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*2nd Virtual  
Conference for Women  
Archaeologists  
and Paleontologists*

7TH-8TH MARCH 2022, ONLINE

Hosted by the Association for early-career  
Women Archaeologists and Paleontologists

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Abstract Book



# 2nd Virtual Conference for Women Archaeologists and Paleontologists

7<sup>th</sup>-8<sup>th</sup> March 2022, Online

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# From Neogene to Neolithic: approaches on past climates, environments and populations

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**MONDAY, MARCH 7<sup>th</sup>**

**Session 1: Dynamics of populations and their environments through time and space**

Chairs: Ana Abrunhosa, Émilie Berlioz, Axelle Walker and Julie Bachellerie



# A spatiotemporally explicit palaeoenvironmental framework for the Middle Stone Age of Eastern Africa

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**Keywords:** Middle Stone Age, palaeoenvironments, climate simulations, Eastern Africa

## Abstract

Eastern Africa has played a prominent role in debates about modern human evolution and dispersal due to the presence of rich archaeological, palaeoanthropological and palaeoenvironmental records. However, substantial disconnects occur between the spatial and temporal resolutions of these data that complicate their integration within a spatiotemporally explicit framework. This study applies high-resolution climatic simulations of two key parameters, mean annual temperature and precipitation, and a biome model, to produce a highly refined characterisation of the environments inhabited during the eastern African Middle Stone Age. Occupations are typically found in sub-humid climates and landscapes dominated by or including tropical xerophytic shrubland. Marked expansions from these core landscapes include movement into hotter, low-altitude landscapes in Marine Isotope Stage 5 and cooler, high-altitude landscapes in Marine Isotope Stage 3, with the recurrent inhabitation of ecotones between open and forested habitats. Through this use of high-resolution climate models, we have demonstrated a significant independent relationship between past precipitation and patterns of Middle Stone Age stone tool use overlooked by previous studies. Engagement with these models not only enables spatiotemporally explicit examination of climatic variability across Middle Stone Age assemblages in eastern Africa but enables clearer characterisation of the habitats early human populations were adapted to, and how they changed through time.

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# The Mesolithic levels of El Toral III (Asturias, Spain): shellfish gathering strategies

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**Keywords:** Mesolithic, paleoclimate, Cantabrian region, archeomalacology, shell midden

## Abstract

The Cantabrian Mesolithic is characterized by the existence of significant changes with respect to the Upper Palaeolithic, both in subsistence strategies and in the settlement patterns adopted by the last groups of hunter-fisher-gatherers after the arrival of the Holocene. Although processes such as the intensification in the use of resources are part of the strategies of Palaeolithic hunter-fisher-gatherers in response to climatic and/or social changes, this intensification has traditionally been attributed to the Mesolithic period. This change towards a more intense exploitation entails the generation of shell middens, very characteristic in the Cantabrian region, and especially in the eastern area of Asturias.

The current state of the art on the exploitation of molluscs, crustaceans and echinoderms reflects the existence of a certain variability in the degree of exploitation intensity during the course of the Mesolithic period in the region, so that human populations probably adapted their gathering strategies to the specific needs of each moment throughout the ~4000 years that the Mesolithic lasted (10,800 - 6,700 cal BP) in the region.

Based on this hypothesis, the present study aims at analysing the shell assemblages from the site of El Toral III (Llanes, Asturias) in order to determine species representation and their abundance as a first step in the evaluation of intensification.

The results show that exploitation was concentrated on marine gasteropods such as limpets of the *Patella* genus and topshells *Phorcus lineatus* (Da Costa, 1778), while bivalves, echinoids and crustaceans are represented in smaller quantities. The systematic pattern in species representation and the significant amount of shells recovered on each shell midden unit points out to an intensive collection of intertidal resources throughout the entire stratigraphic sequence.

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# Reassessing paleoenvironmental data of the Middle-to-Upper Palaeolithic transition in the Cantabrian region (Southwestern Europe)

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**Keywords:** Iberia, Neanderthals, anatomically modern humans, Late Pleistocene, paleoclimate, paleoecology

## Abstract

Climate and environmental changes have been commonly proposed as possible driver factors for the disappearance of Neanderthals in Europe. The Cantabrian Region, in northern Iberia, offers a natural access route from the Pyrenees, where abundant late Middle and Early Upper Palaeolithic sites containing rich archaeological sequences are preserved. This is a key area for understanding the replacement of Neanderthals by Anatomically Modern Humans. To evaluate how climate during late Marine Isotope Stage 3 might have influenced human behaviour, an accurate palaeoecological characterisation is required. This work offers a synthetic and complete review of the regional environmental trends observed during this period based on the available terrestrial proxies link to archaeo-paleontological sites, mainly considering pollen sequences, charcoal data and small vertebrate assemblages. Some relevant records from macro-faunal assemblages and stable isotope studies are also considered. In our analysis, pollen and small vertebrate sequences are transformed into quantitative climatic data (temperature and precipitation), to standardise the information and allow inter-sites comparison. Results show highly variable climatic shifts between archaeological levels, which is consistent with the marine and ice records climatic fluctuations during MIS3. A mosaic landscape of open meadows and forested areas predominate in the Cantabrian region throughout the study period. Some records indicate a progressive trend towards greater aridity during the Middle to Early Upper Paleolithic transition, reflected by changes in vegetation, faunal composition, and existing stable isotope evidence from hunted ungulate remains accumulated by Neanderthals and Modern Humans in the region. Our review indicates that there is a fragmentary environmental record for the region during this key period for human evolution, restricting our knowledge about the effect of climate on human adaptations and survival. Further research, by acquiring high-resolution palaeoenvironmental and paleoclimatic data, is needed and here we present our ongoing research methods to overcome these limitations.

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# Taphonomic study of the Lower Pleistocene site Tsiotra Vryssi (Mygdonia basin, Greece): bone damage patterns and bone surface modifications by the giant hyaena *Pachycrocuta* on large-sized ungulate carcasses

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**Keywords:** taphonomy, Lower Pleistocene, *Pachycrocuta*, carnivores, bone surface modification

## Abstract

The late Villafranchian fauna of the Lower Pleistocene site Tsiotra Vryssi (TSR; Mygdonia basin, Greece; 1.78–1.5 Ma) comprises a rather rich carnivore guild. Previous studies suggested the involvement of carnivores in the primary accumulation and modification of skeletal remains. The present study implements a multivariate approach aiming to identify the main biotic taphonomic agent of the assemblage. For this purpose, we conduct a comprehensive analysis of bone damage patterns and bone surface modifications in large-sized ungulates (150–1000 kg), i.e., the horses *Equus* spp., the Bovini *Leptobos* and *Bison*, the deer *Praemegaceros*, and the giraffid *Palaeotragus*.

Skeletal part representation and gross bone damage patterns indicate intense bone modification and preferential deletion of nutrient dense elements and bone portions (axial elements, stylopedial epiphyses, and tibiae proximal halves). Carnivore tooth marks are present on all long limb bones with varied spatial distribution and frequency. Among them, stylopedials appear tooth-marked more frequently, followed by zygoepiphyses, and finally metapodials that generally display moderate alteration. The intensity and pattern of bone modification indicate the involvement of a hyaenid, pointing towards the identification of the giant hyaena *Pachycrocuta brevirostris* (present at the site) as the main agent of bone modification. This hypothesis is reinforced by the comparison with the late Villafranchian fauna of Venta Micena in Spain, an assemblage interpreted as a denning site of the giant hyaena. The two sites show similarities regarding bone consumption sequence and bone portion deletion according to nutritional value and density. The identification of TSR as a denning area of *Pachycrocuta brevirostris* needs further investigation, but the presence of carnivore coprolites and of a hyaena juvenile mandible at the site are indications in support.

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# Characterization of diagenesis of bones from the Harappan site of Dholavira, Kutch, Gujarat, India

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**Keywords:** Dholavira, archaeofaunal remains, diagenesis, chemical exchange, collagen

## Abstract

Isotopic studies on archaeological bones provide insights into their provenance, paleopathology, palaeodietary and paleoclimate. However, these studies are hindered by taphonomic and diagenetic processes causing morphological and chemical variations in the bones. Studies conducted in India have only begun to emphasise on the effect of diagenesis on hindering the accuracy of isotopic analysis. In this study, we investigate the extent and mechanism of diagenesis of three ancient and one modern animal bone from Dholavira, a 5000 year old Harappan Civilization site located near the Rann of Kutch in the arid western part of India. X Ray Diffraction and X Ray Fluorescence studies were carried out on the bones to discern the viability of the laboratory techniques in characterising diagenesis. Our results indicate chemical incorporation in the bone samples which were corroborated using the soil samples. Overall, all the ancient bones exhibited greater extent of diagenesis as compared to the modern bones. Possible mechanisms of diagenesis include physical weathering inducing groundwater movement within the bones, leading to chemical exchange between soil and bones. Hence, diagenetic studies should be used as a preliminary analysis to determine suitability of further isotopic analysis on archaeological bones.

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# Isotopic analysis of pygmy hippo's fossil bone and tooth apatite from Aghia Napa, Cyprus

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**Keywords:** isotopes, oxygen, pygmy hippos, bioapatite, Aghia Napa, Cyprus

## Abstract

Fossil skeletal material of the pygmy hippopotamus *Phanourios minor*, excavated from the fossiliferous site in Aghia Napa in Cyprus, were used to reconstruct the palaeoenvironmental conditions. The <sup>18</sup>O/<sup>16</sup>O ( $\delta^{18}$ O) ratios used function as a paleothermometer. The geological age of the material ranges from 11,000 to 13,500 years B.P. The isotopic study of this material will possibly shed some light on the paleoenvironmental regime during the time when the hippos lived in the area and the skeletal material accumulated at the site, allowing for taphonomical observations.

Ten samples from long bones were used (femurs and tibias) and ten samples from teeth (canines, incisors and molars) in order to determine the living conditions of this extinct species. The analysis was realized at the Stable Isotope Unit, at the NCSR 'Demokritos'. The study of stable isotopes can be based on the extracted collagen or the skeletal material's bioapatite. In our case, all attempts to extract collagen failed and the material was totally dissolved during purification. Thus, the analysis continued based on the study of the phosphates and carbonates of the bone and tooth bioapatite. In the case of teeth, tooth enamel was preferred. Furthermore, several possible effects that may affect the isotopic composition of apatite were investigated, including age, sex, tooth type and diagenesis.

The detection of diagenetic alteration is critical for palaeoclimate reconstructions based on the oxygen isotope composition of fossil bones and teeth, and so all data from our study was evaluated taking under consideration the diagenetic profile of the skeletal material at the site.

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# Clay minerals as climatic proxies for Archaeological Research: a case-study from the Early Pleistocene of Olduvai Gorge (Tanzania)

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**Keywords:** Early Pleistocene, Olduvai Gorge, Clay Studies, Palaeoecology, Geoarchaeology

## Abstract

Olduvai Gorge provides a valuable case-study to demonstrate the relevance of clay minerals as climatic proxies for archaeological research; clay minerals which are significant archives for the reconstruction of palaeoenvironmental changes.

My project focuses on a timeframe between ~1.9 and ~1.3 Ma (Early Pleistocene), an interval within the deposition of Beds I and II. The overarching goal of my project is to investigate whether it is possible to establish how this landscape was occupied by different hominins, for which it is fundamental to understand the environmental context in which they inhabited this region. Therefore, the objective of this project is to study the chemical changes in the palaeolake Olduvai, as a function of the climatic changes that occurred in the Olduvai Gorge landscape. Climate-derived chemical changes in lakes are manifested in alterations of lake salinity, the latter of which is registered in the mineralogy, especially in the clays. To this end, I am studying the mineralogy and chemistry of sediments from lacustrine and perilacustrine deposits of Olduvai Gorge, with a focus on clays. These have been analysed by X-Ray diffraction, Fourier-Transform infrared spectroscopy and inductively coupled plasma – atomic emission spectroscopy; methods which allow the obtainment of mineralogical, structural and chemical data essential for the identification and study of clay minerals.

Preliminary results and data analysis have shown a significant volcanic material input and evidence of mineral alteration in freshwater or saline conditions. This is of relevance to understand both climatic and environmental changes that occurred in the Olduvai basin. Freshwater and saline conditions are not only associated with the extension and contraction of palaeolake Olduvai, but they can also be related to more humid or arid conditions, respectively. This climatic and environmental knowledge is fundamental to better understand how different Early Pleistocene hominins occupied the Olduvai basin landscape.

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# New bovids findings from the recent excavations at the Upper Miocene locality of Pikermi (Attica, Greece)

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**Keywords:** Bovidae, systematics, craniodental, Turolian, palaeoecology, Pikermi, Greece

## Abstract

Pikermi has been extensively excavated since the 19th century and is regarded as one of the most important fossil-bearing localities for the Upper Miocene of Europe. Having also lent its name to the cosmopolitan Pikermian chronofauna, the locality has revealed a great abundance of fossil vertebrates and especially a significant range of bovids (Family Bovidae). From 2008 onwards, a series of excavations have taken place under the direction of Prof. Em. G. Theodorou of the National and Kapodistrian University of Athens, under the auspice of the Rafina-Pikermi Municipality. Excavation efforts have been focused in the new fossiliferous sites PV1 (Pikermi Valley 1) and PV3 (the latter considered close to or corresponding exactly to the classical site). This latest work is promising in its potential to provide taxonomic, palaeoecological and taphonomic insights on the locality itself and on a wider palaeobiogeographical context. The studied bovid material from the recent excavations, consists of 110 craniodental specimens (skulls, horn-cores and maxillar teeth) distributed to eight species: *Tragoportax amalthea*, *Miotragocerus valenciennesi*, *Gazella capricornis*, *Oioceros rothii*, *Palaeoreas lindermayeri*, *Palaeoryx pallasii*, *Protragelaphus skouzesi* and *Sporadotragus* sp. Morphological and metrical comparisons with taxa typical to the locality, provided some interesting results, such as the possible indications of sexual dimorphism in *Oioceros rothii* and the presence of species atypical to the locality, namely *Sporadotragus* sp., which is not identical to *Sporadotragus parvidens* known so far from this site. Additionally, a preliminary assessment, carried out in a palaeoecological context, pointed out possible inter-site differences in bovid diversity between PV1 and PV3 that may be due to temporal variance. Another notable remark is the near-absolute dominance of mixed-feeding bovid taxa -given by the provisional census of individuals from the available material, which supports the established idea of an environmental shift from woodland-type biomes towards open grassland-type ones during the Miocene.

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# Where is the panther in Panthera cave? Taphonomical analysis of the microvertebrate fossil material from the Middle Palaeolithic Panthera Cave (Kythros islet), Greece

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**Keywords:** Lefkas, Ionian Sea, predation, microvertebrates, palaeozoogeography

## Abstract

Panthera cave is what remains of a collapsed larger cave site, located on the islet of Kythros (Lefkas island) at the Inner Ionian Archipelago (Western Greece). It bears lithic artefacts from the Middle Palaeolithic, as well as fossil bones from small and large vertebrates. In the present study, cranial and postcranial skeletal microvertebrate material was observed and quantitatively analysed in an effort to reconstruct the taphonomical history of the site (predation, post-depositional processes), as well as possible palaeozoogeographical implications on the history of the species that were identified. 1218 specimens were observed in total, corresponding to the lithological units uncovered during the first two years of excavations. 17 taxa of Amphibia, Reptilia, Insectivora and Rodentia were determined, the presence of several of which confirms a past connection of the islet of Kythros with mainland Greece. Taphonomically, the site of Panthera cave seems to have undergone quite a few post-depositional processes, some of which have significantly impacted on the preservation state of the material such as passive material transport, corrosion and rootmarks. Finally, regarding the predators responsible for the accumulation of the microvertebrate material, the patterns of breakage and digestion indicate the effect of a category 3 avian or category 4 mammalian predator.

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# The Late Miocene rhinocerotid assemblage of Samos Island, Greece: New insights through an old collection

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**Keywords:** Rhinocerotidae, Greece, Samos island, Late Miocene, paleoecology, biostratigraphy

## Abstract

The rich and diverse Late Miocene fauna of Samos Island, Greece, consists of an impressive number of mammalian taxa, including the hornless rhinocerotid *Chilotherium schlosseri* and the tandem-horned rhinocerotids *Dihoplus pikermiensis* and *Miodiceros neumayri*. In this work, previously undescribed craniodental material of these three genera, excavated in 1903 in Samos by Professor Theodoros Skoufos of the University of Athens and stored in the collections of the Athens Museum of Palaeontology and Geology (Greece), is studied for the first time. Among other specimens, Skoufos's collection boasts an almost complete juvenile *M. neumayri* maxilla, a *C. schlosseri* mandible bearing part of the lower incisors, numerous partly preserved adult *C. schlosseri* skulls and the skull of an infant *C. schlosseri*. The different type of sediment the fossils are enclosed into indicates that the specimens come from at least two different horizons. The sympatric presence of the three aforementioned taxa is not a unique feature of Late Miocene Samian faunal assemblage. Veritably, the coexistence of brachydont *D. pikermiensis* and more robust, hypsodont *M. neumayri*, along with an aceratheriine genus such as selective feeder *Chilotherium* or more primitive browser *Acerorhinus*, was not uncommon in the Turolian localities of the Greco-Iranian Zoobiogeographic Province. The majority of the craniodental rhinocerotid elements from Samos belong to *C. schlosseri*. Due to the small number of *M. neumayri* and *D. pikermiensis* specimens, no safe conclusion could be drawn on the relative dominance of the tandem-horned rhinocerotids. However, the presence of *C. schlosseri* does point to a more arid, open habitat, adding evidence to the concept of the Samos fauna being more similar to the assemblages of Anatolia and Iran rather than those of the classical Greek Late Miocene localities of Pikermi (Attica) and Kerassia (Euboea Island).

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# Diversity of the saiga antelope in time and space based on cranial morphometry

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**Keywords:** *Saiga tatarica*, *Saiga borealis*, Middle Pleistocene, Late Pleistocene

## Abstract

The saiga antelope was one of important components of the Pleistocene steppe-tundra faunal complex. Although the species is critically endangered now and inhabits several isolated regions in Central Asia, it was widely spread in the Pleistocene in Europe, across Asia up to North America. Such a broad spatial and temporal distribution caused that many authors described several morphological forms. Most often, two forms are recognized and assigned to the species rank as *Saiga borealis* and *Saiga tatarica*, or in the subspecies rank as *Saiga tatarica borealis* and *Saiga tatarica tatarica*. The former became extinct at the beginning of the Holocene, and the latter has survived to the present. To comprehend the morphological diversity of this genus, we conducted extensive morphometric analyses of the cranial material of saiga covering the whole region of its distribution. The study showed that *S. borealis* was larger in several length skull dimensions and occipital region than *S. tatarica*, which in turn showed larger diameters of the horncore base. Moreover, we found a significant decrease in many skull measurements of saiga since the Middle Pleistocene till modern times, which was probably associated with the appearance of unfavourable climatic and ecological conditions. The observed significant distinctions between the Pleistocene and recent forms as well as between some geographical subgroups indicate that the saiga population was subjected to temporal and spatial differentiation, the former factor being more important for variation of the saiga skull than the latter.

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# Snakes (Reptilia, Squamata) from the Lower Pleistocene of Irhoud-Carrière "Ocre" (Morocco): systematics and taphonomy, paleoenvironmental, paleoclimatic and paleobiogeographic implications

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**Keywords:** Morocco, Irhoud "Ocre", Lower Pleistocene, Snakes, Systematics, Taphonomy, Paleoenvironments, Paleoclimates, Paleobiogeography.

## Abstract

Quaternary Snakes' fossils can provide important data on the immediate origin of actual herpetofauna as well as the various processes that led to its installation. On the other hand, they also allow the reconstructions of Quaternary terrestrial environments. However, studies of African snakes' of this period, specifically those from Morocco are still rare. Here we report new data from the lower Pleistocene site of Irhoud, "Carrière 'Ocre'" of the Safi-Marrakech region, (Morocco). It is one of the five deposits in Jebel Irhoud, of which the well-known site of l'Homme de Jbel Irhoud that delivered the oldest remains of *Homo sapiens*. This study lies six hundred and fifty dorsal vertebrae of snakes from the MNHN "Braillon collection" as well as remains collected by Pr. J.J. Jaeger. Five analyses have been performed, systematic taphonomic, paleoenvironmental, paleoclimatic and paleobiogeographic. Eleven snakes' taxa were identified among which a taxon mentioned for the first as a fossil (*Dasypletis*) and a taxon for the first time reported in Morocco (*Telescopus*). This study also highlighted that the snakes' fauna is of a 'modern type'. The taphonomic analysis shows that the main causes of skeletal remains accumulation is due to an accumulation by "natural death" as well as the carriage of surface sediments and to a lesser degree, accumulated by predators. Paleoenvironment and paleoclimate have been inferred for Jbel Irhoud during the Pleistocene on the basis of ecological data of living current species. Unlike the current climate in Jebel Irhoud which is semi-continental with a cold winter, the climate is supposed to have been arid, with hot temperatures. The snakes lived in a mosaic environment with rocky areas with small bushes, sandy areas, steppe or Saharan environments, with the presence of wadis and/or oases. From a paleobiogeographic point of view, this study showed that the distribution of the snake taxa identified in this study is different from their current distribution was different. Many of the identified taxa have a marked thermophilic character and require high and constant heat for a large part of the year. Their biogeographic distribution is therefore strongly impacted by the climate. They are therefore good climatic indicators. This study also underlined the limitations of the results mainly due to the significant lack of the knowledge on the taxonomy, ecology and taphonomy of fossil snakes from North Africa.

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# Mapping procurement areas of lithic resources: a GIS-based approach to the early colonisation of Western Mediterranean islands

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**Keywords:** mobility patterns, procurement strategies, least cost paths, GIS, island environment, lithic raw materials

## Abstract

This research aims to reconstruct the lowest energy cost routes for the procurement of lithic raw materials during the early colonisation of Corsica and Sardinia islands in the Western Mediterranean. Particular attention is devoted to the shaping of both mobility and procurement strategies at the transition from occasional Pre-Neolithic settlements to a stable Neolithic colonisation.

A bibliographic review allowed us to create a systematic database yielding data on 26 Pre-Neolithic and 109 Early Neolithic archaeological sites recorded up to date, and ranging from the Middle Pleistocene up to the 6th millennium BCE. Data concerned the chronology of the sites, their geographic location and the characteristics of the lithic assemblages, with a special focus on chert and obsidian artefacts when present, as the most exploited lithotypes. Archaeological sites and raw materials source areas were then geo-referenced, resulting in a specific cartography that depicts the geographical distribution of chert and obsidian across the territory of the two islands. Eventually, a least-cost path analysis (LCPA) was developed from the archaeological sites to the source areas using QGIS 3.20, proposing diachronic mobility models for chert and obsidian procurement among the human groups settling in the islands.

It is understood that least cost paths do not reflect exact prehistoric routes, since predictive approaches to the study of human behaviour can never incorporate all the variables that are in play in real life. Nevertheless, energy cost is a variable that is usually considered by humans as they move through a territory – and, as opposed to variables concerning habits, behaviour and symbolism, it can be extrapolated. This research should thus be understood as a basis for further studies that will include other facets of human behaviour. Our results will contribute and open new debates on resource management and landscape knowledge among early human groups colonizing insular environments.

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# Bayesian model of Palaeolithic radiocarbon dates from Nerja Cave

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**Keywords:** C<sup>14</sup> dating, Bayesian modelling, archaeological sequence, Upper Palaeolithic, Epipaleolithic, Nerja Cave

## Abstract

The Nerja Cave is an important archaeological site in the province of Malaga (Spain) with a prehistoric stratigraphic sequence that ranges from the Upper Palaeolithic to the Chalcolithic. In the present work, we have reviewed and discussed the methodological requirements (technical, chemical-physical, and archaeological) of the radiocarbon dating obtained in the Nerja Cave to model the prehistoric sequence of the site. Bayesian statistics have been applied, using the OxCal v4.4 program and the IntCal20 calibration curve, carrying out the calibration and modelling of the radiocarbon samples within the framework of a new proposal for the sequence of prehistoric occupations. The Phases model of the Palaeolithic sequence of the Nerja Cave has been built from the correlation of chronological and sequential information between the interventions carried out in the different rooms. In this way, it has been possible to advance in the resolution of the chronology of the beginning and end of the Palaeolithic human occupation phases in the cavity, which correspond to the technocomplexes from the Gravettian, Solutrean, Magdalenian (with harpoons) to the Epipaleolithic.

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# Open science in Archaeobotany

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**Keywords:** archaeobotany, open science, FAIR practice, phytolith studies

## Abstract

Open science promotes integrity, transparency and sharing values as standards to collaborate among scientists and to reach a wider audience of non-scientists. The benefits of open working are many; it increases research impact, allows others to validate our analytical processes, promotes equal representation of gender, ethnic and cultural minorities and strives for more sustainable research. However, open science practises are still new to archaeological research and certain aspects need greater discussion before they are implemented such as how to deal with sensitive data and how we can practically develop transparent and sustainable workflows in each archaeological discipline.

In this talk, we will discuss the benefits of open science to archaeobotanical studies. Archaeobotany is the study of macro and micro botanical remains preserved in archaeological context. There are multiple ways to unveil and interpret archaeobotanical evidence as plants play a crucial role in many aspects of Human evolution.

We will highlight the FAIR Phytoliths project as an example of the application of open science practice to archaeobotany. Phytoliths are micro-botanical remains that are formed within the cells of living plants and survive for long periods of time. They can be used to address archaeological questions concerning anthropogenic plant exploitation and landscape changes. The FAIR Phytolith project aims to improve data sharing through the implementation of the FAIR data principles (Findable, Accessible, Interoperable, Reusable) for the phytolith research community by conducting a FAIR assessment of existing data, training researchers about FAIR and open data, and drawing up community reviewed FAIR guidelines for existing and future phytolith data.

Initiatives in other archaeobotanical disciplines will also be discussed such as full protocols ([www.protocols.io](http://www.protocols.io)), paleoecology-neotoma ([www.neotomadb.org/](http://www.neotomadb.org/)), and geology ([www.pangaea.de](http://www.pangaea.de)) to show that archaeobotanists are striving to make a change towards a more open future for our discipline.

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# Carnivores, humans, and their interaction during the Upper Palaeolithic from El Olivo cave (Llanera, Asturias)

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**Keywords:** Magdalenian, subsistence, biotic interactions, taphonomy, zooarchaeology

## Abstract

El Olivo (Llanera, Asturias) is an archaeological assemblage with Magdalenian and Mousterian levels whose study can be of great interest for the analysis of human occupations in the north of the Iberian Peninsula during the end of Upper Palaeolithic. The occupational history of El Olivo is not easily reconstructed because of the alternation between carnivores and humans in the stratigraphic sequence. However, the faunal remains are examined with the aim of determining the nature of the accumulation.

The bone assemblage is characterized by a high representation of small size ungulates, but the taxonomic analysis shows that *Cervus elaphus* is the most important taxa, followed by *Equus ferus*, *Capra* sp. and *Capreolus capreolus*. Carnivores are less abundant but still represented by diverse species such as *Alopex lagopus*, *Vulpes vulpes* and *Canis lupus*, among others. Human activity is proved due to the presence of cut and percussion marks on the ungulate bones in all levels, but also on *Oryctolagus cuniculus* and bird remains in level 4. On the other hand, high frequencies of tooth marks are observed throughout each level, especially in Level 1, 2, 3, 4 and 7.

Through the taphonomic analysis of those remains, it has been possible to establish an approach to the strategies of subsistence of the hunter-gatherers and their interaction with carnivores. In this way, the study of the remains shows that the origin of the accumulation varies depending mainly on the size of the animals in each of the levels. Carnivores acted as the main agents in the accumulation of small and large ungulates, while humans would have contributed those of medium size.

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# Knapping systems half a million years ago in area D of Jaljulia, Central Israel: Continuities and discontinuities during the Lower to Middle Palaeolithic transition in the Levant

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**Keywords:** Late Lower Palaeolithic, Levant, Lithic Technology, Innovations, Raw materials

## Abstract

In the Levant, different techno-complexes were attributed to the end of the Lower Palaeolithic, such as the Late Acheulean or the Acheuleo-Yabroudian. During the Late Acheulean, we can see the apparition of new technical behaviours that will become dominant during the Middle Palaeolithic. The sites attributed to this period with modern excavations methods are still rare, and thus represent a particular interest: we introduce here a new key site for the understanding of this shift in hominin behaviours.

The site of Jaljulia, Central Israel, was excavated as a preventive operation in 2016 and 2017 by the Israel Antiquities and Tel Aviv University. It yielded numerous lithic artefacts, attributed to the Late Lower Palaeolithic and dated between 200 ka and 500 ka, depending on the area excavated.

We present in this communication the first results of the technological analysis of the productions systems of area D, dated half a million years ago. This archaeological material shows a wide variety of debitage methods, including hierarchical systems, and underlines the ability of hominins to adapt to different raw material morphologies to achieve their goals.

The site of Jaljulia provides thus new clues at a broader scale about the first hierarchical flaking systems in the Levant and gives us the opportunity to consider the continuities and discontinuities leading to the Middle Palaeolithic technical systems in this key area.

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# Morphometric analysis of roe deer *Capreolus capreolus* (Linnaeus, 1758) teeth from the Biśnik Cave (Poland)

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**Keywords:** Roe deer, Poland, teeth

## Abstract

Roe deer, *Capreolus capreolus* (Linnaeus, 1758), has a long evolutionary history. The ancestor of the genus *Capreolus* was *Procapreolus* which occurred in Eurasia from the end of the Miocene to the Middle Pleistocene. The genus *Capreolus* arose in the Upper Pliocene in Asia from where it spread to Europe in the Lower Pleistocene. The remains of *Capreolus capreolus* in Poland were found in the Biśnik cave, the Nietoperzowa Cave, the Deszczowa Cave and the Komarowa Cave.

Biśnik Cave (50°25'35"N 19°39'56"E) is the oldest cave locality in Poland with traces of occupancy by Palaeolithic people. The profile includes 20 layers with bone remains and flint tools (except Layer 20). A total of 23 settlement levels, from the Middle Palaeolithic until the Middle Ages, were distinguished.

In the sediments of the Biśnik cave, the European roe deer was present in all layers. Of the 224 remains of the European roe deer 83 teeth of this species were identified. Roe deer disappears in Poland during the coldest periods of the last glaciation and in the Holocene it re-colonizes the territory of Poland.

The performed morphometric analysis and the comparison of the obtained measurements with the data from the literature confirmed the trend observed in the evolution of the genus *Capreolus*, concerning the size reduction, as well as the reduction of individual bones of the postcranial skeleton. Animal remains from the Middle Pleistocene are larger than those from the Holocene. There is a correlation between the age of the layers and the size of individual roe deer remains in the Biśnik Cave. Specimens from the oldest sediments are characterized by slightly higher parameters.

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# Analysis of the thickness of enamel and morphometric analysis in molars of selected representative of beef from Poland and Bulgaria

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**Keywords:** Bovinae, *Bos* sp., *Bison* sp., teeth, enamel, morphometric analysis, cave, Poland, Bulgaria

## Abstract

One of the methods for determining the species of the subfamily Bovinae (*Bos* sp., *Bison* sp.) is the morphometric analysis of the teeth of these species. This method is especially useful when the material is fragmented or unsatisfactory.

The analysis covered 260 teeth of both *Bos* sp. and *Bison* sp. representatives from six cave sites in the Poland and Bulgaria area. The material is supplemented for the periods from the Middle Pleistocene to the present day. The analysis of the thickness of the enamel and the morphometric analysis was performed.

Morphometric tests of the teeth of members of the Bovinae subfamily proved to be different in terms of both the tooth type and its type/species. In addition, the teeth of members of the Bovinae subfamily have decreased over the centuries (from the Pleistocene to the Holocene), both in terms of the overall dimensions of the teeth and the dimensions of the chewing surface and enamel. After analysing the correlation of the measurements with the MIS stratigraphic age, these enamel measurements turned out to be more important than the measurements of the distance between points on the occlusal surface. The lowest values of the L/W ratio among the juxtaposed species are achieved by domesticated forms of beef (*Bos primigenius* f. *taurus*) and representatives of the species *Bison schoetnsacki*, the highest representatives of *Bos* sp. from the Bacho Kiro cave site in Bulgaria. In occlusal surface analysis and basic tooth measurements (apart from the L/W ratio), higher values are achieved by the fore-teeth.

In order to obtain more accurate results, it would be necessary to analyse in the same way a larger amount of material from the Eurasian area, more diverse in terms of the stratigraphic age of the MIS. The above studies can be a key comparative basis for further analysis.

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# Neanderthals and Carnivores: What is the origin of the reindeer assemblage at Vergisson IV Cave (Saône-et-Loire, France)?

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**Keywords:** zooarchaeology, Middle Palaeolithic, Neanderthals, carnivores, taphonomy, palaeontology, subsistence behavior, bone accumulations

## Abstract

The Vergisson IV site, excavated from 1957 to 1962 by J. Combier, is a small cave where human occupations, mainly attributed to the Middle Paleolithic (MIS 3-4), have been found. Zooarchaeological, taphonomic and palaeontological analyses were carried out on the remains of reindeer, which is the taxon that dominates the faunal assemblage.

The objectives were to better understand the composition of the reindeer populations of the sequence while highlighting the accumulative agents that participated in the accumulation. Finally, it was necessary to specify the subsistence behaviours of the Neanderthals as well as the types of human occupations that could be highlighted at Vergisson IV.

This work was a continuation of a study that had enabled us to obtain initial biochronological and palaeoecological results from a palaeontological approach to the reindeer. The bone surfaces show many modifications by carnivores, testifying to their involvement as a destructive and/or accumulative agent. Based on the size of these marks, it is likely that small and medium-sized carnivores, such as canids, were the taxa that had the greatest impact on the assemblage. Traces of anthropic activity, mainly in the form of unloading and disarticulation, were also found. Evidence of marrow exploitation was observed through the few anthropogenic percussion impacts and the numerous fresh bone fractures recorded on the long bones. Seasonal evidence suggests that the reindeer were slaughtered during autumn, late winter-spring, and spring. The taphonomic analysis confirmed the hypothesis of a mixed (Human-Carnivore) occupation of the site. The hypothesis that at Vergisson IV the occupations were regular hunting stops alternating with the arrival of small and medium carnivores was proposed.

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**TUESDAY, MARCH 8<sup>th</sup>**

**Session 2: Developing actualistic or  
experimental frameworks and accounting for  
biases and limits in past records**

Chairs: Axelle Gardin and Ana Belén Galán López



# Experiments in bone taphonomy: A novel method of analysis using QGIS

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**Keywords:** GIS, taphonomy, zooarchaeology, experiment, methodology

## **Abstract**

The proposed research is interested in using zooarchaeological methods to interpret Neanderthal subsistence strategies at Abric Pizarro, Spain, between 70-40kya to determine broader aspects of behaviour. Specifically, this research aims to standardise a novel method of taphonomic analysis using QGIS. Previously established GIS methods of zooarchaeological analysis will be adapted and expanded using QGIS 3.16.0, the analytical capabilities of QGIS when applied to taphonomy will be explored and demonstrated, an analytical workspace that permits a spatial link between the non-geographic database and its visual representation will be created, and a model that will have high interoperability and provide high value for similar archaeological assemblages will be chosen. This method was experimentally conducted with wallaby tibiae to confirm its viability and usefulness before taking on to archaeological sites. Once the templates and associated attribute tables are created in QGIS, lines representing the locations of marks are drawn. The 'densify by interval' tool is then used to create a comparable number of nodes on each line. Use of the 'extract vertices' tool is then applied to create a point layer. Finally, a heatmap analysis is run on the point layer. The resulting layer shows spatial distribution of modifications and overlaps and demonstrates areas most targeted by modifications. This visual representation of data will reduce human error and allow more complex analyses, permitting further understanding of complex hominin behaviours.

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# New insights into the Neolithic settlement in Ciemna Cave

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**Keywords:** Ciemna Cave, Neolithic, settlement in the caves

## Abstract

Ciemna Cave located in the Pradnik valley, near Ojców, is one of the most significant archaeological sites in Poland. The research has been ongoing since the second half of the 19th century. However, it is still widely known only from the occurring Paleolithic industries associated with the Neanderthal occupations of the cave. The neolithic artifacts from the open parts of the Ciemna Cave system have been analyzed by Ewa Rook and published in 1980 in the summary article about the neolithic settlement in caves of the Cracow-Czestochowa Upland. Since 2007 for the first time, excavations are being conducted in the main chamber and delivered new data for neolithic studies. It was feasible to compare material from different parts of the Ciemna Cave system. Based on the analysis of the various artifacts from the latest research in the main chamber, it was possible to distinguish the materials of the most Neolithic cultures that occurred in Lesser Poland. One of the most important results is capturing the stratigraphic correlation of neolithic materials with artifacts dated on other archaeological periods, which is incredibly rare for most caves with neolithic traces in the Cracow-Czestochowa Upland. The variety and variability of the use of Ciemna Cave are also visible. The most probable usage is related to the nearby Jurassic flint outcrops, which many neolithic cultures used in varying degrees and use caves as short-lived encampments. In the main chamber was found a child burial dated to the classical period of Baden Culture, which proves that neolithic communities used Ciemna cave also in funeral practices.

Without a doubt, with the most numerous and diverse neolithic materials, Ciemna Cave is one of the most influential neolithic cave sites in Poland.

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# New perspective on rare representations of the Late Palaeolithic portable art: insects, reptiles and amphibians

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**Keywords:** insects, reptiles, amphibians, Palaeolithic, art

## Abstract

The interest shown in the artistic representations of insects, reptiles and amphibians in the portable art of the Late Palaeolithic by the various actors in Prehistory has long remained very modest, reflecting the meagre corpus that these different classes of animals constitute. These three classes bring together some of the smallest specimens encountered in Palaeolithic art, which are often grouped in the "various" or "undetermined" categories of iconographic or stylistic classifications.

Ancient excavation methods, often inappropriate for the collection of micro-remains, have contributed to the extreme discretion of these small specimens in the faunal spectrum. These methodological biases have long caused some confusion about our knowledge of the presence, or exploitation for food or technical purposes of such taxa. Artistic figurations of these animals are therefore the very rare witnesses of their presence in the daily environment of Palaeolithic populations.

This study, conducted over two years, aimed to draw up a precise inventory of these figurations, through a historiographical and bibliographical approach, by questioning the documentary archives available. Once this corpus was constituted, it was then necessary to revise the old identifications of these representations, sometimes relatively arbitrary or taken up from one inventory to another without real critical analysis. To this end, identification keys - based on the determining morphological characters or on graphic conventions revealed by the comparative study of several similar objects - were developed for each "family" of animals to facilitate their identification.

To promote the dissemination of these little-known objects, new iconographies (photographs, portable art surveys) were produced from the direct study of certain objects. The aim here is to question the relationships between Late Palaeolithic populations and their environment, by shedding a new and revised light on the characterization of Human-Animal relationships, turned towards the smallest specimens of the animal reign.

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# Approach to the paleodemography of the artists of the Upper Paleolithic

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**Keywords:** rock art, paleodemography, hand stencil, iconology

## Abstract

The interest in knowing the living conditions of the populations of the past has led archaeology to enter the field of paleodemography as one of the basic elements of analysis for its biosocial reconstruction. Within the study and research of Paleolithic art one of the most interesting and least explored aspects is the characterization of the individuals who created it.

The aim of our study is to approach, as far as possible, the biological and anthropological attributes of the Paleolithic artists through their own works in order to understand the artistic phenomenon as an organized and relevant social activity within the communities that cultivated it.

This approach has been approached through the associated iconological remains located in some cavities and the imprints left by them, such as feet, hands and fingers, as a source of relevant and direct information about the people who developed the symbolic activities. This is intended to estimate the number of members of each incursion, approximate age and/or sex.

Thus, with this study we provide an update and systematization of the available information and a detailed morphometric study of the representations of paleolithic hands, in order to contribute to a better understanding of the identity and organization of those societies of which these artists were part. The first results, contrary to traditionalist theories, point to a fundamental role of children and women in the creation of graphic activity.

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# Toward quantifying mesowear proxies: Geometric morphometric mesowear (gmmw) method

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**Keywords:** mesowear, feeding ecology, Early Pleistocene, herbivores, Greece

## Abstract

Mesowear was established as an efficient and quick tool for paleodiet reconstructions. It is a widely applied proxy that is used to infer an herbivore's diet, providing insight into the dietary habits and environmental conditions of a population over years to lifetimes. This tooth wear technique macroscopically studies the morphology of tooth cusps, traditionally using qualitative up to semi-quantitative methodologies.

But the classical approach is not free of bias: it is a (semi-)qualitative, observer-dependent approach, which also depends on the scale of observation. The lack of standardization limits comparisons between studies.

Therefore, herein we propose a "2D Geometric-Morphometric" mesowear method, that adds a fully quantitative dimension to the cusp shape scoring using geometric morphometrics. This new method (GMMW) retains the time efficient quality of mesowear, while providing more accuracy, objectivity and being scale-independent.

To test this novel technique, we used as a comparative baseline 111 sympatric extant ruminants belonging to 4 species (*Cervus elaphus*, *Capreolus capreolus*, *Rupicapra rupicapra*, *Ovis ammon*) with known diets. Additionally performing the GMMW on 82 fossils from the Lower Pleistocene Gerakarou locality (1 equid, 2 cervid, 4 bovid species; Mygdonian basin, Greece). We compared our results with a fully quantitative and a semi-quantitative method, applied on the same specimens. The extant species plot as mixed feeders, which was expected, but surprisingly the browsing roe deer had the most worn teeth. Browsers tend to have higher and sharper cusps than mixed feeders and grazers although there are important overlaps. In Gerakarou, mixed feeders were found to have been dominant, indicating a mosaic environment. The equid had mesowear scores indicative of grazing. This new methodology seems to indeed be more shape-sensitive than former methods. Its standardization could solve the inability of data comparisons amongst studies. It still requires a wider experimentation basis in order to be completed.

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# Skeletal growth rhythm by seasonal environmental fluctuations in Nile perch (*Lates niloticus*): implication for paleoclimatic reconstructions

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**Keywords:** skeletal growth marks, *Lates niloticus*, seasonality, growth rate, paleoclimate

## Abstract

Growth in ectotherm vertebrates, especially actinopterygians, is strongly rhythm by seasonal variation in environmental conditions and by internal physiological controls. Skeletal growth reflects the somatic growth rhythm fluctuation by the alternating deposition of different growth marks, observable on thin sections. In tropical regions, growth generally occurs during the rainy season in many lake and river fishes, while it stops during the dry season when resources are not sufficient or when energy is allocated to other functions (e.g., reproduction or healing). The growth rhythm in tropical species would therefore reflect the environmental seasonal fluctuations experienced by individuals in their lifetime. Therefore, the study of the growth recorded in fossil bones would allow tracking past seasonal regimes, which would constitute a new way of inferring paleoclimates. However, this approach first requires to be validated in extant species which are closely related to the studied fossil taxa. For this purpose, we examined the skeletal growth marks of a Nile perch (*Lates niloticus*) caught in June 2014 in the Chadian Chari River. This species is well represented in African fossil sites since the Miocene. Growth marks were compared within bones and between different bones, and with climatic conditions experienced during life span. Growth occurred at the same rate between the different areas of the same bone and between the different bones (vertebrae, spines, scales). The individual was estimated to be 4 to 7 years old at the time of capture. The skeletal growth rate over the past five years was strongly correlated with the environmental seasonal fluctuations, i.e., reduced growth when temperatures and/or rainfall are lower during the year. Consequently, it appears that any fossil record of Nile perch can be used to reconstruct the seasonality that prevailed in the Neogene and Quaternary localities of Africa.

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# Worked diaphysis from De Nadale Cave: a preliminary study on the bone industry from a Middle Paleolithic deposit in the North-east of Italy.

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**Keywords:** bone tool, Middle Palaeolithic, Neandertal, Quina Mousterian, Italy

## Abstract

For a long time, the intentional production of a bone industry was considered to be one of the features that distinguish the modern human behavior from the Neanderthals opportunistic use of bone fragments as retouchers. In the last few decades, Pre-Neanderthal and Neanderthal specialized bone tools became a reality: some examples, among the others, were found at La Quina, Pech-de-l'Azé, Abri Peryony in France, Fumane Cave in Italy and Chagyrskaya Cave in the Altai region.

In this scenario, De Nadale Cave yielded a consistent bone industry composed by almost 80 bone fragments. They were recognized as retouched tools, intermediate tools or fragments with rounded tips, in addition to over 350 bone retouchers.

De Nadale Cave is a key site for the study of the Middle Palaeolithic in Italy, since it yielded a Quina Mousterian lithic industry in association with a Neanderthal deciduous tooth and several thousands of bone fragments that testify the occupation of the cave around 70 ka BP.

Here we present the preliminary results of the morphological study on the bone tools. The shafts, belonging to limb bones from large sized ungulates (mainly *Megaloceros giganteus*, *Cervus elaphus* and Bovidae), bear traces of anthropic intentional modifications, aimed at obtaining a functional edge, and/or other possible alterations caused by the human action. These results open the way to further research, such as experimental activities and use wear analysis that will lead to a deeper comprehension of Neanderthals' use of bone materials.

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# An ontogenetic perspective on the emergence of sexual dimorphism in the modern human cranium

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**Keywords:** physical anthropology, geometric morphometrics, 3D imaging

## Abstract

The cranium is one of the skeletal structures most used in sex determination by using traditional and advanced morphometric techniques. Furthermore, only a few studies have been focused on the emergence of sexual dimorphism from an ontogenetic point of view. This project aims to analyse differences in cranial morphology between sexes from 8 to 20 year olds individuals. The sample of study consists of 3D models of the cranium from 43 total body CT scans from recently deceased individuals (19 males and 24 females) made available by the New Mexico Decedent Image Database (NMDID). We defined on each cranium 50 fixed landmark and 1000 paired surface semilandmarks. We performed a generalized Procrustes analysis in the form space (i.e., log size added to shape variables) space to investigate the relation between sex, age and cranial morphology. The multivariate trajectories of females and males are not statistically different (angle=37.1°, p-value=0.386). Age and size represent respectively the 17.30% and 26.52% of the total variance. The variance associated to sex (8.90%) is entirely explained by its intersection with age and size. The evaluation of morphological distances between females and males during growth reveal as the highest differences are found at 9, 15 and 20 years. First preliminary results by using a limited sample size suggest that the ontogenetic growth between sexes differ more in size than shape. Interestingly, we found two different peaks (at 9 and between 15- and 20-year-olds) in which on the average females and males are different each other. In the future, these findings need to be confirmed using a bigger sample size and extending the time span of the ontogenetic trajectory.

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# Widening the perception of coloring materials: building a use-wear analysis reference collection

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**Keywords:** coloring materials, ochre, experimental archaeology, tribology, abrasion

## Abstract

Coloring materials (*ochre sensu lato*) include rocks rich in iron oxides and/or hydroxides that are relevant to prehistoric studies in part because of their association with art. These materials are additionally often considered proxies for broader social behaviors.

Due to the recognized limits and need for standardization and systematization in use-wear analysis within archaeological coloring material studies, we created a use-wear reference collection for abrading techniques on various types of geological ferruginous rocks. After observing the qualitative and quantitative data collected from the experimental work, we were able to establish a preliminary technical vocabulary specific to ochre use-wear studies, and to create an analytical grid to help standardize future studies of these materials.

Regardless of their composition, the ferruginous rocks we tested imprinted part of the abrading material’s grains. Quantitative data, in the form of striation width measurements, allowed us to document, in some cases, a relationship between striation width recorded on the abraded coloring material’s surface and the size of the grains in the abrading material (i.e., grinding stones). In particular, the correlation between the grinding stones’ granulometry and the ferruginous rocks’ striations occurred when the composition of the raw coloring material allowed the largest grain’s diameter to be imprinted. These observations also allowed us to prove that the type of raw coloring material has more influence on the size of the striations than the type of movement, the amount of time, and the addition of adjuvants during abrasion. Harder materials will have smaller and less variable striations, while softer materials will have larger and more variable striations. Still, more work will be done in order to fully understand the tribological properties and behaviors of each coloring material, in order for the results to be applied to an archaeological corpus.

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# News and views: the "ciseaux" of Tito Bustillo - Living Area (Asturias, northern Spain)

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**Keywords:** ciseaux, bone industry, antler technology, experimental reproduction, Cantabrian Spain

## Abstract

The research on the Upper Paleolithic bone industry has been focused mainly on the typological characterization of tools, according to their morphology. The lack of techno-functional studies has led to imprecision in the identification of types which, apparently, do not have a clear morphology or function. An example is the beveled deer antler, indistinctly called ciseau, lissoir or coin in French publications, or as cincel, retocador, cuña, útil biselado, romo, intermedio, etc in Spanish historiography. This communication presents the technological study of several beveled deer antler tools from the site of Tito Bustillo (Asturias, northern Spain), which occupations dated in the Magdalenian (ca. 17-12 ka BP). In combination with their experimental reproduction, it has been possible to identify a type of tool that seemingly follows a standardized operational chain and possibly a specific and common function among them. In addition, the documentation of parallel samples from Upper Paleolithic sites on the Iberian Peninsula and in south-western France, leads us to propose the redefinition as ciseaux of those tools that have not been accurately recognized by other investigators in previous works. Maybe, because their study has been overlooked in comparison with other parts of the bone industry record.

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# The riddle of Szeletian - the problem of leaf points industries in Central Europe

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**Keywords:** Szeletian, leaf points, transitional industries, Early Upper Paleolithic

## **Abstract**

The inflow of new data questions existing divisions and schemes of archeological units, such as the so-called "transitional industries" between the Middle and Upper Paleolithic. An example of such an industry is Szeletian, which is spanning the Czech Republic, Slovakia, southern Poland, northern Hungary, Bavaria, and traditionally assigned to late Neanderthals. However after 70 years of research, still, no commonly agreed-upon definition of this industry exists. The next issue is the problem of the distinction between Szeletian, Lincombian-Ranisian-Jerzmanowician (LRJ), and Jankovichian - other leaf points industries occurring in this area. To resolve these issues, we need to re-assess the inventory of Szeletian sites and look beyond the leaf points to estimate if Szeletian integrity is limited to the domain of leaf points.

The research of one of the Szeletian sites in southern Poland - the Oblazowa Cave showed technological, morphological, and raw material similarity to the sites in Slovakia and Hungary. The similarities are also based on the dating of the discussed sites, which suggests the existence of a variant of Szeletian in the eastern territories of Central Europe.

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# Understanding the evolution of the human birth canal through geometric morphometrics: insights from a Brazilian contemporary sample

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**Keywords:** geometric morphometrics, birth, pelvis, obstetric dilemma, head

## **Abstract**

Much has been hypothesized about how the bony pelvis have been accommodating the functional demands of birth in human species, since the brain started to enlarge in our lineage (about 1.8 Ma years BP). Due to the high cephalo-pelvic proportion in the species, the fact that the bony pelvis is the most sexually dimorphic segment of post-crania, and also the only part that has greater dimensions in female's bodies than male's bodies, it's reasonable to think that some morphological variation in its shape has been driven by obstetrical reasons. In this research I analyzed the variation of shape in female's and male's pelvises of a Brazilian contemporary sample through geometric morphometrics, their covariation with head shape and possible associations with anthropometric variables (BMI, stature and body mass). The special insights that this sample could bring to the discussion are related to the fact that the Brazilian population is uniquely miscegenated, with an increased diversity that decoupled many anatomical characteristics along the generations. The results obtained for this Master's thesis so far support the hypothesis that pelvis shape is primarily associated with sex (with sex being the variable that clearly separates the sample along the first principal component), and most probably because of obstetric reasons. The only pelvic dimension that did not show significantly greater values in women (the biiliac diameter, by T-test) was the only analyzed dimension that is not located in the birth canal.

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**TUESDAY, MARCH 8<sup>th</sup>**

**Session 3: Tracking functional and behavioral responses to environments**

Chairs: Léa Jobard and Christelle Dancette



# Possible evidence of intentional body modification in Prehistory: study of a cranium from the site of Arene Candide (Liguria, Italy), Epigravettian levels

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**Keywords:** Labret, dental micro wear, Epigravettian, Arene Candide Cave

## Abstract

My Master thesis research work focused on the analysis of the atypical dental wear pattern on buccal surfaces of maxillary posterior teeth of an adult individual found in the Upper Paleolithic levels in the Arene Candide Cave ("Epigravettian necropolis"). To study the dental micro-wear, we realized replicas of the dental arches using high-resolution epoxy resin; then, we analysed the casts using different devices, such as S.E.M. and the Confocal Microscope. The acquired images were used for statistical analyses performed using the software R (MicroWeaR package). The main purpose was trying to evaluate possible differences in the orientation and number of scratches on the enamel surfaces between the left side and the right one, where the atypical wear pattern is present.

In this study, we evaluated the hypothesis of intentional body modification through the use of a labret, i.e. analogous of a modern piercing. After the analyses carried out, we noticed that the peculiar wear pattern in the right arches is completely different compared to the left side; we can assume that it is likely produced because of the presence of a hard object which was in contact with the right upper and lower dental arches, polishing the buccal surfaces (and creating labret facets) and removing enamel flakes on the lower molars. Similar cases are described in archaeological and ethnological contexts, but accordingly to the literature, this one should be the first documented case in Italy and maybe the oldest known so far.

The labret was probably used to represent identity and social status within groups. This represents a clear signal of the organization and social complexity of this hunter-gatherers group, who lived in the last phase of the Upper Paleolithic period, during a deep climate change and an environmental fragmentation after the Younger Dryas.

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# Opportunities and limits of a cleaver's technomorphometric approach: the cases of Menez-Dregan I (Finistère) and Lanne-Darré (Hautes- Pyrénées)

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**Keywords:** lithic industry, cleaver, technomorphofunctional study, geometric morphometric, edge angle measurement

## Abstract

Researches relating to cleavers can help the characterization of the technocultural landscape of Middle Pleistocene in Western Europe. A technomorphometric approach of this tool could bring key elements about the interpretation of its technocultural implication. Opportunities and limits given by this type of analyses are tested here through the study of two series coming from distinct chronological and geographical contexts: the cleavers from Menez-Dregan and Lanne-Darré. When the studied entities are the entire tools, technomorphometric links are rarely perceptible. Attribute them to specific intent to use are moreover impossible in the current state of knowledge. On the edge-scale analysis, significant and recurrent relations between technical choices and shape are highlighted on the cleavers from both sites. Nevertheless, the structural analyses highlight heterogeneous organizations of these techno-functional units, cleavers from Menez-Dregan showing a clear systemic uniformity while four techno-functional groups are identified on those from Lanne-Darré. The technomorphometric convergences observed on cleavers from Menez-Dregan could reflect specific intent to use. However, the anecdotal nature of this production, combined to the low technical constraints required, does not allow us to reject for certain the environmental determinism. The situation is quite different for cleavers from Lanne-Darré: if the transversal cutting edge directly coming from the debitage of the blank, specific to cleavers, clearly shows morphologic and morphometric similarities on all pieces, differences are observed in the other techno-functional units organization. Many questions relating to the relevance of the tested approach in the case of cultural traditions study are raised after those results. Finally, it is clear that the technomorphometric approach provides us to grasp the functional potential of cleavers efficiency, although the criteria defined to measure its techno-functional variability require to be specified.

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# Maximum body size of reptiles in the Plio-Pleistocene of east Africa in paleoenvironmental context

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**Keywords:** reptile, body size, East Africa, turtle, paleoenvironment

## Abstract

Body size in reptiles is a functional trait that influences ecology including through effects on thermoregulation and trophic interactions. Previous work has proposed that the thermoregulatory function of reptile body size may render this trait a useful proxy for paleotemperature. I developed a series of models relating the community body size distributions of modern turtles to precipitation and temperature and applied these models to reconstruct values of these paleoenvironmental variables for Neogene fossil sites in East Africa based on measurements of turtle fossils. These sites have been intensely studied due to interest in hominid evolution, but few studies have examined their reptile fossils. These reptile faunas include giant terrestrial tortoises up to 1.6m in length and several species of crocodylians, including the extremely longirostrine *Euthecodon*, specimens of which have reconstructed body lengths over 10m. I examined trends over time in the maximum body size of each of these reptile groups. For the Shungura Formation (Omo Valley, southwestern Ethiopia), I found the maximum body size for terrestrial tortoises, aquatic turtles, *Euthecodon*, and *Crocodylus* in each member of the formation. I compared these maximum size time series to paleoenvironmental records including the composition of mammal faunas, mammalian traits, paleosol isotope values, and reconstructed lake levels in the Turkana Basin. Terrestrial tortoise size is reduced when woody vegetation cover increases, which is consistent with modern giant tortoises association with open habitats. Aquatic turtle size is significantly correlated with lake level, demonstrating that maximum size increases with available habitat area. Maximum size for both genera of crocodylians is also observed during a period of lake transgression, but their sizes decrease before the end of the lake highstand. These results suggest that maximum body size evolution is linked to local scale changes in the environment, such as vegetation structure and lake level.

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# Paleoecology of the Plio-Pleistocene canids of southern Africa : contribution of ecomorphology to the restoration of trophic chains

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**Keywords:** Canidae, Pliocene, Pleistocene, southern Africa, ecomorphology, behaviour, trophic level

## Abstract

Ecosystem variations induce specific behavioural evolutions involving morpho-functional changes whose understanding is essential to the paleontological approach. The characterization of ecomorphological specificities and their evolution contribute to a better understanding of palaeoecosystems. Knowledge of the behaviour of carnivores in particular, through their central role in ecosystem dynamics (trophic cascades), allows the characterization of trophic networks, their evolution over time and by extension the identification of the palaeoecological status of hominins evolving within them.

The Plio-Pleistocene carnivores of southern Africa have a high species diversity. The canid guild has six to seven genera and a dozen of species. This diversity includes a wide range of eating behaviour: from hypercarnivores to ubiquitous. This study addresses the question of the ecomorphology of ancient canids from southern Africa (South Africa and Botswana) with a view specifying the palaeoecological organization of this guild for which few studies are carried out. We will discuss the case of *Canis hewitti*, a species newly described in Kromdraai (South Africa) which illustrates mixed ecomorphological features (hypercarnivorous and ubiquitous). Morphogeometry is used to compare the conformation of teeth of *C. hewitti* with other African canids (*Canis*, *Lupulella*, *Lycaon*) and thus correlate its dental morphology with ecomorphological features. At the same time, we will discuss for the first time canids from the Botswanan Plio-Pleistocene (Gcwihaba cave) and put these results into perspective with data from the Cradle of Humankind. The greater the specific diversity, the closer the ecomorphological characteristics of a group are, reflecting slight environmental or ecological variations, but sufficiently divergent to allow cohabitation. This complexity opens up many perspectives for the characterization of food webs over time. The case of canids illustrates the need to infer an ecological status from species in order to identify specific niches.

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# Cultural behaviors of the "Nesher Ramla *Homo*"

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**Keywords:** Levantine Middle Paleolithic, lithic technology, use of space, hominin interactions

## Abstract

This presentation aims at summarizing the data related to the cultural behaviors of the Nesher Ramla Archaic *Homo* population that was recently identified as inhabitant of the central Levant at the end of MIS 6 and during the MIS 5. Different behavioral aspects of the Nesher Ramla population's will be discussed; the technological/technical behaviors, the spatial behavior and their possible symbolic mediated behavior.

The lithic technological analyses of Units III and VI at the open-air site of Nesher Ramla have shown that this archaic *Homo* mastered lithic reduction sequences previously known only among *Homo sapiens* and Neanderthals. The centripetal Levallois knapping system dominate the assemblages, as observed in other contemporaneous sites, whereas the peculiar production of tools with lateral tranchet blow seems to be a unique cultural trait of this population, that has so far not been identified anywhere else in the region.

Furthermore, the results of intra-site spatial analyses of Unit III demonstrate that the Nesher Ramla *Homo* occupied their space in an organized way. Thanks to the discovery of well-defined spatial features, such as hearths and anthropogenic artifact (i.e., lithics, stones and animal bones) accumulations as well as the identification of many lithic refits, two distinct areas were detected, possibly representing different activity areas with different intensities of use.

Finally, the analysis of an incised aurochs bone shaft revealed that the Middle Pleistocene *Homo* from Nesher Ramla, produced abstract patterning as part of a non-utilitarian behavior.

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# Use-wear analysis of Dholavira bone artefacts: A Comparison of morphology and functionalities

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**Keywords:** Harappan Civilization, Dholavira, bone points, use, wear, morpho, functionalities

## Abstract

Dholavira in western India, a Harappan Civilization site, has unearthed a rich repertoire of bone and ivory artefacts. Therefore, a pilot study was carried out on 8 bone points recovered in varying states of integrity from the castle, bailey, middle and lower town areas of the site to comprehend the nature of assemblage. Understanding the functionalities of these bone points and interpreting the nature, frequency, location and association of various marks present on them was primary objective. These bone points were categorised as tools during excavation. But we question if the form equals the function of an artefact? After their thorough microscopic analysis (stereo and SEM), and detailed study of morpho-functionalities of these bone points, concentric circles, short and broad gouging marks below the tip, and a deep chop mark was noted in 3 points. Traceological analysis of some also clearly displayed the morphology of pre-depositional manufacturing marks like profuse longitudinal scraping and polishing on the curved surfaces attributing to blank preparation on fresh or semi-fresh bones. Encrustation was heavy on 2 points while sediments contributed to obliteration of manufacture or use-wear marks in the rest. Other points evidenced use-wear such as oblique grinding marks, numerous and closely situated, but on the flattened apical parts. These marks have led to the assumption that these bone points might have been used for different purposes other than a hunting tool. The form may or may not equal function, and these bone points are also speculated to be hairpins, kohl sticks, needles in spindle whorls, and even part of weaving kits. After integrating the results, no particular patterns or correlations could be drawn that can conclude the difference between artefact types, the marks discerned on them, and the artefacts' provenance and the context suggest similar further studies on the rest of the repertoire.

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# Inhabiting islands: mammalian responses to niche island biogeography

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**Keywords:** zooarchaeology, biogeography, adaptation

## **Abstract**

The Hebrides, located off of the west-northwestern coast of Scotland, have been inhabited since the middle and late Mesolithic – with some variations on each of the isles. While the early human inhabitants of the archipelago during the Mesolithic appear to have been hunter-gatherers, later Neolithic migrations brought both domesticated (cows, pigs, Caprines) and wild (Red Deer) species to the islands. Their ability to thrive and sustain populations on the isles, particularly in reference to their exploitation of Red Deer, is unique in many ways amongst the British Isles. Insular environments - such as islands and archipelagos - provide a unique opportunity for study of biological specimens, whether living or in the archaeological record, and the robust dataset available for the Scottish Hebrides provides an equally unique possibility for a large-scale study. Examining such a project and producing a methodology of how to use the available data is only the beginning. Continued work on the archipelago to fill in gaps in our knowledge about life on the Hebrides over the centuries is an essential move in Scottish Archaeology.

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# The role of lagomorphs in the Palaeolithic sites: The case of level 9d from Sima del Elefante site (Atapuerca, Spain)

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**Keywords:** taphonomy, Early Pleistocene, Sima del Elefante, lagomorphs, hominins, carnivores

## Abstract

In the study of the subsistence strategies of Palaeolithic groups, it is essential to be able to determine which meat resources were consumed. Throughout the Pleistocene, the changes in the type/size of prey consumed as well as the techniques used to obtain it were changing.

Early hominin groups (*Homo erectus*) consumed mainly meat from small animals, possibly because it was easier to obtain, as is the case today with chimpanzees. However, the technological and social development of human groups gradually opened up hunting to larger animals, which does not mean that they stopped eating small animals. In fact, in the archaeological sites of the Mediterranean Upper Palaeolithic we can see that the consumption of small animals, mainly leporids, by hominids is remarkable.

However, the presence of small animals such as lagomorphs or birds in archaeological sites is not necessarily related to anthropogenic activity, but may be the result of the action of other predators such as raptors or carnivores. The identification of the accumulation processes of these small animals in the fossil record allows us to understand the relationship of hominids with these potential preys but also with the environment in which they lived.

In level 9d of the Sima del Elefante (1.2 Ma) we have documented anthropogenic activity from stone tools as well as cut and break marks on the remains of medium and large animals, as well as stone tools. However, the taphonomic study carried out on the lagomorph remains would indicate that the origin of these remains in the cavity would be related to the action of non-anthropogenic predators, specifically small carnivores and birds of prey.

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# A window into the past: Oldest predator–prey interaction between tiger sharks and dugongs

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**Keywords:** *Metaxytherium*, *Galeocerdo*, Miocene, bite marks

## Abstract

Living tiger sharks (*Galeocerdo cuvier*) are known as opportunistic feeders that prefer to feed on large-sized and profitable prey, depending on age and size of the shark. Among the stomach contents of *G. cuvier* are crustaceans, cephalopods, teleost fishes, other elasmobranchs, reptiles, birds, mammals, and undigestible items such as kitchen scraps, tin cans, and clothing. Interestingly, the confirmed food items of *G. cuvier* include both marine (dolphins and dugongs) and terrestrial (horses, goats, dogs, and cats) mammals; however, the latter only represent occasional prey items. Despite the numerous studies dealing with stomach contents of living tigersharks and their feeding behaviour, reports on the feeding habits of the extinct tiger sharks are scarce and limited to indirect evidence. Thus, the majority of fossil predator–prey relationships are limited to bite marks on bones. Fossil bite marks on marine vertebrates caused by different shark species from the Cenozoic are well-known and include bones of mysticete whales and dolphins, odontocete whales, and pinniped bones. Here, we report on an extraordinary fossil finding of a disarticulated partial skeleton of an immature sirenian (*Metaxytherium cf. medium*) from the middle Miocene (14.5 Ma) of Austria, which bones display bite marks associated with seven teeth of the extinct tiger shark *Galeocerdo aduncus*. The morphology and the size of the bite marks are indicative for particular tooth morphologies. To demonstrate a possible correlation between bite marks and tooth morphologies, teeth of *G. aduncus* of different dental positions were selected and individually dragged onto clay, thus reproducing experimental bite mark morphologies. Based on this observation, the very typical and unique tooth morphology of tiger sharks provide distinct evidence that sharks of the genus *Galeocerdo* effectively fed on the *Metaxytherium* carcass and represents therefore the oldest predator–prey interaction between both representatives.

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# What the leaves leave behind: Archaeobotany approaches for the study of subsistence strategies among past herders and farmers

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**Keywords:** neolithic, archaeobotany, subsistence, Iberian Peninsula

## **Abstract**

Throughout prehistory and for much of our history, human communities have obtained most of their food, medicine, fuel or raw materials, among others, from the harvesting and cultivation of plants. Plants are one of the most versatile natural resources and, therefore, have a great economic and social importance for all societies. Since the development of agriculture, plant resources such as legumes and cereals, among other crops, have been the main support for farming communities, used both for human consumption and for various purposes (textiles, fodder, etc.). However, wild plants obtained from harvesting activities were also an important component in the subsistence strategies adopted throughout prehistory and in societies with intersectional systems. The main objective of this project is to provide new information on subsistence practices and strategies, as well as the alternative use of plant resources, in populations of farmers and herders during recent Prehistory in the interior of the Iberian Peninsula, with the aim to better understand the question of adaptation of socioeconomic systems and subsistence behavior in Mediterranean environments affected in the past by changing climate variations and an intensification of human impact on the environment. In order to address these issues, this talk will introduce a comprehensive approach that combines the study of archaeobotanical evidences (seed and fruit remains, phytoliths and ancient starch granules) and sampling strategies, contrasted through an experimental protocol and multi-scalar analysis (optical and electronic microscopy and geometric morphometrics).

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# Across place and time: physical activity and lifestyles among archaeological populations in southern South America

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**Keywords:** physical activity, subsistence strategies, South America, late Holocene

## **Abstract**

In bioarchaeology, the presence of enthesal changes (EC) and degenerative joint disease (DJD) has been generally used as proxies for physical activity and lifestyles of past populations, especially regarding their subsistence strategies. Although for archaeological contexts it was traditionally proposed that agriculture and sedentarization would have implied an improvement in living conditions and less physical demand, the various results that different researchers have reached show that there is no exclusive and distinctive pattern for each lifestyle. In southern South America, research on physical activity has focused more on locally restricted areas and/or certain time periods. Thus, the aim of the project presented here is to apply a comparative approach across a wider geographical and chronological span. The presence of EC and DJD is analyzed among archaeological populations from Argentina and southern Brazil in order to evaluate their relationship with hunter/fisher-gathering and agriculture strategies, as well as those with a mixed economy. Our focus is on the different lifestyles and environmental settings of human populations rather than chronological periods that are usually applied in archaeology.

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# Tell me what you eat and I'll tell you who you live with: the case of the dwarf deer at Pedro Gonzalez Island, Panama (6000 cal.BP)

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**Keywords:** Dwarf deer, preceramic, Panama, Pearl Island Archipelago, microwear, mesowear, stable isotope analysis

## Abstract

The archaeological site Playa don Bernardo (PdB) is located in a tropical seasonal forest near the shoreline at Pedro Gonzalez island, Pearl Island Archipelago (Panama). Eight radiocarbon dates place its occupation between  $5280 \pm 40$  BP (6190–5930 cal yr BP) and  $4880 \pm 40$  BP (5580–5660 cal yr BP). PdB is the only site from this period on a Central American platform island with evidence of human occupation and demonstrates the exploitation and extinction of a population of dwarf deer (~7 kg) of the genus *Mazama* and the farming of maize (*Zea mays*) and other unidentified root crops. This study used stable isotope analyses and micro/mesowear analyses to identify dietary changes in dwarf deer at PdB related to the human occupations on the island. Museum specimens of extant *Odocoileus virginianus* from the Florida Keys and Coiba Island, as well as *Mazama nemorivaga* collected from San José Island were also studied to establish a baseline for mesowear and microwear. Extant *Odocoileus* and *Mazama*, are browser-based. In contrast, the PdB dwarf deer diet was similar to extant grazers or grass-dominated mixed feeders. The isotope data indicate dwarf deer diet was consistently based on C3 plants. However, when human colonizers arrived on PdB, the dwarf deer changed their diet to include more abrasive plants, which is evidence of vegetal cover changes related to the land being cleared for cultivation. It is possible that human occupation was highest during the rainy season.

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# Using C, N and Zn isotopes do identify diet in the coast of Brazil

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**Keywords:** coastal archaeology, isotopes, diet, shellmounds

## Abstract

Coastal adaptations were fundamental in the history of human populations across the planet. From a food point of view, fish and mollusks are among the main elements consumed by coastal populations. However, traditional archaeological methods are not always effective in distinguishing this consumption and its nutritional importance. The purpose of this presentation is to show the PhD research in development linked to the ERC ARCHEIS project. In this research we intend to identify the consumption of aquatic resources in Brazilian precolonial sites, with radiocarbon dates of the middle and late Holocene, through the analysis of Carbon, Nitrogen and Zinc isotopes in human and faunal remains. Isotope analyzes will be carried out associated with three categories of archaeological sites: 1) shell sites (sambaquis/shellmounds) in southern and southeastern Brazil (Cabecuda, Capivari, Jabuticabeira II and Piaguera); 2) in coastal sites of late occupation, in which there was a decrease in shell substrate (fishmounds) in southern and southeastern Brazil (Galheta IV and Tenório); and 3) in an inland site, with consumption of resources from a freshwater environment (Lapa do Santo). The wide sampling will allow the comparison between the consumption of marine and freshwater aquatic resources, as well as the isotopic variability related to different environmental contexts.

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# Reconstitution of a Mousterian ecosystem using strontium and zinc stable isotopes

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**Keywords:** non-traditional isotopes, paleodiet, fossil bones and teeth

## Abstract

Non-traditional stable isotopes have been increasingly studied in the past decades, in part for their interest in the archaeological and anthropological fields. Measurements of modern bones and teeth show that zinc ( $\delta^{66}\text{Zn}$ ) and strontium ( $\delta^{88}\text{Sr}$ ) isotopes are good indicators of diet and trophic position. Thus, they can be used to reconstruct ancient trophic chains in paleoecosystems. These proxies have already been analyzed in fossil materials, giving encouraging results for their use in paleoecology. These two elements can be recovered and analyzed from one single sampling (between 3 and 10 mg), which limits the destruction of precious fossil materials. Despite this advantage, no multi-proxy study has been performed combining these isotopic systems yet.

The goal of this study is to compare the variations of  $\delta^{66}\text{Zn}$  and  $\delta^{88}\text{Sr}$  in a Mousterian ecosystem from the Camiac cave (Upper Pleistocene, Gironde, France). Both bones and teeth enamel have been analyzed in order to verify the conservation of the biological signal in bones. A cleaning method based on acetic acid leaching has also been tested on bones to try removing the potential diagenetic contaminations.

It is the first time that  $\delta^{66}\text{Zn}$  results have been obtained in fossil bones and they are encouraging as the biological signature seems as well preserved as in enamel. The biological isotopic signature of strontium is well preserved in enamel but seems to have been more contaminated in bones. The leaching procedure enabled to remove at least partly this contamination. The  $\delta^{66}\text{Zn}$  and  $\delta^{88}\text{Sr}$  variations discriminate between carnivores and herbivores and show differences between different types of herbivores. This multi-proxy study highlights the importance of analyzing several isotopic systems in a single sample and shows encouraging results for the preservation of biological isotopic signatures in fossil bones.

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# Plio-Pleistocene otters from the Lower Omo Valley, southwestern Ethiopia, and paleoecology of large-bodied fossil otters from Africa

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**Keywords:** Carnivora, Lutrinae, Eastern Africa, Isotopes, Gigantism

## Abstract

We describe otter remains from the Plio-Pleistocene Usno and Shungura formations, located in the Lower Omo Valley, southwestern Ethiopia. Lower and upper carnassials, dated to around 3.3 Ma, belong to a fish-eating otter of the genus *Torolutra*, similar in size to a modern river otter. Isolated teeth, fragments of mandibles, and a femur dated between 3.4 Ma and 2.5 Ma, belong to a new species of bunodont otter (with large, crushing teeth) of the genus *Enhydriodon*. Finally, a humerus from an indeterminate otter, dated to around 1.9-1.8 Ma, represents the last occurrence of this subfamily of carnivorans in the Omo.

The genus *Enhydriodon*, very abundant in australopithecine-bearing fossil sites of the East African Rift, contains six species in this region. Their size and degree of dental specialization towards a durophagous diet (consumption of hard food items) increase from the Late Miocene to the Early Pleistocene. The most recent forms, such as that of the Omo, could weigh up to 200 kg. We analyzed the stable oxygen and carbon isotopes of the dental enamel of *Enhydriodon* from the Omo in order to estimate its degree of aquaticity and its diet. Our results suggest that these large otters were terrestrial and should have consumed both aquatic and terrestrial prey, acquired through hunting or scavenging.

The new *Enhydriodon* species from the Omo represents one of the last occurrences of this genus of gigantic otters in Africa. Their extinction, around 2 Ma, is contemporaneous with those of many large carnivorans (> 21.5 kg) with very specialized ecological niches. The extinction of *Enhydriodon* could be related to the major geological, climatic, and biotic changes that affected the East African Rift in the Early Pleistocene.

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