ICAZ-Zooarchaeology of the Roman Period - 3rd Working Group Meeting: Animals in the Roman Economy: production, supply, and trade within and beyond the Empire's frontiers.

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Abstracts

Table of contents

Is it all about the economy? To what extent did the Roman economy shape the morphology of livestock?

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The main domesticated animals (pig, cattle, sheep and chicken) underwent some of the most prominent size increases and morphological changes in past husbandry practices during the Roman period. The phenomenon is now well described for many parts of the Roman Empire. Variability in the timing and intensity of changes have been highlighted between different regions. The mechanisms behind this morphological evolution are highly debated and probably more than one process was involved. The purposes of rearing taller and more robust animals have also been extensively discussed with a strong bias in favour of economic explanations. This paper aims to further investigate the drivers of livestock morphological evolution by combining both bioarchaeological evidence and written sources. A comparative approach between several areas of the Roman Empire will be conducted to take into account the environmental, economic, cultural, religious and social factors behind these major changes in animal management. By adopting a similar holistic approach to this phenomenon in different

regions of the Roman Empire, I will aim to examine the respective roles of regional and supra-regional drivers within an Imperialistic system.

Roman livestock production in northern Italy: technical innovation or economic re-organisation?

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Roman conquest is known to have had a significant impact on animal husbandry across the Western provinces. Northern Italy is no exception, and zooarchaeological studies have demonstrated a variety of developments to livestock exploitation during Roman times. However, several of these developments have origins in later prehistory, well before Roman political hegemony in the region. In particular, significant size increases in cattle and sheep during the Iron Age point to an early re-organisation of livestock management, which was further impacted in Roman times. This presentation explores zooarchaeological evidence for changes in husbandry strategies in northern Italy over later prehistory and the Roman period through NISP, biometry, and age data, attempting to characterise similarities and differences in these two waves of change. Results are contextualised with historical evidence for Roman farming in Italy and environmental/landscape data in order to better understand the role of livestock in the regional agricultural economy and its development through the Roman period.

Equine exploitation at Pompeii (AD 79)

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Equids were an important component of Roman everyday life. Horses, donkeys and their hybrids have been used as pack animals for moving people and goods. The most prestigious horse breeds were often associated to the social status of the owner, as some equestrian statues seem to suggest. Although Roman writers, such as Pliny the Elder and Columella, inform us about the husbandry practices of different equids, with few exceptions, their exploitation in Italian urban and rural contexts has not yet been zooarchaeologically investigated.
Previous (including very recent) archaeological investigations at Pompeii revealed the presence of a number of stables associated to urban houses and shops, as well as to a rural villa. Morphological and biometrical analysis on equid remains recovered from these contexts allowed to identify the species/type of equids present; the pathological evidence on bones, combined with ageing data have instead been used to assess the nature of the exploitation of these animals. Data on the fodder, likely consumed by these equids, provides further hints about their management. The results indicate that mules were widespread and largely employed in a number of activities inside the city; horses, on the other hand, were kept in the countryside.

This study, focused on the analysis of equid remains collected from the Pompeii stables, provides important information about the management practices of this taxon in the Roman Imperial period.

Economic adaptations or cultural change? The Romanisation rhythms of *Hispania tarraconensis* from a zooarchaeological perspective

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Over the past few years, zooarchaeological studies in the NE of the Iberian Peninsula suggest that a significant dietary change occurred from the Iron Age to Roman times. This entailed different consumption patterns and also changes in the size of the main domesticates. This paper offers an integrated study of the zooarchaeological evidence from present-day Catalonia, part of the Roman province of *Hispania tarraconensis*. Our study shows that cultural change probably took place at different levels and rhythms at different settlements, probably even at the household scale. In addition, our results highlight the value of zooarchaeology as a tool in the study and understanding of colonial encounters, but also the inherent risk in analysing cultural change based on a single archaeological indicator.

Cattle from the far West: changes and continuities in Roman Lusitania

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Zooarchaeological studies undertaken several years ago indicated little change in cattle body size in southern Portugal before the 15th century AD. Subsequent analysis of several animal bone assemblages from cities of the Roman province Lusitânia (south-western part of the Iberian Peninsula) showed increase in cattle size during Roman times. These cities include present-day Mérida (*Emerita Augusta*), ancient *Ammaia* (both founded in the 1st century BC) and Lisbon (*Olissipo*). This last was a very important urban centre in Roman times, but its occupation began much earlier, in the Palaeolithic. Here we consider measurements of cattle bones recovered from excavations in these Roman cities and compare them with results from

smaller towns and from other previous and subsequent periods. The measurements of cattle bones reveal some signs of size increase (and subsequently improvement) during the Roman occupation, which are more apparent in the newly founded Roman cities.

Preliminary results of ancient DNA studies indicate a continuity through time of maternal lineages, supporting the hypothesis of local improvement. Forthcoming genomic analyses should provide more detailed information on the introduction of new breeding stock and modes of improvement.

Western Mediterranean Roman cattle: a genomic perspective

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Cattle played a major role in the Roman economy. The zooarchaeological record indicates a general size increase across Europe, and many urban sites display higher cattle frequency remains compared to previous and later periods. The reasons for this size increase remains unknown: was it the result of the import of new lineages, related to wider mobility and trade networks? Or a consequence of selection and improvement of local stock using new breeding strategies? Or both? While morphological changes such as size increase, as detected in bone measurements, indicate improvement for larger animals, ancient DNA enables tracking changes in genomic diversity associated with mobility and animal selection traits. We aim to understand whether the Roman state enhanced cattle genetic diversity in the Western periphery using genomics. We generated whole-genome shotgun resequencing data (Illumina HiSeqX) to analyze around 100 cattle remains dating from the Roman period collected at archaeological sites in Portugal, Spain and Italy. Here we present and discuss the preliminary results of our analysis. For example, cattle mitochondrial DNA is geographically structured and it is, therefore, possible to associate maternal lineages to specific regions. Mitochondrial genome coverages for these specimens were between 1x and 100x, which allowed to determine the distribution of major haplogroups. Endogenous DNA content ranged between 0.5% and 50%. We will briefly discuss nuclear whole-genome data and their use to model genomic variation over time and investigate genetic relationships between past and extant cattle from these regions.

Animal management in the fortified palace *Felix Romuliana* – Gamzigrad (Serbia) throughout the Late Antique and the Early Byzantine periods

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Keywords: animal husbandry, animal management, Late Antique period, Early Byzantine period, *Felix Romuliana* – Gamzigrad

This paper represents the first results of a zooarchaeological analysis from the fortified palace *Felix Romuliana* – Gamzigrad in eastern Serbia. Faunal material derive from the Late Antique and the Early Byzantine contexts investigated in the tower 15 of the later fortification which was built during the reign of Emperor Galerius (293-311) in the first decade of the 4th Century AD. According to the results, domestic species were the main source of exploitation indicating the significant role of animal husbandry in supplying the inhabitants with meat and secondary products such as milk, physical strength, wool, hair, etc. Low amount of wild animal and fish remains suggests that hunting and fishing were periodically practised by local population and that food supply came from the surrounding environment when it was necessary. This paper will provide an insight into animal management similarities/differences in fortified palace *Felix Romuliana* – Gamzigrad through time, but also, the results will be observed in the wider context for better understanding the economies in the Late Antique and the Early Byzantine periods. It is important to highlight the significance of this research due to the fact that zooarchaeological aspects of the economy in this region for indicated periods are not numerous and that this is the first zooarchaeological analysis of the fortified palace during the period of constant conflicts between the Eastern Roman Empire and the barbarian forces.

A generalized approach to deposits of long bone splinters from Roman sites

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Accumulations of diaphyseal fragments (shaft splinters) from long bones of cattle are frequently reported from urban sites across different areas of the Roman Empire. Regarding the functional origin of these assemblages, various interpretations have been put forward, e.g. waste resulting from certain crafts, like glue production, remnants of specialized meat processing, or selection of sturdy fragments for street covering. It is questionable if each of these “splinter beds” can be interpreted on common terms, but it is obvious that they represent highly structured deposits generated by standardized human behaviour. For categorisation, we suggest a comprehensive, assemblage-based approach relying on the following criteria. Most were already used by other scholars:

- relative dominance of diaphyseal fragments over articulator ends and representation of different areas of the respective skeletal elements
- percentage of long bones (in/excluding metapodials) over other parts of the cattle skeleton
- dominance of cattle over other species

- distribution of anthropogenic surface marks (chop, cut, scoop, shaving) across the fragments and the state of fracture edges
- association with fragment types deemed indicative for meat preservation, e.g. perforated scapulae or ribs with scratch lines
- excavation data: the position of bone dumps in relation to buildings, structures, and the overall number of specimens

By analyzing different splinter deposits retrieved from excavations at Roman sites in Austria, the heuristic value of these criteria for their categorisation and interpretation will be discussed. Starting from the urban sites of Wels/Ovilava, Enns/Lauriacum in the Roman province of Noricum, the mentioned criteria will furthermore be applied at the ancient site of Carnuntum. These three assemblages contain an average amount of 500 fragments each. We believe that they present bone waste of specialized meat processing, possibly related to smoked or otherwise preserved beef, although they are slightly varying in their composition.

Analysis of ichthyoloical residues from Malacitan *cetariae*

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The analysis of the faunal remains found in the pools of fish sauces from different excavations carried out in the city of Málaga, allow us to know the composition of the sauces made in the Malacitan *cetariae* from the Late Republican period to the s. V AD, according to the chronologies provided by the different excavations carried out.

In the analysis of the faunal remains we can find, in general, two types. The first case, one species is highly represented, while others are in a lower percentage, could say anecdotally, usually adult individuals but small size. In the latter case, there is no preferred species, and generally they are juveniles. All this show that this fact is related to the season of the year when they have been captured.

Always all skeletal parts appear, sometimes anatomically articulated. We find abundant fish scale, which indicate that complete individuals were deposited. In the case of larger species identified, only appear vertebrae. In this way, we can divide the samples into different fractions according to their size, which facilitates the analysis. When the size of the ichthyological remains is less than 0.16mm generally appear fish scales and otoliths (*sagittae*). Once the biometry of the analyzed bones, we can calculate the size (length skull – caudal) of live specimens and fresh weight.

Among the identified species: *Engraulis encrasicholus* Linnaeus, 1758 and *Sardina pilchardus* Walbum, 1792 are always the most abundant.

The impact of trade on animal consumption and exploitation in Rome during the Roman period: the evidence from zooarchaeological analysis.

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In this paper some key elements derived from the study of animal bones and teeth assemblages from different contexts of Rome, dating to the Roman period, and that may reflect the trade and circulation of animals, meat and other animal products, will be presented and discussed in detail. A large number of assemblages of animal remains have come to light at the modern city of Rome and have been studied over the past thirty years, providing a large amount of information on aspects of animal consumption and exploitation in the core of the Roman Empire and the arrival point of many products. The presence of exotic or unusual animals and animal products, the frequency of selected body parts of domesticated animals for urban market, the identification of aspects that reflect processing methods linked to the circulation of animal products, will be discussed and compared with the evidence from written sources, in view to outline the main routes engaged in animal and animal products trade.

Reshaping Rome food supply during the late Antique period (4th-6th cent. AD) ? Analysis of faunal evidence from the Palatine hill NE slope.

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Keywords: Late Antique, urban food supply, political transformations, reshaping, change.

A research project carried out for several years onto the Palatine hill NE slope in Rome yielded quite a large faunal assemblage that is providing significant insight on food consumption with regards to the monumental city centre, the Colosseum valley and possibly the palatial surroundings during the crucial political turnover occurring between 4th and 6th centuries AD. Considering the extremely scanty evidence of faunal assemblages examined so far about such a period, the analysis all the more importantly unveils what would appear like a notable change happening around mid-5th century AD in the traditional state-driven urban meat supply dominated since Late Republic (1st cent. BC) by pork. Such a remodelling would probably act for a response to major political and military transformations taking place in the city at those times. It seems to reflect a shift to a more diverse sustainable and shorter-range meat provision as exotic taxa sharply disappeared from the record along with the last shows staged inside the Flavian Amphitheatre. An altered economic and productive background and a changing supply network would have thus required reshaped needs for the city, adjusting to a pronounced drop in urban population and hygienic conditions.

Same place, changing patterns: animal economy at Gabii (Latium, Central Italy) from the Early Iron Age through the Imperial Period

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Largescale excavations at Gabii, located approximately 18 km east of Rome, began in 2009 under the direction of Professor Nicola Terrenato (University of Michigan) and collected a huge faunal assemblage spanning from the Iron Age to the Medieval period. This paper contextualizes the evidence for the exploitation of animal resources from the settlement's initial urban growth during the Early Iron Age to its gradual decline after the Imperial period, especially focusing on the comparison of zooarchaeological material from deposits dating to the Iron Age through Archaic Period (8th-6th centuries BCE) and the Republican period (mainly 3rd -1st cent. BCE), with some preliminary data on the Imperial phase. The aim is to document variations in animal production, distribution, and consumption over time in the same settlement as well as changes in the relationships with the surrounding environment and the available resources. In fact, faunal data from Gabii provide detailed information for how animal procurement, rearing, and supply evolved alongside a changing city that increasingly interacted with Rome. We analyzed species range, herd composition and management strategies, the production of secondary products, breeding improvements, and trade and mobility as they relate to the economy and urbanism in Western central Italy, showing that animal production and supply mirrored larger social and economic trends in the evolving city.

Dama Mia: Investigating Origins and Game Activity of European Fallow Deer in Roman Period Sicily

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European fallow deer have been manipulated by humans since the Neolithic through translocations from their natural origins in Anatolia and the Balkans for hunting, symbols of prestige, religious, and medicinal purposes. Fallow deer can thus serve as a proxy for trade and human-fauna interaction in the past. This study analysed ancient and modern mtDNA, carbon, nitrogen and oxygen isotope ratios, and osteometric data of fallow deer remains from Campanio and Castagna in order to explore fallow deer origins and the extent of game activity, movement, and trade of fallow deer in Sicily during the Roman Period.

The results of this study, including several outliers from isotope analysis, osteomorphic groupings of astragali data, and an astragalus with a size suggesting mainland origins, in addition to the lack of Early Holocene evidence for fallow deer in Italy suggests importation as the origination of Sicilian fallow deer rather than their being remnants of a refugia population, as previously thought. Furthermore, due to low genetic diversity in addition to negative and statistically significant ($p > 0.5$) Fu and Li's F test and Tajima's D test, a founder effect and subsequent expansion event is suggested. Additionally, this study observed a marked increase in prevalence of fallow deer in Sicily during the Roman Period with an emphasis of

younger male deer, indicating a cull potentially motivated for hunting, religious, or medicinal purposes. However, future research is necessary to fully understand the patterns observed and to pinpoint potential regions of origins for the ancient Sicilian fallow deer.

Farming for a growing population: the Roman impact on agriculture in the provinces of Germania

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In the Roman period, population growth, urbanisation and the presence of the army caused an increased demand for food in the northwestern provinces. In this talk, I will discuss the possible ways in which farmers could respond to this demand, and the evidence we find for changed farming strategies. While my talk will focus on animal husbandry, I will include some examples from arable farming, since animal husbandry and arable farming are interdependent in a mixed farming system.

Limiting factors for farming were the amount and characteristics of land and the available agricultural labour. Possible strategies for farmers to increase food production are intensification, extensification and specialisation. Evidence for all three is found in the provinces of Germania.

Provisioning Roman Beirut: the zooarchaeological evidence from excavations in Beirut's souks (primarily BEY006)

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Post-war salvage excavations in Beirut exposed the heart of the Roman city Berytus. Work in three plots in the souks (marketplace), primarily BEY006, yielded a large zooarchaeological assemblage. Very few zooarchaeological assemblages have been published from major Roman ports in the Eastern Mediterranean. This paper will discuss the animal bones and the mollusc shell record of Roman Berytus in terms of the economy of the city. The faunal assemblage provides information on which species were consumed, in which relative amounts, and how. There is ample evidence for butchery, bone working, fish consumption and shellfish and shell use. The results have implications for the understanding of the Romanization of the eastern provinces. The zooarchaeological evidence is critical to understanding of how the citizens were provisioned with animal products, but it is also important to understand how the city became and remained Roman. Last but not least, this might offer insight into how the citizens of Berytus balanced out the constraints of a semi-arid environment with food demands dictated by tradition.

The Faunal Evidence from Early Roman Jerusalem: The People behind the Garbage

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Jerusalem during the Early Roman period (63BCE to 70CE) is the epicenter of political, social, and religious transformations in the Southern Levant. The study of faunal remains from this period of Jerusalem reveals how religious laws, Roman occupation, and pilgrimage economy affected dietary habits. This paper will present the animal remains from the Early Roman period landfill on the "City of David" ridge, the largest assemblage of fauna published from Jerusalem. The research includes both a zooarchaeological and taphonomical study and has a twofold objective: first, to understand landfill site formation processes and the activities related to it; and second, to examine the social and religious identity of the inhabitants of the different sectors of Jerusalem's 'Lower City'. The results are assessed in light of previously investigated contemporaneous faunal assemblages that originated in other parts of the city, as well as from the northern part of the same landfill, which is closer to the Temple Mount. The study demonstrates that garbage was dispatched to the landfill in an organized manner. It identifies the producers of the waste as Jewish. It also establishes that the portion of landfill excavated and presented here includes garbage from daily secular activities rather than from cultic endeavors, to differ from previously excavated assemblages from the same landfill, which is composed of refuse originating from ritual pursuits.

Roman market economy and sheep mobility in Iberia. New clues from a GMM approach

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With the formation and development of the Roman Empire there was a change in animal husbandry, towards a more intensive and specialized practices. This change has been related in Italy and south of France with changes in the management of livestock, with the appearance of large pens and the documentation of laws dealing with movements of herds. These evidences have been interpreted as the beginning and/or systematization of transhumance practices in these regions during the Roman period due to their incorporation in a market economy.

Taking into account these considerations, the aim of this study is to determine the local, regional or inter regional character of north-eastern Iberian livestock practices during the Roman period, focusing our study on the possible movement of animals as a livestock system.

A Geometric Morphometric approach was used to analyse 57 sheep astragali from middle Iron Age and early Roman sites located in the eastern Pyrenees and eastern coastal plain to characterize sheep morphological variability in these two areas and periods.Our analysis revealed a morphological diversity among herds from the mountain and the plain during the middle Iron Age. The morphological diversity is reduced from the early Roman period, documenting a similarity between the individuals from the coastal plain and the mountains. Therefore, we propose the existence of livestock links between the Pyrenees and the northeastern Iberian coast during the early Roman period that could involve a large movement of sheep between the coastal lowlands and the Pyrenees and (at least) a regional livestock economy for first time.

Faunal evidence and the 'consumer city' debate: York and its immediate hinterland

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The nature of Roman urbanism, and its implications for how towns might relate to their hinterlands, has been much discussed by both ancient historians and archaeologists. Moses Finley's original notion, that such cities simply exploited their surroundings and offered little in return, has been debated subsequently in many quarters. Thus other commentators have sought to replace this view with alternative models (the 'service' city, the 'organising' city, the 'processor' city), whilst others still have rejected the very notion of a model and argued for diversity of response across the empire.

All too rarely, however, has environmental evidence been deployed directly and explicitly to consider this fundamental issue, despite faunal data in particular being an obvious source for exploring how much control towns might have had on their regions. Our paper will examine this question using animal bones recovered from a recently-published excavation at Heslington East, in the immediate hinterland of the Roman fortress and civilian settlement at York. We aim to show that there were clear impacts, yet also clear limitations, on the way in which this settlement was able to impose itself on this one particular zone, and that both tendencies changed over time. Although we can only define a single aspect of one settlement in relation to a limited landscape setting, we argue that this approach shows the potential of using animal bones to study big historical questions concerning ancient urbanism.

Geese in the northern roman Gaul's economy: studies of Ambiani and Bellovaci sites.

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Recently, a zooarchaeological study was conducted on the roman town of Vendeuil-Caply (Oise, France). In the theather area, excavations revealed a remarkable collection of votive statuettes but also animal bones, including many geese remains. It was an opportunity to look at the place of the goose in the roman economy and more particularly in this town which marks the border between two neighboring cities (*civitas ambianorum* and *civitas bellovacorum*). It is tempting to consider these bones as offerings, because the archaeological context looks like a sanctuary. However the food supply and trade dimension must be analyzed. Which other contexts and other towns provide so much geese remains ? Pliny the elder wrote that Romans made geese walk from Morini territory, there might have been an expanded goose market with several breeding places in North Gaul ? As such, the position of Vendeuil on the *Gesoriacum-Augustodunum* road, passing through Amiens (*Samarobriva*) and Beauvais (*Caesaromagus*), is interesting.

The exotic animal trade from Roman provinces. The results of animal remains study from the Roman town of Thamusida (Kénitra, Morocco)

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The presence of the remains of numerous African wild animals (lion, hyena, hartebeest, gazelle, reedbuck, ostrich, etc.) at the Roman (1st-3rd c. AD) town of Thamusida (Kénitra, Morocco) will be here analysed and discussed in detail. Some of them were certainly common in Morocco in ancient times, but others testify the contacts with the southern areas of Sahara. It is likely that the Roman town served, in addition to military functions, for the sorting of exotic animals to send to other regions of the Roman Empire for supplying for the amphitheatre games. The data will be compared with those from other Roman towns of Morocco.

Army diet and supply systems of a Roman period fort on the Danube Limes in today's Serbia: preliminary zooarchaeological results

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With the arrival of the Roman army on the banks of the Danube, many fortifications were built. One of them, erected at the beginning of the 1st century, was the auxiliary units' camp Diana – Karataš. During the reign of Emperor Trajan, a canal was dug near it, which enabled the bypass of cataracts, so the entire course of the Danube became navigable. This fact influenced the importance of the camp, which thus became a trade centre and a place for transhipment of ships. During five centuries of its existence, auxiliary units were stationed there. The geographical position of the fortification, i.e. the landscape of the Danube Gorges, was not suitable for significant agricultural production, so the assumption is that the army had to meet its needs by additional supplying from the side. Furthermore, historical sources suggest that one of the units stationed here was the *cohors equitate*, that is, the cavalry unit, which includes another aspect of the constant need for supply, in addition to the already mentioned nutritional requirements. This paper will present the preliminary results of the zooarchaeological analysis of faunal remains from this site, which is currently underway. Also, the analysis of road routes, geomorphological features and previously published small findings from the fortification will serve to present potential supply systems of the Diana – Karataš camp, to better understand possible army diet.

Continuities and discontinuities in animal exploitation throughout the Roman era in the central Balkans: archaeozoological evidence from Viminacium

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The Roman army conquered the region of the central Balkans during the 1st century AD. The territory was urbanized and the network of roads that connected eastern and western parts of the Empire was built. The Roman period in the region is characterized by different phenomena,

such as economic prosperity followed by periods of crises, transformations in material culture, while the Hunnic invasion that destroyed most of the cities in 441AD marked the end of the era. One of the most important Roman sites in the region was Viminacium, where the fortress of the legion VII Claudia was stationed. Next to the fortress a city developed and became the capital of the province of *Upper Moesia*. The area was surrounded by rural settlements and agrarian features. The large scale archaeological and archaeozoological survey of the site enables us to study aspects of the impact of different economic, political, and social circumstances on animal management in the region. This paper will bring together archaeozoological data from different periods and areas of Viminacium (legionary fortress, amphitheater, and settlements in the vicinity). By focusing on intra-site similarities/differences in species ratios, and also mortality profiles, and biometry of domesticates, the paper will discuss specific practices of animal exploitation both diachronically and contextually. This study will tackle questions related to the impact of the Roman socio-economic organization on animal exploitation in the region, such as provisioning cities with animal products, roles of animals in trade, the significance of wildlife and exotic animals in the economy.

Crossing the limes – Animals and economy on both sides of the Germanic frontier

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The Limes Germanicus marked the north-eastern border of the Roman Empire in the ancient provinces of Germania Inferior, Germania Superior and Raetia, from the North Sea to the Alps, using either a natural boundary such as a large river (the Rhine or the Danube, for instance), or a fortification such as a wooden palisade or a line of *castella*. This paper focuses on the region that corresponds to modern-day Germany, where the environmental conditions differed only slightly on both sides of the limes; however, the political and social systems of the Germania Libera and the Roman provinces were radically different and were, therefore, the main factors behind the differences in the use of animals. In this paper, we will discuss patterns of similarities and dissimilarities on the husbandry systems, the hunting strategies and the use of animal raw materials in both regions, exploring the influence that each of the sides of the limes might have had on one another. Furthermore, the character of the frontier will be discussed: was there a strict division of both regions, or was economic exchange possible to some extent?

Zwammerdam on the Rhine: The contribution of archaeozoological research to the current knowledge of Roman *Nigrum Pullum*

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A good deal of archaeozoological information is already available for the Roman frontier area in the Netherlands, but data from certain sites has not always been analysed in detail or made available for further research. This also applies to the Roman fort and *vicus* of Zwammerdam-*Nigrum Pullum*, located on the Rhine in the West Netherlands. Archaeozoological remains

have been collected during excavations in 1968-1971 and in 2003-2004, but a synthesis of the archaeozoological data was still missing and, therefore, certain aspects of life within this Roman settlement remain unknown. As part of the Dutch research project *Romeinse vicus aan de Rijn*, a project in which the development and significance of Roman *vici* settlements along the Dutch part of the Rhine is studied, archaeozoological remains from both excavations at Zwammerdam were analysed and integrated with contextual and chronological data of the associated archaeological structures and previously published archaeozoological reports of *Nigrum Pullum*. This study has brought forward new archaeozoological information for the Roman settlement at Zwammerdam. Not only did the new data make it possible, for the first time, to compare animal use in the *vicus* and in the fort, it also provided an opportunity to study patterns throughout time and to make a comparison with other nearby settlements. While limited to a small area in the Roman Empire, the data from Zwammerdam can provide a further step for new, broader archaeozoological research towards the role of animals in the Roman economy.

Faunal Remains from Dún Ailinne, County Kildare, Ireland: Past, Present and Future research

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Dún Ailinne, one of the Iron Age "royal sites" located in Co. Kildare, Ireland, has been the subject of three programs of archaeological survey and excavation. The initial excavations, carried out under the direction of Professor Bernard Wailes between 1968 and 1975, yielded a substantial collection of animal bone remains that can shed light on animal husbandry and trade in Ireland during the Roman period. A program of magnetometry and targeted topographic survey was conducted between 2006 and 2008 under the direction of Dr. Susan Johnston. This research led to renewed excavations at the site beginning in 2016. Our presentation will review the zooarchaeological evidence from the original excavations, including the recently identified faunal material from the topsoil deposits. We will also discuss the faunal remains recovered from the 2016 excavations and the planned isotopic research to trace the origins of the animals that were consumed at Dún Ailinne as part of ritual feasts.

The zooarchaeological data from Dún Ailinne will be compared to contemporary faunal material from Britain. Metrical data show that the Irish cattle from Dún Ailinne are substantially smaller than their Roman counterparts in eastern Britain.

Elemental fingerprinting of oyster shells to reconstruct provenance

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Provenance determination of archaeological remains is a valuable tool for reconstruction of past exchange networks. As ubiquitous items in sites from all periods, oyster shells appear as promising models for provenance identification. Indeed, they include chemical elements from the environment in their shells, and hence likely record an elemental fingerprint of the region of origin. We present elemental measurements from 15 groups of modern and archaeological shells from continental France and Corsica island (western Mediterranean Sea). Two modern species were investigated (*Crassostrea gigas* and *Ostrea edulis*). Results indicate that (i) a species-specific elemental fingerprint exists although (ii) we can identify Atlantic Ocean and Mediterranean Sea provenances. Moreover, we can observe a fingerprint specific to the watershed, even between groups originating from the same bay, if the shells originated from localities only partially connected to the ocean (*e.g.* estuary or lagoon). Using these measurements as reference fingerprints, we characterize the Mediterranean origin of two groups of antique shells unearthed at Lyons (central France, 200 km away from the nearest shoreline).

Presenting the Roman archaeofaunal initiative (RAF)

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Archaeofaunal studies offer a plethora of information on multiple aspects of the ancient Roman world. The picture of Roman socio-economic structures, the description of developments in agricultural practices and trade, or the characterization of religious and wider cultural practices have all benefited from the study of archaeofaunal remains. As increasingly larger volumes of archaeofaunal data are accumulated from across different regions and time periods within the Roman world it becomes possible to employ sophisticated modelling techniques to perform meta-analysis and investigate broader spatial and diachronic trends. However, to achieve this an effort is required to bring together compilers of Roman archaeofaunal data so that data collection targets and metadata structures may become standardized.

Here, we will present the Roman archaeofaunal initiative (RAF) which brings together a community of Roman archaeofauna data compilers and experts. In our presentation we will describe the efforts being made to achieve common data standards for Roman archaeofaunal data. The RAF initiative is linked to the Pandora initiative which brings together a network of

historical and archaeological databases devoted to the study of the human past. Under the Pandora initiative an emphasis is placed on the recognition of the research and data collection efforts made by both data producers and data compilers. Pandora effectively functions as a hub where data compiled across separate individual databases is made readily visible and accessible to the wider research community.

Within the Pandora initiative, and in collaboration with the IsoMemo initiative (a network of isotopic databases that includes isotopic databases devoted to the study of the ancient Roman world), large efforts are being made to develop open access R-based modelling tools. This includes the development of user-friendly interfaces and online video tutorials so that sophisticated modelling tools, including several for spatiotemporal modelling, are made easily accessible to non-statistical experts.

In this paper, the organizational model behind the RAF initiative and its links to the Pandora & IsoMemo initiatives will be presented. We will also illustrate, through a few preliminary case studies, the research potential of modelling large archaeofaunal, and other, datasets.