



Book of abstracts

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**XXXVII-2. Human subsistence and
settlement patterns during the
Late-Glacial and early Holocene:
insights from bones.**

HUMAN-ANIMAL RELATIONSHIP IN HUNTER GATHERERS CONTEXS (10.700-5.000 B.P). ARCHAEOZOOLOGICAL RESEARCH IN ANDES OF NORTHERN CHILE.

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The Archaic period (10.700-3.700 B.P) en Arica foothill, northern Chile is charecterized by hunter gatherers that developed a close relationship with their environment. This is reflected in a dialectical bond with the surrounding fauna, essentially camelids, through the exhaustive consumption of these animals for adaptive subsistence and social aspects. This research presents the results of the archaeozoological analyzes developed in two archaeological sites: Alero El Bajo and El Alto; both sites contain occupations dated between 10.700 and 5.000 B.P.

The analyzes consist in the contextualization of evidence, taxonomic and anatomical identification and characterization, general quantification index (NISP, MNE, MNI, MAU), quantification of anthropic modifications (IAS, PAR) and taphonomic characterizacion (weathering, animal intervention, plants marks, and trampling). The results obtained allow to characterize the type of relation established between the hunter gatherers and the animals during the Archaic period, and thus to understand one of the factors that influenced the adaptations that occurred in the study area.

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Keywords: Archaeozoology, Hunter Gatherer, Andean archaeology

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Magdalenian fishing : difficulty to identify an highly suspected behaviour

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Fish remains are a significant component of many final Pleistocene archaeological sites, and fishing have considered for long as a typical Magdalenian activity in Southern France. However the Magdalenian fishing behaviour is still poorly understood for the settlements found in northern France. But, why not also consider that fishing, in particular freshwater fishing, was a potential activity in most Magdalenian sites located along rivers. The valley of Gartempe was selected as a model location and we analyzed the ichthyofaunal remains from a cave located on the right bank of the river, "le Taillis des Coteaux" (Antigny, Vienne). The fish remains found in the Magdalenian levels (17 000 - 14 500 years BP) of this site were made up of more than 10 000 bones and scales. Most of these bones belong to salmonid species. Thus, it should be asked if bones remains came from human or non human predator. The systematic recuperation of remains and the development of new methodologies (especially taphonomy) has allowed us to optimize the study of this type of material. The various methods developed thus appear essential to approach the subsistence behaviors of the hunter-gatherers during the Upper Paleolithic period. It also permits to evaluate the role of human fishing practices in comparison with a potential non-anthropogenic origin of faunal assemblage.

Keywords: Fish bones, Predator, Taphonomy, Magdalenian, Taillis des Coteaux

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Fish and resilience among Early Holocene foragers of southern Scandinavia: a fusion of stable isotopes and zooarchaeology through Bayesian mixing modelling

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Here I will explore the importance of different protein sources in the diet of Early and Middle Mesolithic humans in Scandinavia and show how their protein intake changed over the following millennia. By combining previously published stable isotope data with new analyses of human and animal bone remains, in a Bayesian mixing model, I will show that fishing rather than hunting or gathering provided a sustainable economy. By demonstrating that aquatic systems were more important than previously anticipated, the prerequisites for understanding Early Holocene resilience, social dynamics, permanence in residence and sedentism will change; because a diet dominated by fish generate abundance and create a surplus similar to that gained from the cultivation of plants. This research suggests that Scandinavian foragers became increasingly territorial and were able to live sedentary, already, at the beginning of the Holocene, i.e. several millennia before the introduction of agriculture. Furthermore, by incorporating the zooarchaeological record in human stable isotope analysis advanced palaeodietary studies is enabled, which can generate enhanced protein diet estimations through a method that can be applied when investigating subsistence strategies in a diverse set of human cultures.

Keywords: Early Holocene Diet, Scandinavia, Stable isotopes, Bayesian Mixing models, Zooarchaeology, Mesolithic, Forager subsistence

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Reconstructing Rationality of Mesolithic Hunters: A Theory of Rational Relativity and its archaeological application

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Since the introduction of the Mesolithic concept by Westropp and Torell in the second half of the 19th century, the period has been viewed as a time of cultural stagnation with passive societies dominated by their environment (Spikins, 2010). This paradigm has been continuously challenged by studies showing systematic exploitation and conservation of plant and fish resources by Mesolithic hunter-gatherers (Holst, 2014; Boethius, 2016). In the light of this evidence, indicating an active and not passive role of Mesolithic hunter-gatherers when organizing their food economy, it seems valid to also re-evaluate the way Mesolithic hunters chose their prey.

In the reconstruction of hunting behaviour and decisions, animal bones are the main source of information. The methodology used in analysing a faunal assemblage is currently dominated by optimization models mainly advocated within the context of Human Behavioural Ecology (HBE). Optimization models of "optimal foraging theory" have their roots in the analytic tools of economic science, and have been applied in this field since the 18th century. The analytical models are based on a specific concept of human rationality and decision-making, which is the concept of Homo economicus. Interestingly, in economics, the concept of Homo economicus is not used anymore due to its disparity in actual human behaviour and decision making. However, in archaeology, an alternative to the Homo economicus-model for analysing economic behaviour has not been suggested so far.

In this paper, an alternative method of studying past human decision-making, developed in neighbouring fields of research, will be evaluated as a potential tool for archaeologists. For example, empirical research in psychology in the past 20 years by Gerd Gigerenzer and his colleagues has shown that humans today are equipped with simple tools for making fast and frugal decisions by exploiting the structure of the environment in which the decision-making process takes place. These and other non-optimizing approaches will be summarized under the umbrella of a Theory of Rational Relativity (TRR). For evaluating the epistemic value of TRR for archaeology, the current study provides a new comprehensive database on Early Mesolithic hunting behaviour in Central Europe, including four faunal assemblages from northern, western and southern Germany, reanalysed from a zooarchaeological perspective. Based on this information and the modelling of decision-making situations, the decision-making process of Mesolithic hunters will be reconstructed and the causality behind Mesolithic hunting choices will be evaluated. The contextualization of hunting decisions permits the characterization of Mesolithic

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hunters as shrewd decision-makers within the multifaceted decision-making environment of the Early Holocene of Central Europe.

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Keywords: Mesolithic Hunting, Zooarchaeology, Decision, making, Early Holocene, Central Europe

Dietary traits and habitats of the reindeer from Stellmoor and Meiendorf (Northern Germany) during the Late Glacial

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Among other large mammals, the reindeer (*Rangifer tarandus*) is a species widely documented during the Late Glacial in Northern Europe. It is present at many archaeological sites and has the potential to provide information about environmental conditions through analysis of the palaeodiet. Among other techniques, tooth wear analyses permit to infer the dietary traits of a population and its habitat (and more largely the environmental context) at the time of death. In this study, tooth microwear and mesowear analyses were used to characterize the diet and habitat of the reindeer populations from Stellmoor and Meiendorf (north Germany). The microwear data were compared to those from eight populations of extant reindeer from Canada living in different habitats, from wooded areas in the south to the tundra in the northernmost areas. From the study of these extant populations of reindeer, it was established that the increase in lichen consumption is reflected by microwear patterns with high numbers of pits and low scratch/pit ratios and by low mesowear values (less abrasive food). We use tooth wear analyses to estimate the dependence of reindeer on lichen between the early Late Glacial interstadial (GI-1e) and the cold episode of the Younger Dryas (GS-1), which are both characterized by tundra vegetation. New radiocarbon dates were obtained on selected materials from the two sites in order to confirm the chronological attribution to either the GI-1e or the GS-1. In both sites, the results showed that some of the pieces belonged to GS-1 instead of GI-1e, in contrast to the attribution based on the zooarchaeological assemblages that they were selected from. Taphonomic processes, excavation conditions and post-excavation mixing of material are potential causes for this. We observed significant differences between the two periods, with an increase of lichen in the diet in the populations from the Younger Dryas. These fit with the results obtained on the collagen isotopic signature (^{13}C , ^{15}N) of the reindeer from the same sites.

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Keywords: Paleodiet, ungulate, Late Glacial, tooth wear

The roe deer at the end of the Late-Glacial: a high-resolution study of habitat change and hunting strategies at La Fru (Northern Alps, France)

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The roe deer (*Capreolus capreolus*) is one of the ungulate preyed on species regularly documented in the lowlands sites of Western Europe during the Mesolithic period / Early Holocene. During the Last Glacial Maximum, its distribution was restricted to the Mediterranean peninsula, south-western France and the surroundings of the Carpathians (Sommer et al., 2009). The situation during the Late-Glacial represents an interesting window corresponding to a re-opening of habitats and a reorganization of available faunal resources in the Jura and the Alps in particular (Bridault et Chaix, 2009). A marked change of habitat is well documented in red deer at the Late-Glacial to early Holocene transition in Eastern France (Drucker et al., 2011), but very little is known about roe deer habitats.

The Early Azilian occupation at the Northern Alpine site of La Fru (Savoie), documents the earliest evidence of the roe deer in the Northern France: four roe deer bones were radiocarbon dated between 14,9 – 13,9 ky cal BP (2s). This offers a unique opportunity to study the ecology and the exploitation of this ungulate at that time. Stable Isotope analyses were implemented to investigate how the diet and habitat of the roe deer differed from those of the other coeval deer. The study of faunal remains shows roe deer was the second game species hunted during the B'olling (GI-1e) at la Fru, an unusual result that brought us to explore the specific hunting strategies performed during this key period of environmental transition. Wear and eruption patterns recorded on the abundant dental remains allow us to discuss the age profile of targeted animals and seasonality of their capture.

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Keywords: Roe deer, Early Azilian, Late, Glacial, hunting strategies, habitat change, Isotopes

Environment and subsistence in northern France during the Late-Glacial and early Holocene

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The time range spanning from ca. 13,000 to 4500 years ago may be divided into three key climatic periods corresponding to the global warming of the Late-glacial interstadial (GI-1e), the last significant cold episode of the Younger Dryas (GS-1) and the definitive warming of the early Holocene. For a large part of northwest Europe, it corresponds to a general expansion and intensification of human settlement, which is reflected by a large number of archaeological sites delivering faunal remains. Major changes in faunal composition occurred over the Late-glacial and early Holocene, with arctic and steppe species dominant until the GI-1e, replaced by transitional faunal associations during GI-1e and GS-1 and by forested faunas from the beginning of the Holocene.

The stable carbon and nitrogen isotopes of bone collagen provide interesting insights into the impact of climatic change on the diet and environment of large herbivores. The abundances in ¹³C of large herbivores are linked to dietary specialization as well as habitat context, such as closed forest *versus* open areas. The amounts in ¹⁵N of the ungulates can reflect the degree of soil activity and thus the ecosystem productivity, which depends on conditions of temperature and humidity.

We will consider the evolution of the collagen ¹³C and ¹⁵N abundances of different species of large herbivores over time in northern France, and especially in the Somme Basin. Our investigation will focus on red deer (*Cervus elaphus*), a species of high ecological plasticity and quite well represented over the considered periods. The determination of the isotopic signature of large herbivores preyed upon by human groups is of crucial importance when trying to reconstruct the food web. It gives access to the local terrestrial baseline from which the isotopic signature of human individuals can be interpreted in term of relative sources of food proteins. An example of such application will be presented dealing with an individual from a secondary inhumation at La Chaussée-Tirancourt dated to the early phase of the Mesolithic.

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Keywords: collagen, environment, early Holocene, Late, glacial, stable isotopes, subsistence, northern France

How did they eat? Inference from wear and enamel thickness in human teeth

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The study of teeth allows to infer the dietary regime of past individuals because tooth size, shape, structure, wear and chemistry all relate to what individual eats. Relationships among enamel thickness, tooth form and dietary ecology have been identified. Notably, enamel thickness has been linked to functional aspects of masticatory biomechanics and has been demonstrated to be an evolutionary plastic trait, selectively responsive to dietary changes and wear. Dental wear patterns are the result of complex interactions between individuals and their environment, caused by food processing and consumption but also non-dietary activities. Furthermore, the study of microwear signatures retained on the crown surfaces allows to discuss the consumption of hard and/or tough food items.

While European Late Paleolithic and Mesolithic hunter-gatherers should exhibit a flat wear pattern, oblique molar wear has been reported as characteristic of Neolithic agriculturalists and related to functional demands of food reduction and higher abrasive impact of more refined and ground food. Although major sociocultural and economic changes occurred at the end of the Pleistocene and the beginning of the Holocene, representatives of these periods have been poorly assessed by means of advanced virtual anthropology. Indeed, little work has been done to quantify variation in enamel thickness in these human populations and no holistic approach involving the study of dental tissue volumes and thicknesses as well as of macro- and microwear patterns has been conducted.

Here we studied the permanent molars of European individuals dated from Middle Magdalenian to Late Mesolithic from macroscopic to microscopic levels. Occlusal wear patterns were scored in 53 Upper Paleolithic and 65 Mesolithic permanent molars. Enamel thickness was evaluated by microtomography in subsamples of 18 Upper Paleolithic and 23 Mesolithic molars. A first exploration of microwear patterns has been realised on 10 molars using 3D dental microwear texture analysis.

The results show that Upper Paleolithic and Mesolithic hunter-gatherers exhibit an unexpected proportion of oblique wear. While the average and relative enamel thicknesses decrease through time, the heterogeneity of enamel thickness increases between lingual and buccal cusps of the molars. These changes are discussed in regard to dietary and/or masticatory aspects related to diet and hunting strategies for those periods.

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By characterising teeth at high-resolution and at different structural levels, analysis of dental macro- and microwear combined with meso- and microstructural analysis of dental tissues and biogeochemical studies can offer the best resource for understanding human diet in the past.

Keywords: enamel thickness, dental wear, microwear, human populations, Late Pleistocene, Early Holocene

Magdalenian Site Use in the Lone Valley of Southwest Germany

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Several studies have shown that Magdalenian (approximately 16.3 to 12.7 cal yr BP) land use and settlement patterns are distinctly regional. This regional variability is likely, at least in part, a result of local environmental conditions. Exploring the connection between environmental conditions and human settlement patterns requires paleoenvironmental and archaeological datasets that are directly comparable. Several sites from the Swabian Jura of Southwest Germany have assemblages that fit these criteria; large microvertebrate assemblages, that are ideal for paleoenvironmental reconstruction, are commonly found in direct association with archaeological remains. Despite this, few studies have explored how regionally-specific paleoenvironmental change affected site use by humans and non-human predators in the Swabian Jura during the Magdalenian. In this study, we use macro- and microfaunal remains to interpret site use during the Magdalenian at Langmahdhalde, a rock shelter in the Lone Valley of the Swabian Jura. Our interpretations of site use are based on three reconstructions: paleoenvironmental conditions, human subsistence behavior, and non-human predator use of the site. We reconstruct environmental conditions during this time period using the large microfaunal assemblage from the site. We use traditional zooarchaeological analysis to infer human subsistence patterns and taphonomic analyses of both the macro- and microfaunal remains to interpret non-human predator use of the site. Our results include some of the first microvertebrate-based paleoenvironmental reconstructions for the late Pleistocene (post-Last Glacial Maximum) in Southwestern Germany. As a whole, these results allow us to discuss how past environmental change affected site use and subsistence strategies in the Lone Valley. To conclude, we place our results in the context of large-scale settlement patterns across Central Europe during the Magdalenian.

Keywords: Magdalenian, Site Use, Paleoenvironment, Swabian Jura, Germany, Microvertebrates

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Spatial distribution of Mesolithic scattered human remains from Noyen-sur-Seine (France)

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As during the late Paleolithic, and more specifically the Magdalenian, the occurrence of scattered human remains in Mesolithic sites is a quite widespread phenomena in northwest Europe. However, these dispersed remains, often in the context of settlements, may differ in their meaning. Cannibalism, disturbed burials, complex funeral practices, non-funeral practices or wastes are the different evoked hypotheses. Bioarcheological analyses of the bone remains allow enlarging the investigation to the study of mobility and subsistence pattern during the Mesolithic.

The site of " Haut-des-Nachères " at Noyen-sur-Seine (France), which has provided 63 human cranial and infracranial remains distributed on a surface of 400m², offer the opportunity to conduct such studies. We present here a spatial analysis (GIS), macroscopical and isotopical examination of the remains fragments to document the mortuary practices and subsistence pattern of 11 individuals, adults and juveniles, who lived in the Seine valley during the first (8000 to 7300 years BP) and second (7000 to 6200 BP) Mesolithic.

The investigation of the spatial distribution of the human remains suggests the influence of taphonomical parameters, especially water displacements of remains located in the paleochannel. Other factors seem also to have contributed to the dispersion and partial representation of the skeletons. Indeed, most bones are fragmented and 58% show the occurrence of cut-marks. These traces are interpreted as resulting from dismemberment of the bodies and cleaning of the heads. The isotopic analyses and paleobiological study of the teeth conducted on three individuals (adults and juvenile) have revealed a significant exploitation of the local aquatic

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resources. These hints, combined with other archaeological data, would testify to a long-term occupation of the site of a group well-adapted to its environment.

Keywords: Mesolithic, scattered human remains, mortuary practices, spatial distribution, isotopic analyses, paleobiological study, human subsistence, environment

Human masticatory adaptations among Epipalaeolithic and Mesolithic hunter-gatherers in Western Europe: evidence from mandibular morphology and dental wear.

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Many studies dealing with mandibular morphology and dental wear have shown that agriculturalists experience reduced masticatory stress and show changes in form and degree of occlusal wear when compared to hunter-gatherers. Multiple major sociocultural and economic changes occurred with the "Neolithic revolution," and the intense and rapid environmental modifications that Late Glacial and early Holocene hunter-gatherers experienced probably resulted in numerous biocultural adaptations. One such adaptation appears to have been a broadening of the dietary spectrum. Isotopic and archaeological evidence suggests that small fauna, marine and freshwater resources, and vegetal foods were incorporated into Mesolithic diets. Variation in mandibular morphology and occlusal dental wear can be linked to dietary habits and reveal information about both the type of food ingested and masticatory behaviors. Unlike the cranium, the mandible significantly reflects subsistence strategies and dental wear can be used to infer food processing and consumption. In order to assess differences in the masticatory behaviors of Epipalaeolithic and Mesolithic populations, we studied variation in mandibular morphology and occlusal wear. We analysed 11 measurements and 2 indices of 134 mandibles dating from the Epipaleolithic (ca. 12,700- 9,700 cal BC), First Mesolithic (ca. 9,700-6,700 cal BC) and Second Mesolithic (ca. 6,700-4,500 cal BC) from Western Europe, as well as the occlusal wear pattern of 390 lower molars from the same individuals.

Compared to Epipaleolithic mandibles, those of Mesolithic individuals show a shorter mandibular corpus, a larger bi-condylar breadth, and a narrower and more angled ramus. Additionally, inland individuals exhibit a longer mandible with a narrower and more upright ramus than do coastal ones. In general, occlusal wear increases through time, but the pattern appears more complex once region of origin is taken into account. Mesolithic coastal individuals exhibit more occlusal wear than inland ones, while the opposite is found during the Epipalaeolithic period. These results suggest differences in masticatory biomechanics between the Epipaleolithic and Mesolithic periods, as well as between coastal and inland Mesolithic human groups. These changes in mandibular shape and occlusal wear pattern are consistent with a change in

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the subsistence strategy and the hypothesis of a decrease in masticatory stress among Mesolithic hunter-gatherers.

Keywords: late Pleistocene, early Holocene, human mandibular morphology, dental occlusal wear, masticatory stress

Enquête archéozoologique dans le Tardiglaciaire du Sud-Ouest de la France

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Cette communication se propose de rechercher dans le Tardiglaciaire du Sud-Ouest de la France, les indices d'un lien entre évolution climatique et environnementale d'une part et transformations sociales et culturelles d'autre part. La reconstitution des cortèges fauniques - en particulier la raréfaction des gibiers grégaires et migrateurs comme le Renne au profit de gibiers réputés plus solitaires comme le Cerf, le Sanglier ou le Chevreuil - a en effet souvent été invoquée pour tenter d'expliquer la disparition des traditions magdaléniennes et l'émergence des traditions aziliennes. À travers l'étude archéozoologique de différents gisements clés comme Troubat (Hautes-Pyrénées), Rhodes II (Ariège), Murat (Lot) ou Bois-Ragot (Vienne), une reconstitution des modes de chasse et de boucherie en œuvre au Magdalénien récent et à l'Azilien a été tentée, afin de discuter du rôle de l'évolution des gibiers disponibles dans la transformation des habitudes des groupes humains. Comme on pouvait s'y attendre au vu des données d'autres régions, les résultats obtenus plaident pour l'existence de chasses plus individuelles à l'Azilien qu'au Magdalénien, entraînant un partage moindre des carcasses au sein de groupes certainement plus restreints. L'acquisition des gibiers semble par ailleurs plus planifiée au Magdalénien, de même que la gestion des ressources. Les quelques indices de stockage identifiés pour cette période, notamment dans les modalités de récupération de la viande, sont en effet totalement absents à l'Azilien. L'hypothèse d'un lien entre comportement des gibiers et possibilités de planification de l'acquisition des ressources animales est par conséquent discutée.

Keywords: archéozoologie, Tardiglaciaire, Magdalénien, Azilien, chasse, boucherie, Cerf

*Speaker

Fish exploitation at the end of the Pleistocene in the Upper Jordan Valley : a case study from Eynan/Ain Mallaha (Israel)

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The importance of fish in the subsistence of late Pleistocene societies is a crucial issue that has been raised for several decades but has long lacked comprehensive faunal studies. At Ain Mallaha/Eynan (excavation F. Valla and H. Khalaily) the recovery of tens of thousands of fish remains from the final Natufian level, allows this issue to be examined. The site is located in the Hula Valley, itself part of the Upper Jordan Valley (Israel). Natufian hunters-fishers-gatherers settled at the foot of a hill, some meters above the spring of Enot Enan, itself part of a complex of springs, and close to the Hula lake and its swamps. The present study focuses on the structure 228, a fireplace and an ashy area, where an abundant discarded material (flint, bones, shells) has been recovered. The spatial patterning of the mammals and birds remains relative to the fireplace has stressed the culinary function of this structure. Some methodological aspects as well as the results of the study will be presented. The taxonomic identification reveals that two families of freshwater fish, Cichlids and Cyprinids, are the main source of fish at the site. The Minimum Number of Individual was estimated for each family based on one diagnostic skeletal element. An analysis of skeletal frequencies was conducted to estimate if fish were brought entire or not at the site. Size and weight were reconstructed per individual, based on the measurements of the first vertebrae to estimate the dietary contribution of fish (cumulative meat weight). Seasonality of the captures was also examined based on the lines on the centrum.

Keywords: Fish, Eynan/Ain Mallaha, Final Natufian, Hula Valley, Southern Levant

*Speaker

Paleodiet at the high-altitude Cuncaicha rockshelter (Pucuncho Basin, Southern Peru), based on stable carbon, nitrogen, and sulfur isotope abundances in bone collagen

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Even though the harsh climate, steep gradient, and high altitudes of the Andean Cordillera present natural hurdles to human settlement, its colonization in the Terminal Pleistocene-Early Holocene was swift and widespread, up to the highest plateaus. The question whether the early settlers of the Andean highlands occupied these challenging environments on a permanent basis remains nonetheless unresolved. Indeed, not only do coastal sites bear archaeological evidence for redundant occupation of the Pacific lowlands and coast; further archaeological evidence also points towards a connection between Andean highland and lowland sites. To evaluate the extent to which these humans were permanently living at high altitude, we used multi-isotopic ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and $\delta^{34}\text{S}$) analyses on bone collagen of coeval archaeological human and animal remains from the high-altitude rockshelter Cuncaicha (4480 masl) in the south Peruvian puna. Due to the differential abundances of carbon, nitrogen, and sulfur isotopes in coastal and high-altitude ecosystems, the protein ingested by an individual can be traced to food resources originating from either ecosystem thanks to distinctive $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and $\delta^{34}\text{S}$ values in the individual's collagen. These new isotope results, in conjunction with already published values for carbon and nitrogen, provide insights into the palaeoecology of the Pucuncho Basin, where

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Cuncaicha is located, and help complete the growing body of knowledge of isotopic baselines in high altitude and arid environments. Additionally, comparing archaeological and modern material provides higher-resolution data on chronological variation of the productivity of the basin and subsequently of human foraging patterns. This paper also presents some of the oldest $\delta^{13}C$ results on archaeological material in the central Andes, thus expanding our understanding and knowledge of trophic and ecological variation of this element's isotopic ratios in complex mountainous arid landscapes. The obtained results detected a distinct local palaeoecological signal. Despite evidence for a coast-highland exchange system involving Pucuncho Basin, the results from human collagen indicate that Early Holocene foragers relied predominantly on a range of highland terrestrial animal protein resources. This exclusive dietary reliance on highland habitats adds to our understanding of human behavior within highly contrasting yet culturally connected low- and high-lands. In addition, the results are relevant for the study of subsistence strategies by individuals, here the earliest high-altitude Andean settlers, within extreme environments, and subsequent human adaptations.

Keywords: stable isotopes, Andes, paleodiet

Human Occupation and Adaptation to the Andean Highlands during the Early Holocene: Evidences from Oxygen and Strontium Isotopic Analyses

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The settlement of the Americas challenges us to detail the process of adaptation that people experienced when occupied new environments. In the case of the occupation of the Andean highlands, there is a debate around the mobility and settlement strategies that people could implement for surviving at such altitudes. Recent investigations at the Cuncaicha rock shelter (4480 m.a.s.l) in the Peruvian Andes, bring new insights about the way people occupied and settled the highlands. At this site, Sr and O isotopes of dental enamel carbonates of buried individuals as well as meteoric water samples were analyzed. Both analyses helped to characterize biochemically the highland environment surrounding the rock shelter (Pucuncho Basin) as well as the other ecological zones at lower altitudes. They also helped to detail the mobility strategies and the ecologic zone where human individuals lived since their childhood. The results suggest that people from the Cuncaicha rock shelter occupied permanently the Pucuncho Basin and they were likely already adapted to the harsh conditions of the highlands.

Keywords: Isotopes, highlands, mobility, adaptation, dental enamel

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Stop and go. Inferring goat mobility patterns through biomechanical features of the long bones. Tibiae and humeri from Tell Halula under the scope of digital cross-sections.

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The study of animal mobility and activity patterns is fundamental to understand animal management strategies through archaeozoology. Methodological approaches to infer physical and biomechanical characteristics such as geometric morphometrics have been increasingly developed within the archaeozoological research framework, showing significant and interesting advances in our knowledge on the acquisition and management of the first domesticated animals. We present in this communication the results derived from the study of husbandry regimes in first domestic goat populations based on computerized tomography scanner (CT scan). A significant sample of goat humeri and tibia remains recovered from the settlement of tell Halula (7700 cal BC to 5500 cal BC, middle Euphrates valley, Syria) has been analysed. A modern sample has been also included in the analysis to establish a reference framework for interpretation. The raw data obtained from the CT scan was processed and allowed to generate 3D models of each bone. Digital cross-sections measurements were taken and were used to calculate physical properties of these bones, including bone area, anteroposterior and mediolateral moments of inertia and polar moment of inertia. The values obtained are representative of the modifications that the bone tissue may undergo as a result of its adaptation or response to the different loads received during the life of the animal, being a reflection of its intensity, recurrence, duration and direction. Results show that a group of domestic individuals with activity levels and mobility patterns similar to those of wild goats whereas most of the domestic show different activity levels between domestic populations as well as differentiated mobility patterns which are especially visible regarding lateral movement.

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Keywords: Biomechanics, Domestication, Near East, tell Halula, Neolithic

Pig size variability during first domestication stages in Western Mediterranean: new insights on animal husbandry during early Neolithic

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Animal domestication processes involve important changes to the subsistence strategies of Neolithic populations in the first half of the Holocene. Domesticated pigs (*Sus domesticus*) played an important role in the early Neolithic economy of the western Mediterranean and their exploitation followed a systematic pattern oriented to the production of meat. Although this pattern appears relatively homogeneous over this broad geographic areas, it is difficult to be discriminating between domestic (*Sus domesticus*) and wild (*Sus scrofa*) species. Several methodological approaches have been applied to address this issue, the most common being based on morphological and biometric criteria. Because of the diversity of scenarios of domestication or adoption of domestic pigs during early Neolithic proposed in other geographic areas it is necessary to study this phenomenon from a wide territorial perspective. We present in this communication the results of an exhaustive analysis of the biometric data currently available in the western Mediterranean area between 10,000 and 4000 cal BC. In the first place, the variability of *Sus scrofa* from the Epipalaeolithic to the late Neolithic is assessed and later compared diachronically with the characteristics of the domestic populations. The results reveal differential dynamics between the wild and domestic form resulting from environmental changes and the increasingly systematic selective pressure of husbandry. The range of variability is relatively greater in the Neolithic, which may be connected with the existence of different ways of adopting and breeding domestic pig among the first Neolithic communities.

Keywords: Biometric analisys, western Mediterranean, pig size, early Neolithic

*Speaker

Environmental changes in Southwestern France during the Late Glacial and their impact on hunter-gatherers' subsistence

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During the Late Glacial, the significant changes in plant communities relating to climate changes were responsible for faunal recompositions perceptible throughout Europe. In Southwestern France, at the end of the G1e, the reindeer disappears and prey such as red deer or ibex were more regularly hunted by Upper Magdalenian people and later on by Azilian groups. New radiocarbon dates done on key Palaeolithic faunal species in the framework of the Magdatis project (dir. Pétilion, Laroulandie) and a Fyssen project (dir. Costamagno) show that the reindeer disappears from southwestern France at ca. 13,800 cal BP and that, as soon as GI-1e, the natural range of that species began to fragment. By the end of GI-1e, only residual reindeer populations remained in the Perigordian area (Costamagno *et al.* 2016). Continuously present in the southwest of France, red deer remained rare until the end of the HS1 Event. At this period, the western part of the Pyrenean chain provides favourable conditions for the expansion of this species. In this presentation, we will focus on these results to understand how, at a local scale, the environmental changes of the Late Glacial impacted the hunter-gatherers' subsistence in the North Aquitaine and the Pyrenean foothills. First, the relative abundance of the different mammal species found in the assemblages from the Middle Magdalenian, Upper Magdalenian, and Azilian will be presented to see what species were preferentially targeted in each area. The scheduling of the hunting as well as the game processing techniques will be discussed to evaluate to what extent these climatic changes drove human societies, particularly their relationships to

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their prey but also their mobility. COSTAMAGNO S., BARSHAY-SZMIDT C., KUNTZ D., LAROULANDIE V., PETILLON J.-M., BOUDADI-MALIGNE M., LANGLAIS M., MALLYE J.-B., CHEVALLIER A., 2016.- Reexamining the timing of reindeer disappearance in southwestern France in the larger context of late Glacial faunal turnover, *Quaternary International*, 414, p. 34-61.

Keywords: Late Glacial, subsistence, southwestern France

Late Pleistocene and Early Holocene Environmental Change and Prehistoric Human Resilience in the Eastern Adriatic Region: Zooarchaeological Perspectives

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The resilience of past human populations and their responses to previous episodes of climate change are pressing topics today. To what extent do palaeoecological changes correlate with shifts in prehistoric settlement, food procurement, material culture, and social organization? In this presentation I examine evidence for palaeoclimatic changes and human responses to them in the Eastern Adriatic region during the Late Pleistocene and Holocene periods, using zooarchaeological proxies for human food procurement and management strategies. The Eastern Adriatic region witnessed significant environmental changes during the Late Pleistocene and Early Holocene periods. Some changes, like the rise in sea level were time-transgressive with steady and prolonged impacts over several millennia. Other changes, like fallout from volcanic eruptions (Neapolitan Yellow Tuff at c. 14.3-13.9 Kyr, Mercato at c. 9-8,7 kyr), late-glacial oscillations (e.g. GI-1d), and the 8.2 Kyr event, were punctuated, potentially sharp in impact, and relatively short in duration (a few years to a few centuries). In this paper I synthesize evidence for these changes in regional records (sediment cores and archaeological sites), focussing on southern Dalmatia. I then examine the extent to which regional changes are expressed in a long, high-resolution sequence from Vela Spila Cave (Korčula, Croatia), focussing on the zooarchaeology of Late Upper Palaeolithic, Mesolithic and Early Neolithic assemblages deposited between c. 20,000–7,500 Cal BP. During the late glacial period Late Upper Palaeolithic people seasonally visited Vela spila to process and consume large game animals (e.g. red deer, European ass, wild cattle) that they hunted on the exposed Great Adriatic Plain. Human activities at Vela Spila changed significantly after the deposition of the Neapolitan Yellow Tuff (NYT, c. 14.3-13.9 kyr) shortly after the onset of rapid, late-glacial warming (GI-1d, starting c. 14.7 kyr). Immediately after the deposition of the NYT the Pleistocene ceramics disappear, the intensity of site visits drops significantly, and the cave was abandoned. After a break in occupation for about 5 kyr, Mesolithic people revisited the cave during the Holocene starting about 9.5 kyr. Rising sea levels had a dramatic impact on Vela Spila's Mesolithic inhabitants; roe deer, fox, fish, and shellfish dominate the food waste. Over the course of the Mesolithic occupation, the human use of subsistence resources intensified. The 8.2 kyr event is roughly correlated with the first appearance of Neolithic technologies (domestic animals followed by pottery) at the site. The archaeological assemblages display aspects of both continuity and change across the Mesolithic-Neolithic transition. With the adoption of food production in the Neolithic, Vela spila was used primarily as a pen for keeping domestic sheep and goat.

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Keywords: Upper Palaeolithic, Mesolithic, Zooarchaeology, Croatia, Resilience

Animal exploitation and hunting strategies in a changing environment during the Late-Glacial and Early Holocene in the French Jura

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The Late-glacial period (18-11.6 ky cal BP) has witnessed significant changes in ecosystems, particularly in the Jura area where the complete disappearance of the local ice cap is dated to ca 17 ky cal BP. Zooarchaeological data coupled with AMS radiocarbon dates of targeted animal species, reveal a rapid faunal turnover between ca. 15 and 14 ky cal BP in the French Jura. The regional demise of reindeer follows the arrival of the red deer (*Cervus elaphus*) and moose (*Alces alces*) at the Gs2a-GI1e transition. No evidence has been found to support a reappearance of reindeer populations in the area during the last cold oscillation (GS-1). Predation strategies are a key element of the human re-occupation at the Jura margins and of its expansion within regional territory during the Late-glacial and Early Holocene. Well dated faunal assemblages and revised stratigraphies, offer the opportunity to examine what were the changes in hunting strategies between ca. 15 and ca 8 ky cal BP, with regard to risk management in particular, in a context of faunal reorganization.

Keywords: Late, Glacial, Early Holocene, faunal turnover, hunting strategies

*Speaker

Environmental context of Badegoulian and Magdalenian activity in Late Glacial Switzerland

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Chronological and palaeoenvironmental evidence suggests human presence in Switzerland during the final phase of the Last Glacial Maximum (LGM) and the Late Glacial was more likely mediated by the structure of local plant and animal communities, rather than being directly controlled by climatic events (Leesch et al., 2012). Here we discuss the ecological and environmental context of this human presence, based on stable isotope analysis of archaeological fauna remains.

Radiocarbon dates on cut-marked reindeer from Kastelh'ohle Nord and Y-H'ohle indicate that humans were utilising the ice-free area of northwest Switzerland during, or immediately after, the Last Glacial Maximum. This Badegoulian presence (assigned based on lithic characteristics at Kastelh'ohle Nord) occurred less than 50km north of the ice sheets, in a region where vegetation was presumably sufficient to sustain reindeer herds, at least seasonally. The breakdown of the ice sheets, following the LGM, provided newly accessible landscape, particularly in the Swiss Plateau. However, the recolonisation of these new landscapes was likely delayed until plant communities were sufficiently established to support large herbivore populations (Leesch et al., 2012).

Here were present stable isotope data from horse, reindeer, and bovids, from Kastelh'ohle Nord, Y-H'ohle, and Monruz. Carbon, nitrogen, and sulphur isotope data is discussed in relation to the chronology of human presence, environmental change, and landscape development. Data is compared to adjacent regions, such as the French Jura (Drucker et al., 2012) and south west Germany (Drucker et al., 2011).

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Keywords: isotopes, collagen, Switzerland, Magdalenian, fauna, Late glacial

UP-North: Exploring the environmental context of the Late Upper Palaeolithic peopling of Northwest Europe

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Human subsistence, mobility and environmental interactions at the end of the Palaeolithic were undoubtedly influenced by large-scale and rapid climate change. With the melting of ice sheets and expansion / contraction of ecosystems, new landscapes and resources became available to Late and Final Palaeolithic hunter-gatherer people. The UP-North project is examining the dispersal of people and animal populations into Northern Europe after the Last Glacial Maximum. Using a range of techniques, including stable isotope, radiocarbon and ancient DNA analyses, UP-North is establishing local chronological, palaeoclimatic and palaeoecological frameworks in which links between cultural innovation and/or persistence under changing environments can be explored. A key aspect of the project is to assess the timing, pace and scales of change at a local level, and to evaluate whether these changes varied by or were consistent between locations. Here we present new stable isotope and radiocarbon data from Belgium and the British Isles. We apply a multi-isotope approach to key herbivore prey species (reindeer, red deer, horse, elk, and aurochs) to infer habitat change, local landscape evolution and ecological context of the human activity in the area. We explore the timing of human presence in the regions through radiocarbon dating faunal remains that show evidence of human modification. By developing multiple integrated lines of evidence the project provides an insight into the Late-glacial landscape and environment change that Palaeolithic people experienced and evaluates how these may have influenced the decisions they made.

Keywords: Late Upper Palaeolithic, isotopes, bones, palaeoclimate, late glacial, palaeoecology, radiocarbon dating

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