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Zooarchaeology

INTRODUCTION

Zooarchaeology refers to the study of animal remains excavated from archaeological sites. The goal of zooarchaeology is to understand the relationship between humans and their environment(s), especially between humans and other animal populations. Zooarchaeology is characterized by its broad, interdisciplinary character, which makes it difficult to write a review that adequately covers all aspects of the field. This diversity can be traced to the application of many physical, biological, ecological, and anthropological concepts and methods to the study of animal remains throughout the world by scholars with a wide range of theoretical interests and training.

ZOOARCHAEOLOGY, AN INTERDISCIPLINARY FIELD

Although animal remains, especially fossils, have intrigued the human mind for centuries, the first critical examinations of these remains were not conducted until the 1700s. Since then, zooarchaeologists have relied on combinations of the natural and social sciences, history, and the humanities for concepts, methods, and explanations. By tradition, many studies focus on zoogeographical relationships, environmental evolution, and the impact of humans on the landscape from the perspective of animals. Many zooarchaeologists pursue anthropological interests in nutrition, resource use, economies, residential patterns, ritual, social identity, and other aspects of human life involving animals or parts of animals. All of these topics are encompassed within modern zooarchaeology.

Biological principles and topics are fundamental to zooarchaeology. Biological research includes exploration of extinctions and changes in zoogeographical distributions, morphological characteristics, population structure, the history of domestication, paleoenvironmental conditions, and ecological relationships of extant fauna using subfossil materials to provide historical perspective. Paleontologists explore these issues in

deposits that predate modern humans. Many of these topics can be studied without reference to humans, although the human element is important (Weigelt 1989:62; Wintemberg 1919). Much archaeofaunal research continues to reflect biological interests, especially ecological ones.

The anthropological or historical orientation of archaeology is an important source of diversity in zooarchaeology. Many researchers practice archaeology as a subfield of anthropology and strive to achieve a holistic perspective on human biological and cultural behaviors (Willey and Sabloff 1974:12–16). Anthropological archaeologists have studied the cultural aspects of archaeological deposits under a succession of theoretical perspectives on the human–environment relationship, which contributes to the diversity of the field. In other academic traditions, archaeology is a separate discipline with strong ties to classics, economics, and history.

Another source of diversity in zooarchaeology lies in themes traditionally associated with specific regions of the globe or specific time periods (see Figure 1.1). Much research in Eurasia and northern Africa focuses on domestic animals within developing agricultural systems during the recent millennia. Researching the evolution of hunting behavior among early members of the human family dominates zooarchaeology in much of sub-Saharan Africa. Post-Pleistocene migratory patterns and the processes of human immigration are research themes in the Americas, Australia, and many Pacific islands. Research into the role of animals in the development of complex cultures is characteristic of other settings and other time periods.

Perhaps the greatest source of diversity in the field is the multidisciplinary background of zooarchaeologists. Despite an early debate over whether zoologists or anthropologists (Chaplin 1965; Daly 1969; Reed 1978; Thomas 1969) should study animal remains from archaeological sites, in reality, the person working with them may be trained in a number of fields. Zooarchaeologists may be anthropologists, paleontologists, archaeologists, biological anthropologists, zoologists, ecologists, forensic biologists, veterinarians, agricultural scientists, geographers, or geologists. Each field brings different perspectives, methodologies, and research goals to the study of animal remains.

WHAT'S IN A NAME?

This combined biological and anthropological background is reflected in disagreements over the name for the field. One of the first clear references to the field was by Lubbock (Avebury 1865:169), who used the term "zoologico-archaeologist" to refer to Steenstrup and Rütimeyer – Europeans who studied animal remains from archaeological sites. These scholars and this term influenced American zooarchaeology through Morlot (1861) and Wyman (1868a), among others. For example, the Danish term "kjøkkenmøddinger" (kitchen middens) appears in the title of one of Wyman's publications (1868a). Many nineteenth-century American studies refer to European research.

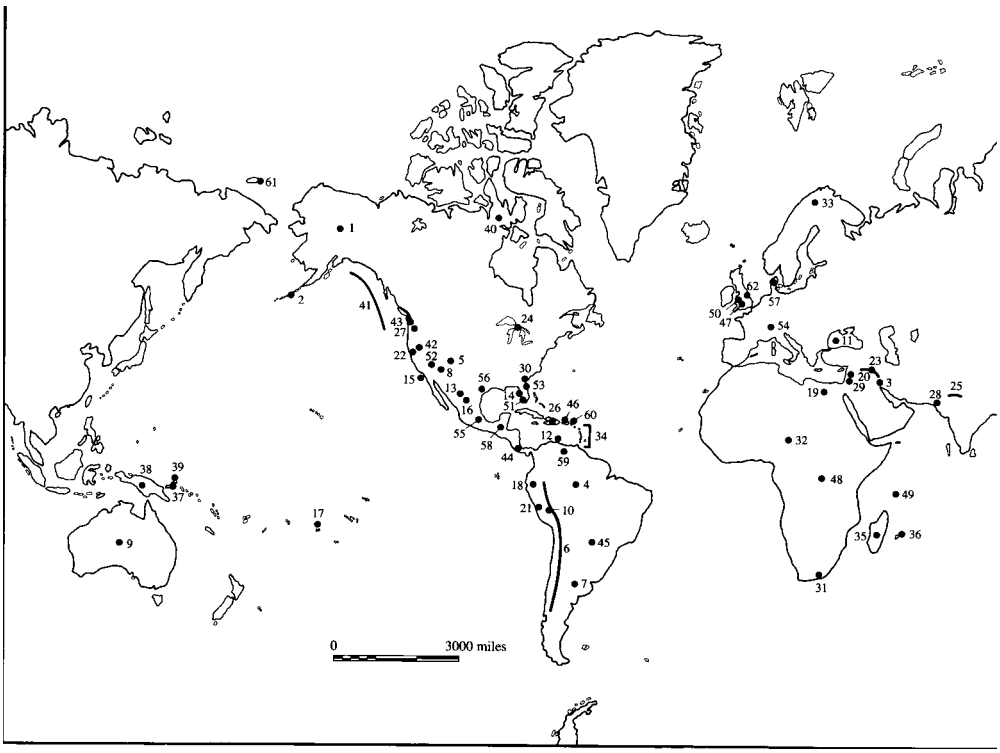

FIGURE 1.1. Locations mentioned in the text. 1. Alaska, USA; 2. Aleutians, Alaska, USA; 3. Ali Kosh, Iran; 4. Amazon Basin; 5. Anasazi, Colorado, USA; 6. Andes, western South America; 7. Argentina; 8. Arizona, USA; 9. Australia; 10. Ayacucho, Peru; 11. Black Sea; 12. Bonaire, The Netherlands Antilles; 13. Casa Grandes, Chihuahua, Mexico; 14. Cedar Key, Florida, USA; 15. Channel Islands, California, USA; 16. Chihuahuan Desert, USA and Mexico; 17. Cook Islands, Polynesia; 18. Ecuador; 19. Egypt; 20. Ein Mallaha, Isreal; 21. El Paraiso, Peru; 22. Emeryville, California, USA; 23. Fertile Crescent, southwest Asia; 24. Fort Michilimackinac, Michigan, USA; 25. Himalayas; 26. Hispaniola, Greater Antilles, Caribbean; 27. Hoko River, Washington, USA; 28. Indus Valley, Pakistan; 29. Jericho; 30. Kings Bay, Georgia, USA; 31. Klasies River mouth, South Africa; 32. Lake Chad, northern Africa; 33. Lapland; 34. Lesser Antilles, Caribbean; 35. Madagascar; 36. Mauritius, Indian Ocean; 37. New Britain, Melanesia; 38. New Guinea; 39. New Ireland, Melanesia; 40. northern Canada; 41. Northwest coast, North America; 42. Old Sacramento, California, USA; 43. Ozette Village, Washington, USA; 44. Panama; 45. Paraguay; 46. Puerto Rico; 47. Salisbury Plain, England; 48. Semliki Valley, Zaire; 49. Seychelles, Indian Ocean; 50. Somerset Levels, England; 51. southwest Florida, USA; 52. southwestern United States; 53. St. Augustine, Florida, USA; 54. Swiss Lake sites, Switzerland; 55. Teotihuacan, Mexico; 56. Texas, USA; 57. Troldebjerg, Denmark; 58. Uaxactun, Guatemala; 59. Venezuela; 60. Virgin Islands; 61. Wrangel Island, Russia; 62. York, England.

The modern derivatives, such as *zooarchaeology*, *zooarchéologie*, or *zooarchaeología*, are probably the most commonly used terms in the Americas and reflect the anthropological perspective of studying animal remains from archaeological sites for information about human behavior (Bobrowsky 1982b; Hesse and Wapnish 1985:3; Olsen and Olsen 1981). Although Lyman (1982) proposes that "zooarchaeology" be confined to studies

of paleoenvironmental conditions, the term more often implies a cultural perspective rather than a zoological or ecological one (Mengoni 1988). Many workers trained in the Americas do emphasize the cultural aspects of animal remains over zoological ones and prefer to call themselves zooarchaeologists.

The term "archaeozoology" is commonly used by researchers working in Eurasia and Africa, and it emphasizes the biological nature of animal remains. Strictly interpreted, "archaeozoology" means "old zoology" or "paleontology" (Legge 1978). Although Bobrowsky (1982b) argues that "archaeozoology" subsumes both zoological and archaeological interests, it may be interpreted as the study of ancient animal remains without any relationship to human behavior (Hesse and Wapnish 1985:3; Olsen and Olsen 1981). The research of many people who prefer the term "archaeozoology" often is more biological than anthropological in nature. This name is widely recognized in the Americas both because many American faunal specialists work in Eurasia or Africa and because it appears in the title of the International Council of Archaeozoology (ICAZ).

Two other terms are occasionally used to describe the field: "ethnozoology" and "osteoarchaeology." Ethnozoology may be defined as the study of human/animal relationships from the participant's (emic) rather than from the observer's (etic) viewpoint (Vayda and Rappaport 1968:489). It primarily refers to ethnographic studies of extant interactions between humans and animals, although it once included studies of archaeological materials (e.g., Baker 1941; Cleland 1966; Gilmore 1946; Moreno-García 2004). The term "paleoethnozoology" might refer to the study of human behavior in the past using animal remains from archaeological sites, much as "paleoethnobotany" does for plants (Pearsall 2000).

Uerpmann (1973:322) defines "osteoarchaeology" as the study of animal bones from archaeological sites for their contribution to cultural and economic history. *Osteoarchaeology* appears in the title of Reed's (1963) influential article, although he uses *zooarchaeology* in the text. Osteoarchaeology implies that only vertebrate bone is studied (Olsen and Olsen 1981), and, hence, studies of invertebrates or of vertebrate structures, such as scales and teeth, might not be included. Most faunal analysts consider both vertebrates and invertebrates to be important evidence of site-formation processes, economies, and environmental conditions, so few use the term "osteoarchaeology" except in reference to the study of human osteology (e.g., Derevenski 2001).

The term "bioarchaeology" refers to the study of animal remains. In some academic traditions, bioarchaeology is a term that refers only to the study of human remains (e.g., Derevenski 2001; Larsen 1997). In others, bioarchaeology refers to all biological remains, human and nonhuman animals, as well as plants (Branch et al. 2005; Wilkinson and Stevens 2003:17). From this second perspective, zooarchaeology is a component of bioarchaeology, and, is ultimately, a discipline in environmental archaeology.

Although the discussion over a name seems trivial, and largely can be traced to the ways different languages handle compound words, it demonstrates that animal remains

are sources of both biological and anthropological data (Bobrowsky 1982b; Chaplin 1965; Grayson 1979; Lawrence 1973; Lyman 1987; Ringrose 1993; Uerpmann 1973). In many ways, emphasis on either biological or anthropological questions reflects the variety of roles played by animals in human lives and the diversity of information provided by animal remains from archaeological sites – not all of which are pursued by every researcher. Depending on the specialist's training and interests, the nature of the archaeological deposit, and the research objectives of the project, faunal analysis may include all vertebrate and/or invertebrate classes, or focus only on one taxonomic group. Hair, horn, feathers, hide, scales, feces, blood residue, DNA, stable isotopes, trace elements, insects, mites, or egg shells recovered from archaeological contexts may be central to a faunal study, occasionally examined, or ignored altogether. Using animal remains, one may explore urbanization, bioturbation, nutrition, predator–prey relationships, settlement patterns, social boundaries, meat exchange, domestication, faunal successions, ritual, animal husbandry, or human-induced climate change. Such differences are reflected in the names applied to the field.

In essence, zooarchaeology and archaeozoology are alternate ways to view the same materials. It is not so much that the perspectives of anthropology, archaeology, biology, classics, ecology, geography, history, or the humanities dominate a study, but rather that they be integrated. An anthropological analysis of animal remains begins with a sound biological foundation, but we must always be aware of the human context of the materials studied. Hence, "zooarchaeology" is used throughout this volume. The field is strengthened by the diverse interests subsumed under this name, including some that are traditionally viewed as biological or historical. Most faunal analysts do not find these perspectives mutually exclusive. They recognize that humans respond to the same biological requirements governing the behavior of other organisms and that these responses influence cultural institutions. Humans alter the world around them, as do other organisms. At the same time, faunal assemblages reflect cultural systems from economic institutions to ideology. These must not be exclusive research perspectives (e.g., O'Connor 1996). The integration of all facets of animal remains enlivens the field and is fundamental to its intellectual health.

The biology/anthropology dichotomy has another facet that has an impact on the relationship between zooarchaeology and archaeology. Although zooarchaeologists recognized long ago that animal remains in archaeological sites are artifacts that passed through the "cultural filter" (Daly 1969; Legge 1978; Reed 1963:210; Uerpmann 1973), some archaeologists distinguish between "artifacts," which are modified by humans, and "ecofacts," which are culturally relevant nonartifactual materials (Binford 1964; Shackley 1981:1). To separate the consequences of human behavior from natural phenomena, it is critical that the *artifactual* nature (the cultural context) of animal remains be appreciated (Daly 1969; Legge 1978; O'Day et al. 2004). Biologists and paleontologists recognized the artifactual nature of unmodified as well as modified animal remains in

archaeological contexts more quickly than did archaeologists (e.g., Weigelt 1989). Some animals are considered inedible. Others are important as sacrifices, but would never be eaten and their remains would not be used to make ordinary tools. In some cases, these classifications have little to do with the local abundance of the resource or its nutritional value, though they may have an ecological basis (Harris 1974). Even those animals present in a faunal assemblage without human intent reflect human behavior because hedgerows, attics, and gardens are important animal habitats. The animals, for whom human behaviors unintentionally create such habitats, offer a wealth of information about the built environment, though their usefulness as a source of information about the *natural* environment may be limited. As zooarchaeologists increasingly contribute to conservation management decisions, this cultural context needs to be recognized.

THE INTERACTION OF HUMANS AND ANIMALS: THE MANY USES OF ANIMALS

The primary purpose of zooarchaeological research is to learn about the interactions of humans and animals and the consequences of this relationship for both humans and their environments. Most animal remains are the result of complex human and nonhuman behaviors with resources in the environment, cultural perceptions of those resources, and the technological repertoire used to exploit them. On the one hand, exploration of change in human societies is one of the most common areas of zooarchaeological research, but many geological, biological, and historical factors may be responsible for such changes. On the other hand, stasis is a common feature in the zooarchaeological record. Explaining cultural change and continuity is complicated by those interactions, and it is important to consider the many uses of animals and the diverse paths over which animal remains travel to become part of the archaeological record. This is what Reed (1963) meant by the "cultural filter." Zooarchaeologists may find evidence of these uses hard to define, but doing so is an important component of zooarchaeological research.

One of the most fundamental uses of animals is to meet nutritional needs. This is the foundation of subsistence strategies and eventually of economic and other cultural institutions. Associating animal remains recovered from archaeological sites with nutrition is one of the primary goals of many zooarchaeologists. Some of these uses leave ambiguous archaeological evidence. For example, salt fish may leave little evidence for fish consumption at the recipient end of a trade network, and the purchase of meats from markets may be invisible at a residential site. Viscera, brains, and eggs are used for food but leave little evidence of their use. Antlers, often interpreted in terms of tools or ornaments, are ingested for medicinal purposes in many parts of the world today. Ethnographic observations, as well as coprolites (paleofeces), indicate that what is edible, and what is not, cannot be assumed (Price 1985; Sobolik 2007; Szuter 1988, 1994; Weir et al. 1988).

Much of an animal's carcass may be used for nonnutritional purposes. Wool, hair, and hide provide clothing, shelter, carrying devices, cordage, watercraft, traps, and other tools. Some elements may be used as tools after their food value is depleted, and others, such as a clam shell, may be more highly valued as raw material for tools and ornaments than as food. Oils, fats, gelatin, and glue are important by-products, but the activities related to extracting them may be difficult to distinguish from other processes (Mulville and Outram 2005; Schmid 1972:46–9). Manure may be used as fuel, building material, or fertilizer. Many of these uses leave little or no archaeological evidence. They are, however, important in the relationship between humans and the environment, as well as in the formation of the archaeological record.

Domestic animals are widely used as work animals. Their labor is important in trade and tilling fields, and they sometimes serve guard duty. We tend to think of dogs (*Canis familiaris*) in this role, but birds, such as the double-striped thick-knee (*Burhinus bistriatus*), (Reitz and Cumbaa 1983; Thomson 1964:816) and geese (e.g., *Anser anser*) provide alarms, too. Animals are used for hunting (dogs), gathering truffles (pigs [*Sus domesticus*]), and fishing (cormorants [Phalacrocoracidae]). Animals may be so valuable in these roles that they are not slaughtered until they are very old, if at all, and their remains may not be discarded in locations commonly excavated by archaeologists (e.g., Payne 1972a).

Animals are used to signify cultural attributes, such as social affiliation and belief systems. Symbolic associations may either mean that an animal is represented in a faunal assemblage for nonnutritional and nontechnological reasons, or mean that the animal is absent from the faunal assemblage even though it was culturally important. Many people keep animals as pets (Gade 1977; Redford and Robinson 1991; Serpell 1986, 1989). The animal, parts of the animal, or images of the animal may be kept so that the individual, household, or community will be associated with its special powers. Bones from a rabbit's foot (Lagomorpha) could be skinning refuse, but they might be from a charm. Cattle astragali may be gaming pieces, butchering refuse, or ritual sacrifices. Many ceremonies use animals to symbolize social structure and shared values.

REQUIREMENTS FOR THE STUDY OF ANIMAL REMAINS

The study of animal remains from archaeological sites requires a sound biological foundation. Without this background, the faunal study is, at best, incomplete and, at worst, inaccurate. Such knowledge begins with basic biological and ecological concepts. This includes skeletal biology and morphology of tissues, such as teeth, bone, shell, and crustacean exoskeleton usually recovered from archaeological sites. Taxonomic classifications, such as those in Table A1.1, are not static. Therefore, it is necessary to be familiar with current systematic classifications and the basis for those classifications.

It is important to be familiar with animal behavior and ecology, especially with those concepts related to predator–prey relationships, biogeography, ecosystems, population ecology, and the habits and habitats of the animals with which humans interact (Tchernov 1992a).

Components of a Study

Inadequate attention to the biological component of animal remains hampers interpretations of such data in terms of human behavior. All zooarchaeologists can cite cases where inattention to biological details undermines conclusions. For example, failure to know the zoogeographic history of Eurasian rats (*Rattus norvegicus* and *R. rattus*) may mean that the significance of these species if they are found in an archaeological sample deposited in the Americas prior to European colonization will go unrecognized. Our current understanding is that members of the genus *Rattus* were introduced into the Americas by European expansion (Armitage 1993). Therefore, a *Rattus* identified in the Americas means that the archaeological context was deposited after A.D. 1492, the rat was in an intrusive context, or the attribution is incorrect. Similar knowledge of the zoogeography of the turkey (*Meleagris gallopavo*) enabled the identification of an intrusive deposit in Egypt (Gautier 2005).

Consideration of site-formation processes and excavation procedures is equally important for an adequate interpretation of animal remains. The taphonomic history of a site may introduce or remove animal remains and is an important contributor to the final character of archaeological deposits. Human disposal patterns, the function and structure of the site, and archaeological techniques all have an impact on faunal composition.

The complexity of the relationship between humans and their environments requires pursuit of numerous lines of inquiry using techniques that do not mask or skew the evidence and that are appropriate to the research questions. Many zooarchaeological techniques originate in biology and geology. Additional techniques develop as the need arises and are then applied in other situations. All techniques have strengths and weaknesses that should be considered before they are applied to faunal studies.

After assessing the history of the assemblage and recording the biological data, researchers interpret the results using information from many sources. This is especially true when data can be subject to several interpretations. Support for each hypothesis should be derived from several lines of evidence (e.g., Kislev et al. 2004). This includes multiple faunal data sets, but also ethnographic analogy, modern experimental studies, and the cultural contexts of the materials. Ethnographic analogy is widely used in archaeology to broaden our horizons about the ways humans and animals

interact and the consequences of those behaviors (Hudson 1993; Wylie 1985; Yellen 1977a: 4–5). Experimental and ethnoarchaeological studies contribute to our understanding of depositional, spatial, temporal, and social factors that might have an impact on archaeological deposits (Brain 1981; Gifford-Gonzalez 1989; Kroll and Price 1991). The cultural context of an assemblage is critical in the interpretation of archaeological data because activities involving animals are quite different depending on whether the context excavated is a temple, midden, house, storage structure, or kill site. Cultural institutions are involved in storage, resource control and exchange, warfare, wealth, kinship, and ritual aspects of animals. Additional information may come from petroglyphs, figurines, murals, written records, or other archaeological artifacts.

Terminology

Zooarchaeologists use a great many names and abbreviations (Casteel and Grayson 1977; Lyman 1994a). This large nomenclature creates confusion but some terms need to be defined in this volume. In the following presentation, a "specimen" is an isolated bone, tooth, or shell (Lyman 1994b; Shotwell 1958). The term "element" refers to a single complete bone, tooth, or shell. A "specimen" is either a complete bone, a tooth, or a shell or a portion thereof. If a specimen is complete, it is an "element," and if it is broken it is a "fragment of an element." This same concept may be applied to complete or broken molluscan valves and crustacean carapaces. Elements rarely are found in archaeofaunal samples; fragmentary specimens constitute most of an archaeofaunal sample. "Samples" contain multiple faunal specimens of various taxa that presumably had some relationship before excavation began. A sample is contained within an individual collection container from a unique archaeological provenience or context identified and segregated in the field. All samples from a single time period from a single site comprise a "collection." Many sites have multiple occupations of different time periods. These represent an "assemblage."

Systematic relationships are valuable tools in communicating clearly which species or other taxonomic levels are under discussion (Gentry et al. 2004). Scientific names, as well as their related common or vernacular names, are usually used by zooarchaeologists with precise meanings in mind. By following a standard systematic scheme, most zooarchaeologists understand what their colleagues mean in their choice of scientific and common names. Domesticated members of the family Bovidae, however, are an exception to this because common English terms are not directly related to taxonomy. Strictly speaking, only female members of the species *Bos indicus* and *Bos taurus* should be called cows, but the term is often used in reference to male bulls and castrated steers as well. However, the term "cattle" may be used to encompass all domestic members of

this family, including neat cattle, such as goats (*Capra hircus*) and sheep (*Ovis aries*). In the following pages, the term "cattle" refers only to *Bos taurus, B. indicus*, and their hybrids. When other members of this family are meant, other terms are used.

CONCLUSIONS

Zooarchaeologists explore many exciting topics. One of these is the use of resources by human populations and the common threads that run through the diverse adaptations that humans and their animals made to different environments. Another is the integration of plant, animal, human, and geological evidence into a holistic understanding of the human past. Others explore animals in nonfood roles, such as raw materials and social identity. Biological research, especially that focusing on the evolutionary history of landscapes and animal populations, engages many zooarchaeologists. In the following chapters, we introduce the concepts on which such studies are based, the biological basis for zooarchaeological procedures and interpretations, the methods by which these are applied to animal remains from archaeological sites, and some of the interpretations that may be developed.