700, respectively), together with other overlapping skeletal elements (epistrophei, humeri). These results challenge the idea of monospecific composition of the local multituberculate fauna. Additionally, a third femur specimen, associated with cranio-dental material of a new small-sized kogaionid (EME 655) that originates from the much older, Campanian-Maastrichtian boundary interval of Petrești-Arini vertebrate locality near Sebeș (SW Transylvanian Basin), is also analyzed. Finally, based on these specimens, the postcranial morphology of the endemic kogaionid multituberculate mammals from Transylvania is discussed.

# GROWTH RATES AND AGE DISTRIBUTION OF DIFFERENT JURASSIC SAUROPOD TAXA- DORSAL RIB HISTOLOGY REVEALS LONGER GROWTH TIMES FOR MACRONARIANS THAN FOR DIPLODOCIDS

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**Keywords:** *Sauropoda, growth rates, dorsal rib histology, life history traits, ecology*

Sauropod dinosaurs are not only the largest terrestrial vertebrates that ever lived, they also had the largest size ranges from hatchlings to adults. Therefore, their life history traits and growth rates are of special interest. Skeletochronology, using histological growth marks in long bones, is frequently used to construct growth curves in dinosaurs and other tetrapods. However, this approach is difficult in sauropods because formation rates of primary and secondary bone tissue in the long bones are too high to produce and preserve lines of arrested growth (LAGs) in all but the outermost cortex. Previous studies have shown that sauropod dorsal ribs in contrast commonly preserve a remarkably complete growth record. Therefore, this study analyses the growth record preserved in ribs of 15 different Jurassic sauropod taxa represented by 63 different individuals (including 13 type specimens) from 13 different localities. Independently of body size, the analysis shows that diplodocoid sauropods have higher growth rates and shorter growth times than their sister taxon, the macronarians. On average, diplodocoids reached sexual maturity after 12 to 14 years of growth and skeletal maturity with 20 to 22 of age, while macronarians took 16 to 18 years to become sexual mature and reached skeletal maturity at the age of 27 to 30. This difference is useful for taxonomic assignment of indeterminate sauropod rib material to one of the sister clades. The age distribution is adult-dominated, suggesting that large sauropods may have inhabited different environments than their juveniles that were more appropriate for fossil preservation.

## RAPID RADIATION OF LACERTID LIZARDS (SQUAMATA, SCINCOMORPHA) IN THE OLIGOCENE OF FRANCE

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**Keywords:** *Lacertidae, Oligocene, species variability, France, phylogeny*

Climate change largely impacted the diversity of squamates. During the relatively cold climate of the Oligocene, a faunal transition from old Eocene to modern Miocene faunas took place. The crown group of Lacertidae is assumed to have originated in the Eocene of central western Europe. Material from four Oligocene localities in France (Coderet, La Colombière, Roqueprune 2 and Mas de Got B) provides new information about diversity and coexistence of lacertid species shortly after the origin of the clade. Based on morphological characters such as the differences in tooth size and the presence or absence of dermal ornamentation, six different morphotypes could be identified in the Chattian deposits of Coderet and La Colombière, whereas for the Rupelian localities Roqueprune 2 and Mas de Got B four morphotypes were determined. Some of the morphotypes occur at both chronostratigraphic stages. Several lacertid species are known from the Oligocene in France, including the Gallotiinae *Pseudeumeces cadurcensis* and *Dracaenosaurus croizeti*, and species of unclear systematic placement within the family (*"Lacerta" filholi*, *Mediolacerta roceki*, *Plesiolacerta lydekkeri*, *Escampcerta amblyodonta*, *Gracilicerta sindexi*, *Quercycerta maxima* and *Hugueneysaurus globidens*). *M. roceki*, *D. croizeti*, *H. globidens* and *"L." filholi* were already described from the localities studied herein, but only *M. roceki* and *"L." filholi* resemble some of our morphotypes. Therefore, lacertid diversity in the Oligocene of France was likely higher than previously recognized. The high diversity at an early stage after the Eocene/Oligocene extinction event indicates that Lacertidae underwent a rapid radiation soon after their origin.



# THE MOSAIC ACQUISITION OF MARINE ADAPTATIONS IN METRIORHYNCHOID CROCODYLOMORPHS, FURTHER EVIDENCE FROM A NEW LARGE-BODIED SPECIES FROM HUNGARY

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**Keywords:** *Crocodylomorpha, Hypocercal tail, Marine adaptations, Phylogenetics, Thalattosuchia*

Thalattosuchians were a clade of aquatic crocodylomorphs that thrived during the Jurassic and Early Cretaceous in marine ecosystems. One sub-clade, Metriorhynchoidea, evolved from being superficially gharial-like into open-sea dolphin-like forms. Unfortunately, the timing and sequence of the adaptations involved in this evolutionary transition are still poorly understood, due to the incomplete preservation of basal metriorhynchoids. Here we report on associated, and three-dimensionally preserved, cranial and postcranial remains of a new basal metriorhynchoid that begins to fill this gap. The new species was discovered from the upper Toarcian (Lower Jurassic), Kisgerecse Marl Formation of the Gerecse Mountains, Hungary; thus, unlike most estuarine, lagoonal or coastal thalattosuchians, the “Gerecse crocodile” comes from an “ammonitico rosso” type pelagic deposit. Besides expanding our knowledge of basal metriorhynchoid diversity, the “Gerecse crocodile” gives the first insight into Lower Jurassic thalattosuchian biodiversity in the Mediterranean region of the Tethys Sea. Based on femoral length, the “Gerecse crocodile” has an estimated body length of 4.67–4.83 m, making it the largest known non-metriorhynchid metriorhynchoid. Overall the specimen is similar to *Pelagosaurus typus*, except for a distal caudal vertebra that looks like those in metriorhynchid tail bends: a mediolaterally compressed centrum, and an unusually elongate and dorsally projected neural spine. This combination of retaining heavy dorsal and ventral osteoderm armour and having a slight hypocercal tail (or a slight ventral displacement of the distal caudal vertebral column) is unique. It suggests that the loss of dermal ossifications seen in metriorhynchids came after the acquisition of a hypocercal tail.

## WHERE DO THALATTOSUCHIANS GO IN THE CROCODYLOMORPH TREE? INTRODUCING THE CROCSUPERMATRIX PROJECT

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**Keywords:** *Crocodylomorpha, Marine adaptations, Neuroanatomy, Phylogenetics, Thalattosuchia*

Here we introduce the CrocSuperMatrix project, a collaborative effort lead by the authors listed herein, to rectify multiple uncertainty issues currently found in the crocodylomorph tree. Thus far, two datasets have been successfully merged, those of Alexander Hastings and Mark Young – leading to the formation of the H+Y matrix. Currently, three datasets are in the process of being merged. Firstly, the H+Y matrix, the second is a modified version of the Andrade (mA) dataset, while the last is a modified version of the Wilberg (mW) dataset. These datasets have been restructured into the same anatomical order and share the same 20 common anatomical sub-sections.

The first issue for the project to investigate is the evolutionary position of Thalattosuchia, a unique clade that thrived during the Jurassic and Early Cretaceous in marine ecosystems. At present our datasets return conflicting positions for Thalattosuchia, with the H+Y matrix finding thalattosuchians to be mesoeu-crocodylians basal to Notosuchia + Neosuchia. The mA dataset recovers Thalattosuchia as the sister taxon to Tethysuchia, while the mW dataset has Thalattosuchia as the sister group to Crocodyliformes. This wide range of possible positions for Thalattosuchia, a major crocodylomorph clade, is bizarre at first-glance. However, thalattosuchians evolved a wide-range of osteological, soft-tissue and neuroanatomical adaptations for an aquatic and/or marine existence that clearly unite the clade, but also makes them disparate from all other crocodylomorphs. Our aim is to unite the character-lists from our datasets and use the combined weight of them to rectify this long-standing issue in crocodylomorph systematics.

## THE LATE TRIASSIC DINOSAUR LOCALITY FRICK – NEW SAURISCHIA

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**Keywords:** *Saurischia, theropod dinosaur, new taxa, Late Triassic, Switzerland*

Since 1961 the clay pit Gruhalde in Frick, Switzerland is well-known for its abundant, articulated *Plateosaurus* material (Sauropodomorpha, Saurischia), which is derived from the Norian Gruhalde Member of the Klettgau Formation (Upper Keuper). Within this lithological unit, immediately below the Triassic-Jurassic boundary, an additional dinosaur layer was discovered in 2006. So far, excavations in this layer yielded two saurischian taxa that have previously not been known from Frick. These are a subadult carnivorous dinosaur with stomach contents (SMF 06-1 and 09-2), whereof remains of a tuatara could be identified, and six individuals of a sauropodomorph (SMF 06-2, 09-4, 09-5, 13-3, 13-4, 13-5 and 13-6). Both the first theropod skeleton from Switzerland and the sauropodomorph material comprise an exceptional well preserved skull (SMF 09-2, SMF 13-5). Generally, the newly-discovered sauropodomorph shows anatomical accordance with the genus *Plateosaurus*, but differs from the geologically older specimens in several aspects. The theropod skeleton is impressively complete and the by far best preserved from the Late Triassic of Europe, where fossils of carnivorous dinosaurs are usually very fragmentary. The subadult individual furthermore represents the holotype of a new genus and species, which is characterized by plesiomorphic and apomorphic features of different neotheropod clades. It exhibits characteristics typically found in Coelophysidae but also shows traits that are distinctive for *Dilophosaurus* and its closest relatives. Due to its special character combination, the Swiss specimen is very important to understand the early evolution and diversification of dinosaurs in general and of Neotheropods in particular.

# NEOGENE EVOLUTION OF CONTINENTAL ASIAN WATERFOWL COMMUNITIES (AVES, ANATIDAE)

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**Keywords:** *waterfowl, Miocene, Northern Eurasia, taxonomic turnover, dispersal*

Waterfowl (Anseriformes, Anatidae) are among the most common in the fossil record of birds. However, until recently, our knowledge of their past diversity in the Neogene of Asia was limited mainly to data on the latest Miocene – Pliocene of Western Mongolia, when many modern genera already existed. Recent studies of older diverse faunas, which date to the middle Miocene and late early Miocene, allow reconstructing the early Neogene stages of waterfowl communities on this territory for the first time. Ducks from the middle Miocene Sharga locality in Mongolia and early Miocene Tagay locality in Eastern Siberia belong to various primitive and extinct genera of unclear affinities. Many of these taxa were also found in Europe and even North America. These data indicate the existence of waterbird taxa dispersal across vast territories of the Northern Hemisphere, which took place close to the Middle Miocene Climatic Optimum. Information on some taxa shows that this likely was “out-of-Asia” dispersals similar to previously documented dispersals for some Neogene mammals. A taxonomic turnover appeared in the late Miocene when all of those archaic genera were replaced by extinct (morphologically distinct) species of the living genera. This turnover may result from both documented climatic changes (intensifying cooling and aridization) and arrival of allochthonous taxa. During the Pliocene to Quaternary, these faunas gradually obtained their present taxonomic appearance.

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