Zooarchaeology

Taxonomic Identification of Zooarchaeological Remains

By R. Lee Lyman

Identification, Classification and Zooarchaeology (1992)


INTRODUCTION

Animal remains recovered from archaeological sites are today often used to address one or more research questions. Further, in the last several decades those who study faunal remains have learned which questions can be answered and which cannot given the vagaries of taphonomic histories (Lyman 1994). The development of what is generically referred to as faunal analysis reached the point some years ago that demanded it be given a unique name. Europeans often refer to it as archaeozoology. Americans often refer to it as zooarchaeology. Irrespective of what it is called, the analytical focus is on the zoological remains found in archaeological contexts. Stanley J. Olsen's (2000) recent retrospective on the history of the field prompted this review of two articles that speak to what he characterized as the "first important step toward faunal analysis"—the taxonomic identification of the faunal remains, a topic on which Olsen has
written significant papers and monographs for forty years.

Much like the analysis of other archaeological materials, such as the determination of a style of pottery or the type of a projectile point, faunal analysis begins with the identification of the skeletal element and the animal taxon represented by each individual specimen. The research questions the analyst wishes to answer dictate the other kinds of data that are recorded for each specimen, and also dictate which of the myriad analyses available are to be performed. The point here is the importance of those first bits of data to be recorded on each specimen—the skeletal elements and the biological taxon represented. This topic has seen minimal coverage in the recent literature; Driver's (1992) and Gobalet's (2001) are virtually the only discussions published over the last decade. Reading them, particularly the latter, gives one the distinct impression that zooarchaeology produces unreliable—do we get the same answer if we measure something twice—and invalid—are we measuring what we hope to measure—results. To ascertain why this might be so, I first outline a brief history of taxonomic identification in zooarchaeology, then I discuss basic taxonomic identification procedures. I next consider how taxonomic identifications are reported by paleontologists and by zooarchaeologists before concluding with a consideration of the main points of Driver's and Gobalet's articles.

Identification to Taxon: History

In the early days, those who made the taxonomic identifications of archaeological remains were zoologists or paleontologists who had the requisite anatomical knowledge as well as access to comparative collections (Gilmore 1946; Merriam 1928; White 1952, 1953, 1956). It is therefore perhaps not too surprising that some of the earliest literature on archaeological faunal analysis comprises identification keys intended for use by osteologically naive archaeologists (Brainard 1939; Lawrence 1951). The production of such keys and guides virtually became an independent industry in the 1960s and 1970s as the analytical value of faunal remains came to be more fully understood and more archaeologists attempted to make their own identifications (Brown and Gurtason 1979; Gilbert 1973, 1980; Gilbert et al. 1981; Hargrave 1970; Kasper 1980; Lyman 1980; Mundell 1975; Olsen 1960, 1964, 1968, 1972a, 1972b, 1979; Sandefur 1977; Schmid 1972; Smith 1979). That publishing industry has allowed a bit since 1980, but guides that provide general osteological descriptions of multiple taxa (Hillson 1986, 1992) and guides that provide very detailed descriptions of a limited number of taxa continue to be published (Balkwill and Cumbaa 1992; Cannon 1987; Ford 1990; Morlan 1991; Pacheco Torres et al. 1986). In addition, popular guides such as Gilbert's (1973) have been revised (Gilbert 1980) and reprinted (Gilbert 1990). What might be considered the first textbook on zooarchaeology concerned virtually only the identification of mammal remains (Cornwall 1956). The second such book was half as long as the first, and devoted one of ten chapters to identification procedures (Chaplin 1971).

The published literature suggests much about the history of zooarchaeology. First, we had to determine what we were looking at; that is, we had to learn how to identify the faunal remains recovered. That now seems to be a rather dead topic (so pun intended) as recent textbooks hardly mention taxonomic identification as a significant issue. The space devoted to the first and most fundamental step of zooarchaeological research—taxonomic identification—has come to occupy an average of less than 5 percent of zooarchaeology textbooks (Davis 1987; Hesse and Wapnish 1985; Klein and Cruz-Uribe 1984; O'Conner 2000; Reitz and Wing 1999). It is perhaps no wonder that Gobalet (2001) found the results that he did (see below).

Identification Procedures

The basic task of "identification" involves determining the taxon of an animal represented by a bone, tooth, or shell. This in turn demands that one first determine which skeletal part is in hand if the identification is to be at a more discriminating level than, say, taxonomic order. Thus, a basic familiarity with skeletal anatomy is required to make a taxonomic identification at the family, genus, or species level. Further, the person doing the identifications must be able to distinguish intertaxonomic variation from intrataxonomic (individual) variation within the species level of the taxonomy. Failure to make such a distinction can result in an incorrect species identification of a bone or tooth; recognition of an inability to make the distinction often results in an identification of a specimen to only the family or genus level rather than the species level.

There is a way to ease the job of identification. First, consult biological listings of taxa in the area where the collection originated. Numerous lists are available for groups at general taxonomic levels such as mammals, and typically these are variously restricted geographically to a continent, a physiographic region, or a political unit such as a state or country. Consulting these lists allows one to become familiar with the taxa present in the area. And, it will provide a guide as to which comparative materials to consult during the second phase, though most analysts realize both that the distributions of many animal taxa have not been static over time and that some taxa are now extinct and may therefore not be included in lists of modern taxa. In some cases looking beyond the list of taxa historically documented in an area has resulted in the identification in archaeological
collections of new, unique species previously unrecognised because they are historically extinct (e.g., Mead et al. 2000). Thus, one may also want to search zoological and pertinent palaeobiological reports from the area for any unusual taxa.

To distinguish intertaxonomic from intrataxononomic variation one should follow two steps, though the first can be skipped. The first step involves consultation of a published guide or key, and the second step involves comparison of archaeological specimens with specimens of known taxonomic identity typically housed in museums of natural history. The first step often produces tenous results because the illustrations of bones and teeth in published guides and keys show an average specimen, often in only one or two views and at a scale that is difficult to translate to an actual specimen. The result is that not only is intertaxonomic variation difficult to ascertain, but individual variation is masked. This does not mean that illustrated keys should not be consulted, but rather it means that only infrequently will a good match be found between an archaeological specimen and an illustration. Verbal descriptions are sometimes included with illustrations; these are often helpful because they highlight the taxonomically diagnostic features (not always indicated on illustrations). Rarely is the range of variation observed across multiple specimens of a single taxon (particularly of different sexes and age classes) described in published keys and guides.

Zooarchaeologists may quibble over analytical methods and their implications, but they speak with one voice when it comes to taxonomic identification of faunal remains. The best way to identify bones, teeth, and shells, is with a comparative collection. Such collections often contain skeletons of multiple individuals of varying sex and ontogenetic age (growth and development). The procedure is simple. Compare the taxonomically unknown archaeological specimen with comparative specimens of known taxonomy until the best match is found. Often the closest match will be obvious, and the unknown specimen is "identified" as belonging to the same taxon as the known comparative specimen. The more taxa represented in an archaeological collection, the more variables the zooarchaeologist must consider and the larger the comparative collection required to identify specimens. In general, the larger the archaeological collection, the more animal taxa will be represented, save in those rare cases when a collection represents a kill site, such as the well-known bison-kill sites common in the Great Plains of North America. Irrespective of the size of either the comparative collection or the archaeological collection, there will always be fragments of bones and teeth and shells that cannot be identified to even taxonomic family or order because the specimens do not retain taxonomically diagnostic anatomical characters.

The largest and most taxonomically complete comparative collections of skeletal materials are housed in natural history museums. Given space limitations, sometimes a single individual skeleton (or occasionally just a skull) of a taxon will be included in these collections. Thus, multiple museums may have to be visited to learn the full extent of individual variation displayed by one or more taxa. Zooarchaeologists contend with these limitations by compiling their own comparative collections, sometimes by collecting road-kill animals, sometimes by collaborating with taxidermists, wildlife agencies, or sportsmen, sometimes by obtaining trapping or collection permits from the local fish-and-wildlife or natural-resource agency. Here, there is no right or wrong way, or even any best way to build a collection (if one doesn't mind an occasional abundance of rancid tissue or foul odor).

The single caution with respect to building a comparative collection for use when identifying archaeological remains is to avoid (if possible) the skeletons of captive, especially zoo-raised or laboratory animals. Behaviors and diets affect skeletal growth, development, and final anatomy of zoo/laboratory animals which differentiate them from wild animals. Predatory domestic animals are not necessarily a different matter. Judgement as to the value of processing and storing a bulky skeleton that may have no archaeological counterpart phenotypically will need to be made on a skeleton by skeleton basis.

**Taxonomically Diagnostic Characters**

In order to utilize a collection of comparative skeletons effectively, the analyst needs to know which anatomical characters are taxonomically diagnostic and which are not. Many of the former, especially those concerning teeth and skulls, are summarized in various biological treatises. Various taxonomically diagnostic characteristics are also verbally described and illustrated in some keys and guides. The anatomical characters used to make identifications can be conceived of as belonging to one of two types. Qualitative or morphological traits are those that are present or absent; for example, domesticated horses (*Equus caballus*) have what is known as a third trochanter on the femur whereas the femur of a domesticated cow (*Bos taurus*), although about the same size as a horse femur, does not have a third trochanter. Quantitative traits can be meristic and involve counts of anatomical structures, such as the number of each of several kinds of teeth. Horses have six upper incisors whereas cows have no upper incisors. Quantitative characters may also be metric in which case they involve the size of the anatomical structure or feature. Bones of North American wapiti (*Cervus canadensis*) are noticeably larger than commensal deer (*Odocoileus spp.*), but the bones and teeth of the two are virtually identical morpholog-
ically and metristically. In some cases, metric characters can be used to identify remains only statistically. The distinction of deer and waipiti remains does not require measurements of bones because there is no overlap in the size of adults of the two taxa. The distinction of teeth of the several species of woodrat (Neotoma spp.) present in western North America does require such measurements (Harris 1984), and even these sometimes do not allow the identification of the species represented but rather only the genus because tooth sizes of the several species are indistinguishable statistically (Grayson 1983).

Experience may be the best teacher in terms of the taxonomic level to which the identification of a particular specimen can confidently be taken; this is particularly so with fragments of skeletal elements, where the latter is a complete anatomical unit such as a third lower molar, or a humerus or a fifth lumbar vertebra. Palaeoecologists recognized early on that many vertebrate skeletal remains could only be identified to the species level and not to the subspecies level (Fedele 1964; Taylor 1957). The finest level to which an identification can be taken will depend on a number of things, including the bone or tooth represented, whether the specimen is anatomically complete, and whether there are multiple taxa with similar skeletal or dental anatomies in the spatio-temporal context of the collection. For example, in the northeastern region of the United States, there are two species of small, wild cats—the bobcat (Lynx rufus) and the Canadian lynx (Lynx canadensis). The two are congeneric and very similar in size. Unless one has the base of the skull or a particular portion of the palate, the remains of the two species cannot be readily distinguished. Based on a sample of comparative materials from the Pacific Northwest that I have measured, an identification could be made if a complete lower first molar were the archaeological specimen in question. The m1 of Lynx canadensis tends to be longer than that of Lynx rufus.

**PALEONTOLOGICAL IDENTIFICATIONS**

I am aware of very few cases in which a published incorrect original taxonomic identification is corrected in a later publication. Perhaps the best known one involves what was originally identified as a "hominoid clavicle" that seemed, on further study and comparative analyses, to represent a fragment of rib from a dolphin (White et al. 1983). This particular example undoubtedly owes its notoriety to the fact that the original identification was published in high-profile journals, both professional (Nature) and popular (Natural History), and also to the fact that the original identification suggested the particular fossil might shed light on our own (human) evolutionary history. In another example, Grayson (1977) pointed out that he had the original identification been correct, the biogeographic history of the incorrectly identified taxon would have had to be significantly rewritten. He was able to show, however, that the incorrect taxonomic identification resulted from a confusion of what was actually intraspecific variation—specifically, sexual dimorphism—with what was thought by the original investigator to be intertaxonomic variation. Discussion of a history of taxonomic identification involving fossils is worthy of mention here because it helps underscore several final points regarding such identifications.

Seventy years ago, mammalogists E. Raymond Hall (1926) studied some late Pleistocene-age faunal remains recovered from two caves in northern California and proposed that a unique subspecies of pine marten—a large weasel—(Martes canis [now Americano] noliii) existed in western North America prehistorically. A decade later he decided that what he had thought were taxonomically diagnostic features of the fossils were not sufficiently distinctive to warrant the recognition of a new type of marten (Hall 1936). In 1970 palaeobiologist Elaine Anderson (1970) studied numerous skeletons of modern North American pine martens (M. americana) and foxes (M. pennanti), another large weasel of the same genus as the marten. She also studied the fossils that Hall (1926) had examined, including a number of fossils that had come to light since his study. She concluded that there were sufficient differences between the bones and teeth of living populations and certain of the fossils to warrant assigning some of the fossil material to the noble marten. She argued that the fossil noble marten should be considered a unique species—*M. nobilis*—that was now extinct. At least thirteen palaeontological and archaeological sites in North America have produced remains that have been identified as those of noble marten (Graham and Graham 1994; Grayson 1993). Chronological data indicate that this type of marten existed from the late Pleistocene until about 3000 years ago.

Twenty-one years after Anderson resurrected the noble marten as a valid taxon, biologists Phillip Youngman and Frederick Scheeler (1991) questioned whether the fossils assigned to it in fact represented a distinct species. After comparing measurements of fossil bones and teeth assigned to the noble marten with measurements taken from a set of modern pine marten skeletons, they concluded that the fossils were in many respects so similar to the modern specimens that there was little reason to assign the fossils to a distinct species. The only difference was one of size, and that criterion, they argued, was a poor one for designating a distinct species. Within three years, Anderson (1994), palaeobiologist Russell Graham (and Graham 1994) and zooarchaeologist Donald Grayson (1993) argued that the noble marten did in fact warrant recognition as a separate species not only because of its
distinctive size but because of the distinctive shape of its teeth.

The major difficulty in identifying fossil remains of the genus *Martes* as representing the noble marten resides in the fact that this taxon's definitive criteria have been extracted from fossils of unknown taxonomic affinity in comparison with modern bones and teeth of known taxonomic affinity. Anderson (1970) and Youngman and Schaefer (1991) measured bones and teeth of modern martens and fisheaters and then compared those measurements to fossil remains. If the differences between the larger and the two modern taxa were sufficient, then a new taxon was said to have been identified. If the differences were minor, then a new taxon was argued to be not evident. The problem, then, reduces to two issues: (1) the nature of the comparative materials used to establish the morphometric boundaries of the two known taxa, and (2) a rule dictating how much and what kinds of difference must be observed between bones and teeth to indicate separate taxa. With respect to the first issue, Anderson, and Youngman and Schaefer, measured different modern specimens, so it is not surprising that their results differ. The literature therefore does not provide a consistent set of definitive criteria that must be displayed by a prehistoric specimen of *Martes* for it to be assigned to the noble marten. Until such time as these kinds of data are available, debate over whether the noble marten really existed will continue.

With respect to the second issue, the general rule palaeoecologists use to dictate how much and what kinds of difference must be observed between bones and teeth to indicate separate taxa is based on observed differences in modern taxa. If an average modern pine marten and an average modern fisher differ 10% in size and in the shape of various teeth, then an extinct species of *Martes* should differ from them to the same degree and in the same way. Regardless, the important lesson of the noble marten in the context of this discussion is a simple one: The establishment of morphometric criteria definitive of a taxon—whether extinct or extant—depends on the comparative materials examined.

**Reporting Identifications**

The lesson of the noble marten is neither an isolated nor a unique case within palaeontology (see, for example, the discussion in Graham 2001; Mead and Spier 2001; Mead et al. 2000). Perhaps because palaeoecologists often deal with extinct taxa, their reports typically include detailed presentations of the anatomical features used to ascribe the fossil specimens to taxon. Exemplary studies include Guilday et al. (1978). Of course, unless such lengthy descriptive data are critical to the hypothesis or question being addressed (e.g., Guilday and Parmalee 1972), they will likely not be published in a journal article today. Although detailed descriptions of the anatomical criteria used to identify archaeofaunal remains are sometimes included in published archaeological reports (e.g., Grayson 1983), this seems to be more than an exception than a rule. One recent study that provides a good model for reporting and publishing sufficient, if not lengthy, information on identification procedures and taxonomically distinctive criteria is provided by Brougham (1999).

Because various interpretations of archaeofaunal remains rest on the taxa identified, it is important that the anatomical features used to make identifications be summarized in data-rich reports such as the familiar site report. These descriptive data can then be left out of published papers that summarize research findings if, and this is important, the original descriptive report containing discussion of the procedures and criteria used to make the identifications are summarized. What is truly unfortunate is when the descriptive reports do not contain information on the procedures and criteria, and taxa that are biogeographically unusual or palaeoecologically significant are said to have been identified. There is no way to evaluate the identification and thus no way to assess the biogeographic or palaeoecological significance of the identified specimen(s). An example may help make this clear.

In the Pacific Northwestern United States where I work, the single terminal Pleistocene archaeofauna that has been studied is said in an unpublished descriptive report to contain the remains ofundra voe (Microtus oeconomus) and lynx. On the one hand, the latter is today found no closer than 75 km away, a perhaps palaeoecologically insignificant distance were it not for the significant environmental differences between the setting of the archaeological site and the setting of the closest modern record of lynx. The closest record of modernundra voe, on the other hand, is 2400 km away! Not only is that an incredible biogeographic distance but it is a palaeoecologically significant distance as well. Unfortunately, in the case of both taxa the anatomical criteria used to make the identifications are not reported, and thus I am hesitant to accept the identifications as valid.
itia, Microtinae, and Microtus montanus comprise. Otherwise, the taxonomic identification procedure one uses can involve several different independent steps as well as varied independent criteria. For example, Driver notes that we often use the geographic and temporal context of a faunal specimen to help identify the taxon. This is so because, for example, pronghorn antelope (Antilocapra americana) only occur in portions of western North America; they are not known to occur naturally in the Old World. Thus, as noted above, we consult lists of taxa local to the area from which an archaeofaunal collection derives.

In my view, the most important point Driver (p. 39) makes is that many zooarchaeologists implicitly assume that our "methods for [taxonomic] identification are sufficiently well tested that one does not need to justify most [such] identifications, except in relatively rare circumstances." In particular, he notes that "we do not systematically test the quality of our identifications using 'blind' tests" and thus zooarchaeologists "have no empirical or theoretical basis" for the claim that their taxonomic classifications are correct (p. 40-41). I disagree with the latter in two ways. First, organisms of the same species share many genes, given modern Darwinian evolutionary theory, and that comprises the theoretical basis of our identifications. Second, the empirical basis of our identifications rests on visual comparisons of the archaeological unknowns with comparative knowns, whether the latter derive from illustrated keys or skeletons in natural history museums. As noted above, zooarchaeologists prefer the latter, particularly those with multiple specimens of each taxon so as to better visualize—empirically—intertaxonomic and intrataxonomic variation. Nevertheless, I agree with Driver's (p. 45) conclusions that we must (1) make our identification procedures and the criteria used explicit and (2) perform blind tests of those procedures and criteria. The first is what I noted in the preceding section. The second is a sound scientific idea because no comparative collection or several combined comparative collections is likely to contain all of the possible intrataxonomic and intertaxonomic variation possible. Blind testing is the subject of Gobalet's discussion.

Gobalet makes many of the same points suggested above. He notes, for example, that often there is no indication in an archaeological publication "of the criteria [used] for the [taxonomic] determinations" and implies this is a particularly pernicious problem in top-notch journals such as Science (p. 377). I suspect Gobalet is unaware of the fact that such data is presently perceived by most editors as merely descriptive and insignificant if not unimportant. It therefore does not warrant the cost (both monetary and page space) of publication, just as every identification of a rock specimen as granite or schist or basalt by a geologist does not require description of the various definitive criteria of a particular lithic type that are displayed by the specimen under consideration.

Gobalet had four zooarchaeologists identify the same sample of fish remains recovered from an archaeological site. In a sense this is a double-blind test because no one, not even Gobalet, knows the correct taxonomy of the remains; thus all four individuals could be equally incorrect in their identifications, but in widely different ways. The number of specimens identified by the four individuals ranged from 53 to 69; the number of species identified ranged from 4 to 18. Both results are rather disconcerting, but even more surprising is the fact that Gobalet really has no idea why these discrepancies occurred. All he can suggest is that those discrepancies "might result from [differences between] the educational or experiential background" of the four individuals who conducted the identifications (p. 384) and that "problems with comparative collections may explain some discrepancies" (p. 385).

Having identified archaeofaunal remains from five states over the past 25 years, I believe that I improved with more experience. I also know that the more extensive the comparative collection(s) at my disposal and the more variation in the archaeological collection under study, the less sure I became of the possibility of some potential identifications I might make and the accuracy of some previous identifications I have made. That, however, seems to me to be the nature of the beast (keeping this faunal) we all call science. Gobalet suggests that individuals who specialize in a particular taxonomic group and geographic area, and who have much experience in both should make taxonomic identifications. As an instructor I perceive this to be a "Catch-22"—to gain experience one must do some identifications, but if only experienced individuals make the identifications, how are they to gain their experience? I work closely with my students, teaching them how to identify bones, checking and correcting their identifications before they are written up. In addition, my students learn to report the procedures and criteria used to make the identifications. This is the way most zooarchaeologists in teaching positions I know operate.

The taxonomic identification of faunal remains is the most fundamental first step of zooarchaeology. If it is flawed, then it is likely that all that follows is to some degree flawed. As Driver and Gobalet before me, I strongly suggest that zooarchaeologists make explicit the procedures and anatomical criteria they use to make their taxonomic identifications. Blind tests using specimen of known taxonomic affinity would serve a useful purpose if we knew why particular identifications are in error (inadequate comparative collection) and how they are in error (identified as incorrect genus, or species identified when identification to genus level is finest practical level). Even without such tests, zooc-
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