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Actualistic Taphonomy of Small Mammals from Owl Pellets in South America and Its Archaeological Implication

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Abstract

Owl predation is one of the most recurring causes of small mammal (<1kg) accumulations in both archaeological and paleontological rock shelters, karstic system and open-air sites. The earliest actualistic taphonomic researches of small mammal remains have emerged in the 1970s and 1980s. However, it was not until the 1990s that a clear and analytical methodology was established, using small mammal species from North America, Europe and Africa. During the mid- to late 1990s actualistic taphonomic works began to be developed in South America, with exclusivity in Argentina and Chile. Since 21st century started to exponentially multiply the actualistic papers mostly of owls with a strict application of the taphonomic methodology. The useful of these studies in the archaeology (even paleontology) of South America also followed this growing tendency. However, since some years, it has been highlighting the disparity in the evidence of digestive action on different taxa. Thus, this methodology was recently re-evaluated considering the dentary morphology of rodents and marsupials from South America. The results achieved to date, added to what we intend to develop in the future will allow to obtain a higher level of detail and a better interpretation of the small mammal assemblages recovered from archaeological and paleontological sites of South America.

Keywords: Zooarchaeology; Strigiformes; Rodents; Marsupials; Argentina; Chile

Introduction

The small mammals (<1kg) can be deposited in archaeological record by many agents. Some which stand out are natural and/or catastrophic death and transport, human exploitation, and predation including mammalian carnivores and birds of prey [1-3]. A taphonomic perspective is mandatory in order to distinguish which of these agents were the causes of the bone accumulation [1-3]. This is because of taphonomy is the discipline that study the agents and processes involved in the transition of the organisms from the biosphere into the lithosphere [4].

Among the aforementioned agents, owl (Strigiformes) predation is one of the most recurring causes of small mammal accumulations in both archaeological and paleontological rockshelters, karstic system and open-air sites [1-3]. This is due to some species of owls (e.g. *Tyto alba, Bubo virginianus*) are very abundant, can nest and roost in rock shelters and karstic system, feed mainly on a wide range of small mammal species, and produce little modification on their skeletons [1]. This good preservation also allows in most cases their taxonomic identification. Both the taphonomic and taxonomic differentiation of these agents is interesting for zooarchaeology, because it can provide relevant information about the predator/prey interaction and about the environmental conditions at the time of the deposition of the fossil assemblage [5]. In fact, most of the small mammal species are abundant and diverse in the archaeological and paleontological records and have relatively strict environmental and ecological requirements; being frequently associated to particular microenvironments, thus, they have been widely used as indicators of paleoenvironmental conditions [1,2]. However, predators may remove microfauna (potential prey) from their original habitat and select prey by their size, behavior and, in general, hunting-diet preferences of the predators accumulating these prey (small mammal) remains in their living areas where nesting or roosting, which are the actual archaeo-paleontological sites today. Hence, a comprehensive taphonomic approach of these raptor birds is important to detect specific patterns for identifying micromammal assemblages associated with the archaeological record.

The earliest actualistic taphonomic researches of small mammal remains contained in pellets of birds of prey and scat of carnivorous mammals have emerged in the 1970s and

1980s [6-11]. However, it was not until the 1990s that a clear and analytical methodology was developed by Andrews [1]. In general terms, this methodology makes the distinction between five categories of predators, that broadly correspond from low to high degree of modification to strigiforms (categories little, intermediate and moderate), falconiforms, Accipitriformes (categories moderate and great modification) and carnivorous mammals (categories great and extreme). These categories are based both on the degree of modification and frequencies of affected elements, considering digestive corrosion marks on the surfaces of teeth (i.e., incisors and molars) and postcranial remains (i.e., proximal epiphysis of femur and distal epiphysis of humerus), the degree of breakage of cranial (skull and mandibles) and postcranial remains (i.e., diaphysis, proximal epiphysis and distal epiphysis), and the relative abundance of skeletal elements. This methodology was based mainly on actualistic studies of bones and teeth of insectivores (Soricidae, Talpidae and Erinaceidae) and rodents (*Arvicolinae & Muridae*) recovered from pellets of birds of prey (Strigiformes, Accipitriformes), and scats of carnivorous mammals (Felidae, Canidae, Mustelidae, Mephitidae) from different places of North America, Europe and Africa. The results obtained from these current samples were used as analogs for evaluating fossil and archaeofaunistic accumulations in different parts of the world [1,12,13].

South america context

During the mid-to late 1990s actualistic taphonomic works began to be developed in South America, with exclusivity in Argentina and Chile. Pioneering investigations have incorporated valuable statistical tools such as taphonomical indices to know the origin of the assemblages [2,3,14], and intraspecific variabilities in the modification patterns of the common owl *Tyto alba* [15]. Since 21st century started to exponentially multiply the actualistic papers mostly of owls with a strict application of the taphonomic methodology of Andrews [16-20]. The useful of these studies in the archaeology (even paleontology) of South America (mostly in Argentina) also followed this growing tendency [18,21-26] among several others]. Unfortunately, this type of study did not reach other countries of this subcontinent.

As mentioned earlier the classical taphonomy methodology developed by Andrews was made using small mammal species from other continents and subcontinents [1,13]. Nonetheless, since some years, it has been highlighting the disparity in the evidence of digestive action on molars and incisors of different taxa, allied directly with the dentary morphology of each one (degree of hypsodont, enamel thickness, type angle formed by the edges of the molars, among other characters). Thus, this methodology was recently re-evaluated considering the dentary morphology of rodents Sigmodontinae, Caviinae, Ctenomyidae and Abrocomidae, and the marsupials Monodelphini from South America [27]. The comparison between the South American samples with the North American, African and European samples allowed us to establish similarities and differences in the digestive corrosion of the teeth. The main agreements have been recorded in the following groups: Arvicolinae with Caviinae and Abrocomidae; Murinae with Sigmodontinae; Soricidae, Talpidae and Erinaceidae with Monodelphini. However, the particular and simplified configuration of the molars of Ctenomyidae with thicker enamel and dentine exposed has promoted a new description of the categories of digestive corrosion. Likewise Muridae and Sigmodontinae molars, Ctenomyidae presents a delay in the appearance of signs of digestion with regard to other caviomorphs (Caviinae, Abrocomidae). This is interesting because of the Ctenomyidae is usually abundant in archaeological and paleontological sites characterized by sandy and friable soils; in addition they have been associated with anthropic exploitation [27].

There is still a lot of work to do with South American predators and potential prey (both modern and fossil microfauna). For instance, evaluate samples with data that include the seasonal, environmental and ecological variation of the prey is need. The analysis of this variability could reduce the bias related to a unique sample (even if the number of pellets is high) of the predatory species. In fact, the classic researches of actualistic taphonomy show the modifications as “instantaneous”. The lack of knowledge of the seasonal variability of the species preyed is associated to the opportunities offered by the environment at different times of the year.

Conclusion

Despite the fact that the actualistic taphonomic investigations of small mammals and its archaeological implications in South America have had a suitable and growing developed since de last three decades, it is necessary to perform an extensive local actualistic taphonomic analysis of different raptor species and seasonal variation of their prey, in order to apply to fossil assemblages and interpret the past ecosystems at a high level of accuracy, as well as interpret the origin and formation of the fossil assemblages. Recently, we have started to correlate and adapt the original taphonomic model to the different South American small mammal groups (Sigmodontinae, Caviinae, Ctenomyidae, Abrocomidae and Monodelphini) which inhabit in different environments of South America [27]. However, we consider essential to continue with the evaluations of other groups not included in those research (e.g., Octodontidae, Echimyidae) and extend the study to predators that are endemic of this geographical area. We encourage extending this exercise to other areas where the microfauna and the predators are also different, such as Australia, China and oriental countries.

The results achieved to date, added to what we intend to advance in the future will allow to obtain a higher level of detail and a better interpretation of the small mammal assemblages recovered from archaeological and paleontological sites of South America.

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