HISTORIC AND PREHISTORIC ANIMAL PATHOLOGIES FROM NORTH AMERICA

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Summary

Although animal pathologies are recognized as a potential source of information to North American archaeologists, this subject has gone virtually unused. In this paper, we address why this information has not been used, and present a comparison with archaeological data gathered over the past six years. A survey of over 400,000 specimens from the United States was made seeking evidence for paleopathologies. Seventy-five pathological specimens were found among a subsample of 260,475 specimens. Pathologies were rare in this subsample (<0.03%). Of the disorders observed, frequencies and types of ailments differed between animal types. However, results indicated that the recovery of pathological specimens is tied closely to taphonomy and even then, correlation of disorders with human activity was uncommon.

Résumé

Pathologies animales historiques et préhistoriques d'Amérique du Nord.

Bien que les archéologues nord-américains reconnaissent que les pathologies animales offrent une source potentielle d'informations importante, celles-ci ne sont que rarement utilisées. Dans cet article, nous verrons pourquoi il en est ainsi, et présenterons les données archéologiques recueillies durant les six dernières années. Plus de 400 000 spécimens provenant de sites des États-Unis ont été examinés à la recherche de paléopathologies. Sur un sous-échantillon de 260 475 os, seuls 75 (< 0,03 %) présentaient des pathologies. Les fréquences et les types de modification observés variaient selon les espèces animales. Cependant, nos résultats indiquent que la découverte de spécimens pathologiques dépend étroitement de la taphonomie, et qu'une corrélation entre ces anomalies et des activités humaines est difficile à confirmer.

Zusammenfassung

Pathologie von Tieren historischer und prähistorischer Zeit in Nordamerika.

Obwohl die Krankheiten von Tieren von nordamerikanischen Archäologen durchaus als mögliche Informationsquelle anerkannt werden, ist dieser Bereich bisher kaum berücksichtigt worden. In diesem Beitrag wird gezeigt, warum diese Informationen bisher nicht genutzt worden sind. Außerdem werden Daten vorgestellt, die in den vergangenen sechs Jahren gesammelt wurden. 400.000 Knochen aus den USA wurden nach pathologischen Verändetungen durchgesehen. Nur an einigen Fundstellen mit zusammen 260.475 Knochen konnten insgesamt 75 Exemplare mit pathologischen Veränderungen festgestellt werden. Sie machen damit weniger als 0.03 % aus. Die Häufigkeit und Art der Krankheitsbilder ist von Tierart zu Tierart verschieden. Außerdem deutet sich an, daß die Möglichkeit, Pathologien nachzuweisen, eng mit der Taphonomie der Knochen zusammenhängt. Einflüsse menschlicher Aktivitäten konnten nicht nachgewiesen werden.

Key Words

Vertebrate Paleopathology, Taphonomy, North America.

Mots clés

Paléopathologie des vertébrés, Taphonomie, Amérique du Nord.

Schlüsselworte

Paläopathologie, Vertebraten, Taphonomie, Nordamerika.

Introduction

Despite earlier works calling specific attention to pathology in archaeozoological samples (Brothwell, 1969; Siegel, 1976; Baker, 1978; Baker and Brothwell, 1980), little attention has been given to the subject, especially in North America. Until more animal paleopathological information is published, it will be difficult to approach the topic systematically (Chaplin, 1971: 117; Baker and Brothwell, 1980: v). Studies of modern animal disease and improved equipment and techniques for its study were hoped to improve our understanding of animal paleopathologies (Baker and Brothwell, 1980: 207; Rothschild and Martin, 1993: 3). Since 1980, increasing research has focused on areas of human paleopathology in Prehistory and the technology and techniques for identifying these conditions, though little work has been conducted on animal paleopathology. It was under these parameters that the research presented here was started six years ago. Each archaeozoological sample that we analyzed included descriptions of any pathologies present. As the work continued, however, it became clear why this information is rarely reported.

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Animal paleopathological information has not been included in most archaeological reports for several reasons. The first is due primarily to a lack of training among archaeozoologists in medicine, veterinary science, or veterinary pathology. Additionally, once a disorder is encountered, archaeozoologists are often not familiar with proper descriptive nomenclature (Baker, 1978: 107). Without the proper background, archaeologists have hesitated to describe conditions that they recognized as abnormal (Baker and Brothwell, 1980: v). Secondly, animal pathologies are an infrequent condition in the archaeological and paleontological records (Chaplin, 1971: 108; Baker and Brothwell, 1980: 91; Hesse and Wapnish, 1985: 82). Therefore, animal paleopathology has not become a common topic of research.

Recovery of primarily isolated or disarticulated specimens, from areas such as garbage midden assemblages, further hinders the study of animal paleopathology (Rothschild and Martin, 1993: 4). As in human paleopathology, assessment of medical disorders is best conducted when an entire skeleton is present. Complete skeletal recovery allows for comprehensive analysis that may indicate that the disorders are local, regional, or systemic.

Preservation has also greatly affected the ability to recognize animal paleopathology. Non-cultural taphonomic factors such as weathering, ground compaction, breakage, carnivore and rodent gnawing, etc. will all affect bone preservation. Cultural factors such as butchering, carcass part distribution, and especially marrow and grease processing of the bone can substantially deteriorate bone condition. Thus, many disorders that were present may be less visible to researchers due to both non-cultural and cultural taphonomic processes.

There are additional reasons why paleopathology has remained obscure in archaeozoology. Many pathological conditions are difficult to link positively with specific causes. Some skeletal lesions are non-specific and may be the result of one of a variety of causes or combination of causes (Chaplin, 1971: 108-109; Siegel, 1976: 349; Hesse and Wapnish, 1985: 82). Many of the researchers who have been interested in studying animal pathologies in Prehistory have had only particular interests (often not archaeological) in specific conditions (Hesse and Wapnish, 1985: 82). Even when animal paleopathology is pursued, the rates of modern afflictions in wild and domestic taxa that could be used for comparative purposes are often poorly known (Hesse and Wapnish, 1985: 82).

Lastly, the information provided by these pathological studies is primarily of natural historical interest (medical, environmental, population studies) and usually not a reflection of cultural activity. Such temporal information is helpful for studying the history of diseases, and for assessing the environments in which the animals lived (Baker and Brothwell, 1980: v). Baker and Brothwell (1980: v) felt that this information had the potential for contributing to our understanding of the relationship between humans and animals, although this potential has not been widely explored. At least one study found that certain pathologies thought to be due to human interaction are really non-cultural disorders (Rowley-Conwy, 1990). Additionally, the study of paleopathology has not provided significant useful information on human exploitation of wild animals, and only limited amounts of information on domesticated animals. Of the studies where much of this information is found, most are from the Old World.

A review of the literature on animal paleopathology as it relates to archaeology shows that these studies are conducted primarily by Old World researchers (e.g. Brothwell, 1969; Chaplin, 1971; Noe-Nygaard, 1974; Hatting, 1975; Siegel, 1976; Harris, 1977). This is probably due to the long span of human occupation in the Old World, and due to the importance of domestic taxa which are the focus of many of the studies. Most of the archaeozoology conducted in the New World deals with wild taxa and is of a short span of time compared to the Old World studies. As such, reports relating to animal paleopathology in the New World are quite rare. The focus of New World archaeozoological research also has been primarily dietary, without much consideration of animal diseases or domestic taxa. With the exception of the dog, camelids, Muscovy duck, turkey and guinea pig, most domesticated animals were introduced from the Old World where they had been domesticated, in some cases, for thousands of years. Even so, the implications of animal pathologies in relation to domestication has been overlooked (Siegel, 1976: 370).

Background

In starting this New World study, a survey of relevant New World archaeology journals was undertaken[1]. An attempt was made to review titles of all archaeozoology

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[1] Journals reviewed for references to New World Animal Paleopathology: *American Antiquity*, *Archaeometry* (after volume 14), *Artic Anthropology, Journal of Archaeological Science, Journal of Ethnobiology, Journal of Field Archaeology, MASCA Journal, North American Archaeologist, Pacific Coast Archaeological Society Quarterly* (Vols. 12-21), *Plains Anthropologist.*

articles, creating a bibliographic database. The results of this search verified the scarcity of papers centered on animal paleopathology. None of the articles was concerned directly with the animal paleopathology in the New World. One paper (Crader, 1990: 695) correlated naviculo-cuboid exostoses of cattle with use as draft animals. While showing a connection between the paleopathology and culture, the passage was only a small portion of a diet-oriented paper. Another paper by Frison *et al.* (1976: 52-53) discussed genetic abnormalities and post-cranial pathologies of bison from a kill site, although none of the pathologies discussed were correlated with human involvement.

There is little doubt that there are other examples that have been overlooked because key words such as pathology, lesion, medical disorder, etc. were not part of the article title. Much of this information also occurs in the grey literature of local society journals or in contract archaeological reports. In fact, most of the analyses that we have conducted that contained animal paleopathologies have been reported in contract archaeological reports as part of a larger faunal analysis.

Other grey literature animal paleopathology reports include an article in the newsletter *Zooarchaeological Research News* by Amorosi (1983) that included a discussion of rat paleopathology, and elsewhere avian bone disorders have been reported by Parmalee (1977) and Gilbert *et al.* (1985). Additional examples of animal paleopathology were found published in North American natural history literature (e.g. Guilday, 1961; Wing, 1965; Baker and Shaffer, 1991). Pathological data has also been found recorded in sections of archaeological reports (Wilson, 1974: 165-171), although the primary focus of these reports has been the archaeology and not animal health. Other grey information includes that of presentations. One presentation by Morey (1992) did incorporate trauma-related pathology of dogs from Greenland in relation with their Neoeskimo owners. Morey was able to correlate traumas in the skeletal remains with ethnographically recorded practices of dog-beating to manage the animals.

One unusual report ostensibly linking animal pathologies and humans in North America comes from Rothschild and Martin (1993). Here, a short-faced bear (*Arctodus simus*) was found to have treponemal infection. This specimen dated to about 11,500 bp, about the same time humans migrated into and throughout North America (Rothschild and Turnbull, 1987). Rothschild and Martin (1993: 312-314) hypothesized that the bear may have contracted the disease after eating an infected human. This finding is also unique in that it links treponemal disease in Precolumbian America, although the human/animal connection is tentative at best.

Results

One of the primary problems in the study of paleopathology is that of diagnosis. The foundation of diagnosis is detailed description (Siegel, 1976: 350; Ortner, 1994). Due to the difficulties involved in determining the etiology of pathological animal specimens from a broad range of taxa, the approach taken in this study was a descriptive one (tab. 1). This information was gathered from 1988 through 1994. From table 1, it is clear that animal paleopathologies were very infrequent with only 75 specimens being recognized out of a subsample total of 260,475 from 18 sites, although more than 400,000 skeletal elements from more than 50 sites were analyzed during this period.

Disorders were identified on all classes of vertebrates except amphibians (tab. 1). Most of these conditions appear to be of lower intensity or are chronic disorders that posed little threat to the animal. These conditions include dental disorders, fusion of non-mobile tarsals, arthritic lipping, enthesophytes, a variety of foot maladies, and hyperostoses. Surprisingly, the most common disorder recognized was hyperostosis of fish spines (including vertebral, dorsal, ventral, or pectoral spines; n = 33), although some may have been pterygiophore fragments. Wheeler and Jones (1989: 112-113) used the term "Tilly-bones" to describe hyperostosis of the fish spines. Apparently, the etiology of this condition is poorly understood. Wheeler and Jones (1989: 112-113) and von den Driesch (1994: 37-45) stated that the cause of this condition is unexplained, although von den Driesch (1994: 37-45) in her review of the condition noted that it was more prevalent in older individuals, and that locations of particular hyperostoses may be taxon specific. Additional data presented by Meunier and Desse (1994: 47-53) indicated that hyperostotic conditions are the result of osteogenesis resulting in spongy bone formation that is often rich in fat or lipids in living specimens. The actual reason for osteogenesis, however, may include ageing, genetic factors, physiological factors, and external environmental factors (Meunier and Desse, 1994: 51-52). In some species this condition is so frequent that it appears to be almost normal (Wheeler and Jones, 1989: 112) and apparently does not significantly impact the "vitality of the individual" (von den Driesch, 1994: 44). Each of the fish Tilly-bones (tab. 1) were from coastal sites and probably are marine taxa.

Other pathologies were of greater intensity or threat to the animal and include bone trauma and possible systemic disease. These specimens were few in number (n = 9). One deer humerus from 41CH70 exhibited a pseudoarthrosic joint. The humerus was broken distal to the midshaft and had never mended. Additional traumas in the form of

Site	Quantity	Taxon	Description	Context	Site/Qty	Reference
15HD249, Hardin Co. (Kentucky)	1	*Sus scrofa* (Pig)	Maxilla and associated teeth. The P1 has a carious lesion and the roots and alveolus around the roots are eroded, alveolus also shows reactive bone.	Historic	86	Shaffer (1993)
15MA179, Madison Co. (Kentucky)	1	*Odocoileus* (Deer)	Proximal phalange with hyperostosis on distal abaxial surface, ebernation on distal condyles.	Historic	34	Presley and Shaffer (1994)
41BO125, Brazoria Co. (Texas)	3	Osteichthyes (Bony Fish)	Hyperostosis of one radial. Thickening, bulbous swelling of two fin rays.	Historic	19,532	Shaffer *et al.* (1994)
	1	Rodentia (Rat-sized rodent)	Reactive bone along distal and ventral portion of metatarsal shaft, not involving articular surface.			
	2	*Sus scrofa* (Pig)	First tarsal with arthritic lipping on proximal articulation. Distal end of humerus with subperiosteal bone deposition.			
	1	*cf. Odocoileus* (Deer)	Radius with a bone spur projected laterally approximately six millimeters from the lateral margin of the midshaft.			
41CH70, Chambers Co. (Texas)	1	*Odocoileus* sp. (Deer)	Midshaft pseudoarthrosis of humerus, much hyperostosis around fracture area.	Prehistoric	968	Shaffer (1995)
41CH252, Chambers Co. (Texas)	2	*Odocoileus* sp. (Deer)	Uneven tooth wear on upper PM2 and Lower M3.	Prehistoric	17,949	Shaffer (1995)
	19	Osteichthyes (Bony fish)	Hyperostosis of spines, "Tilly bones" (Wheeler and Jones 1989: 112-113).			
41CH357, Chambers Co. (Texas)	11	Osteichthyes (Bony fish)	Hyperostosis of spines and hyperostosis of one caudal vertebra process.	Prehistoric	7,929	Shaffer (1995)
41DT11, Delta Co. (Texas)	1	Mustelidae	Carious lesion in permanent lower premolar 4.	Prehistoric	18,166	Shaffer (1994a)
	1	Artiodactyla (Deer?)	Fused 2nd and 3rd tarsal with pronounced enthesophytes.			
41EP321, El Paso Co. (Texas)	1	Artiodactyla (Deer?)	Astragalus with large enthesophyte on medial surface of proximal end.	Prehistoric	9,430	Shaffer (1994b)
	1	Mammalia (Mammal)	Caudal vertebra with arthritic lipping.			
	1	*Lepus* sp. (Jackrabbit)	Proximal phalange with hyperostosis on distal end. Distal articular surface remodeled. Dislocation?			
41GV53, Galveston Co. (Texas)	1	Sciaenidae (Fish)	Irregular thickening of ventral margin of otolith.	Prehistoric	19,023	Zimmerman (1992)
41GR474, Garza Co. (Texas)	1	*Sus scrofa* (Pig)	Two carious lesions on lower M2.	Historic	421	Shaffer (1994c)
41GR559, Garza Co. (Texas)	8	*cf. Canis lupus* (Wolf)	Two atlases, one thoracic, and one UID vertebra, one proximal phalange with arthritic lipping. One fourth metacarpal with reactive bone along its shaft. One middle phalange with a callous (healed fracture?). One scapula recovered with several enthesophytes on ventral margin.	Prehistoric	3,580	Shaffer (1994c)
41HR273, Harris Co. (Texas)	1	*Odocoileus* sp. (Deer)	Naviculo-cuboid fused to 2nd and 3rd tarsal.	Prehistoric	128,673	Baker and Shaffer (1991), Baker *et al.* (1991)
	1	*Odocoileus* sp. (Deer)	Fused proximal radius and ulna.			
41LB4, Liberty Co. (Texas)	1	*Odocoileus* sp. (Deer)	Remodeled proximal end with eroded anterior portion and hyperostosis on lateral portion.	Prehistoric	17,784	Shaffer (1995)
41SY92, Shelby Co. (Texas)	3	*Odocoileus* sp. (Deer)	Ulna with arthritic lipping on the lateral side of the proximal humeral articular surface, and enthesophytes along the lateral side of the proximal end. Distal end of humerus with bony "button" on the anterior, superior surface of the condyles. Mandible and associated teeth, each of the cheek teeth with calculus on the buccal and lingual surfaces. Below the calculus, the alveoli have resorbed approximately 2-5 mm on the lingual surface 2-3 mm on the buccal surface.	Prehistoric	1,703	Shaffer (1994d)
	1	*Terrapene carolina* (Eastern box turtle)	Healed (but not closed) puncture wound in pleurals of carapace.			
41TV632, Travis Co. (Texas)	1	*Sylvilagus* sp. (Cottontail rabbit)	First tarsal fused to second metatarsal	Historic	607	Baker and Shaffer (1994)
	1	*Gallus gallus* (Chicken)	Expansion of ulna shaft, subperiosteal reactive bone formation, hyperostosis.	Historic		
41TV633, Travis Co. (Texas)	2	*cf. Sigmodon* sp. (Cotton rat)	Right os coxa with hyperostosis around acetabulum and pubis, right femur with eroded femoral head and neck.	Historic	255	
	1	*Sigmodon* sp. (Cotton rat)	Reactive bone deposition on frontals of skull	Historic		
	1	*Ovis/Capra* (Goat/sheep)	Broken and worn lower cheek tooth	Historic		
	1	*Ovis/Capra* (Goat/sheep)	Lower cheek tooth with diseased roots	Historic	2,687	
41TV634, Travis Co. (Texas)	3	*Didelphis virginiana* (Opossum)	Ribs with healed fractures	Historic		
LA15049, Grant Co. (New Mexico)	1	Corvidae (jay)	Healed fracture in mid-blade of scapula, possible bird burial.	Prehistoric	11,648 + 23 animal burials	Shaffer (1991)
Totals:	**75**				**260,475**	

healed fractures were noted on opossum ribs and a jay scapula. An Eastern box turtle carapace was recovered that showed a partially healed puncture wound in one of the pleurals. One final case involved three rat (*Sigmodon* sp.) elements from the same provenience and probably from the same animal. A skull exhibited reactive bone on the frontals. An additional right os coxa exhibited pronounced hyperostosis around the lip of the acetabulum and a right femur exhibited atrophy of the head and neck. Combined, these specimens appear to be the result of a systemic infection and may have caused the death of the animal.

The eight wolf remains from 41GR559 (tab. 1) show a variety of maladies. A total of nine individual canids were identified from 603 canid specimens in this assemblage including three juveniles, three adults, two old adults (identified as wolf), and one individual that could not be aged (Shaffer, 1994d: 312-320). The elements were disarticulated and scattered throughout a rock shelter. The eight pathological specimens were from the old adult wolves. There is no way, however, to determine if these disorders are the result of a variety of causes, or due to a systemic disorder, correlated with the advanced age, or if they occurred in one or both of the older individuals.

A superficial examination of the data reveals that most of the conditions in the terrestrial vertebrates occur in elements associated with locomotion or dentition (tab. 1). Examples of pathologies include fusion of tarsals, arthritic lipping, enthesophytes, reactive bone, carious tooth lesions, alveolar resorption, and diseased tooth roots. These are found in various foot bones, long bones, and areas of the dental arcade. Concomitantly, these elements are more resistant to taphonomic factors, allowing them to be more commonly preserved in the archaeological record than more fragile elements.

Elements associated with locomotion undergo more stresses than other skeletal elements and therefore are denser bone. Such bone can withstand more taphonomic processes. Next, tooth enamel is the hardest substance of the animal body. Thus, if elements were going to be recovered with pathological conditions, it would be expected that they would be most prevalent in those skeletal regions that are best preserved. This is also true for the fish Tilly-bones. We identified these compact, bony masses from coastal archaeological sites with large fish samples showing good preservation. In addition, these elements (podials, phalanges, Tilly-bones, and dental elements) are not commonly consumed or processed by humans for marrow or grease. These discarded elements, then, show greater paleopathological visibility than less dense or highly processed animal remains.

Table 1: Pathologies from North America examined by the authors. To illustrate the infrequency of pathological conditions, the quantity of specimens recovered from each site is also provided.

Discussion and conclusions

North American archaeozoologists have not widely used paleopathological information for the interpretation of faunal remains for several reasons. Historically these include a lack of training, low frequency of paleopathologies often as isolated finds, non-specific or multiple etiologies, and because most of the animal paleopathological conditions were rarely archaeological issues. We conducted a six year systematic study encompassing more that 400,000 bones from more than 50 archaeological sites. We found that paleopathologies were very infrequent. In fact, paleopathological specimens (n = 75) were present in only 18 of the sites, accounting for 260,475 of the specimens. Of the pathological specimens that were recovered, most of the disorders were non-life threatening, chronic conditions that did not significantly impact the host animal (i.e. arthritic lipping, dental disorders, Tilly-bones, etc.). Some of the specimens recovered were the result of trauma, may have been life threatening, and possibly impacted the animal's behavior. These conditions include fractures (healed and unhealed) and systemic disease.

Of particular interest in our findings was that most of the specimens with pathologies were usually specimens that would be most likely to survive taphonomic conditions. These elements include phalanges, podials, dental elements, and fish spines with hyperostosis (Tilly-bones). Additionally, most of the foot, dental elements, and Tilly-bones are elements that normally would not be consumed or subjected to cultural food processing practices such as removal of meat or the processing for marrow or grease. Thus, the picture of pathologies gleaned from our samples is one that is apparently dictated in large part by cultural and natural site taphonomy. The paucity of pathological specimens in archaeological sites, however, may also be a function of the relatively infrequent development of pathological osseous elements in natural animal populations.

Finally, the most significant reason why archaeologists have been slow to incorporate animal paleopathological information into reports, especially in North America, is that the majority of pathological material (100% in our study) cannot be correlated directly with human involvement. The issue of animal health, especially for wild taxa, is more of a paleontological question, more so than archaeological. This information is important from a natural history perspective, but because it usually does not directly tie human and animal behavior, archaeologists are hesitant to pursue or publish the information. In those rare cases where a connection can be made, the information gained is often very insightful for examining the roles between humans and animals in the past.

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