Taphonomy of Late Pleistocene faunas at Fuego–Patagonia

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Abstract
The taphonomic analysis of faunas associated with early human occupations of Fuego–Patagonia clearly shows how complicated their depositional histories were. The same places often were alternately selected by humans and carnivores. Humans likely displaced carnivores from those places, but the material remains from the human use of the sites probably is mixed with those from previous carnivore occupations. Cases of occupational succession also exist that involve other animals. Again, averaged samples result. The physical association of bones and artifacts cannot be used uncritically as proof of a behavioral association between humans and their prey in the absence of taphonomic analysis.

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Résumé
El análisis tafonómico de las faunas asociadas con ocupaciones humanas tempranas en Fuego–Patagonia muestra la presencia de complicadas historias depositacionales. Muchas veces los mismos lugares fueron seleccionados alternativamente por seres humanos y por carnívoros. Es probable que los primeros desplazaran a los segundos, pero aún así los restos de sus ocupaciones probablemente se mezclaron con aquellos dejados previamente por los carnívoros. También existen casos de ocupación secuencial que implican a otros animales. El resultado es, nuevamente, la formación de muestras promediadas. La asociación física de huesos y artefactos no puede ser utilizada acríticamente como prueba de explotación humana de las faunas asociadas, si no se cuenta con el respaldo de análisis tafonómicos.

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1. Introduction
Taphonomic research in southern South America is still in its infancy. Only recently has this discipline begun to be integrated with the archaeological and paleontological agenda (Borrero, 1990; Pardiñas, 1999). This dearth of taphonomic research is especially problematic in attempting to recognize human signals in the earliest archaeological deposits. Effectively, these sites are caves and rockshelters, places where preservation usually is good. Accordingly, a strong bias against behaviors that do not occur in caves has resulted. This bias not only affects our understanding of human activities but also limits our knowledge of the paleobiology of the faunas that used the same places. It is difficult to conceive that caves available in Fuego–Patagonia before the arrival of humans were not used by other species; caves were not closed until the arrival of humans and probably had been used by denning carnivores or herbivores seeking shelter during the winter (Martin and Borrero, 1997; Borrero, 2001a). Therefore, faunas not related to humans also must be deposited in these caves.

Moreover, the Patagonian archaeological record shows that humans spent only a limited part of their annual cycles in caves (Borrero, 1993) and, in historical times, used them sparsely (Goni, 1995; Borrero, 2001b). As for faunas, a significant component of our knowledge of many Patagonian extinct species depends on these cave samples. Even though felids are not known for their preference of cave habitats, our knowledge of their behavior in Patagonia...
2. Taphonomy and fossil faunas

Taphonomy is a well-established discipline that helps explain the formation processes of faunal accumulations (Lyman, 1994). Taphonomic analysis takes into account the list of species involved and their ecology, as well as variables such as weathering, carnivore marks, and completeness or degree of articulation of the bones. Together with chronological and sedimentological information, these indicators serve to explain cases in which causal agents other than humans are involved. The analysis of faunal assemblages recovered at Patagonian caves should be informative about the degree of participation of humans and other agents in their accumulation. In turn, this information is needed to proceed with the study of the significance of those faunas for the process of exploration and colonization of Fuego–Patagonia.

2.1. Pali Aike lava field

Several fossil faunal assemblages were recovered at the Pali Aike lava field, Chile and Argentina. The case of Fell Cave is important, because it is often mentioned in the literature in relation to the early human peopling of the Americas (cf. Saxon, 1979; Dillehay, 2000). The evidence from this site was collected in the 1930s (Bird, 1938) and 1950s (Emperaire et al., 1963). The physical association of Pleistocene megamammals and humans was clear at the site and thus was used as proof of human hunting of Late Pleistocene faunas. However, the faunas from the lower layers were never studied from a taphonomic perspective (Poulain-Josien, 1963; Amorosi in Bird, 1988). Therefore, the interpretation rested solely on the physical association of bones and artifacts. A recent analysis of the faunal assemblages from the lower layers showed several complicating factors. Up to 68% of the remains found at one of the lower layers belong to hawks, falcons, and terrestrial carnivores (mostly foxes) (Saxon, 1979; Clutton-Brock, 1988; Humphrey et al., 1993). Several horse (Hippidion saldiasi) bones display large carnivore marks (Borrero and Martin, 1996). Either those remains were scavenged from a horse hunted by felines, or the agents of accumulation were felines.

Because the evidence for the presence of humans at the cave is strong, such as hearths, projectile points, and broken bones with cut marks—including horse bones—this new evidence lends support to the hypothesis that carnivores were using the cave before the arrival of humans. Another interpretation is that they may have been alternating use of the cave with humans. The necessary result from either scenario is the mixing of human and carnivore material signals.

The Pali Aike Cave is another well-known site that often is cited in relation with the early peopling of Patagonia (Bird, 1938, 1988). Again, a physical association claim was taken as support for human involvement in the exploitation of megamammals. A recent analysis of the fauna from the lower layers in no way supports the notion that the megamammal remains are the result of human activities. Junius Bird, the excavator of the cave, found a buried layer of volcanic ash and noted the following:

over the surface of the underlying volcanic ash, were scattered broken and burnt bones of native American horse, and the ground sloth (Mylodon sp.), and good occupational refuse, yielding stone and bone tools. In all [approximately], 3800 artifacts were recovered. On the surface of the volcanic ash, at the base of the wall near the rear of the cave, were three cremation burials... in clear association with extinct fauna... Embedded in the top part of the volcanic ash was the stem of a... point (Bird, 1988: 77–78).

He also identified the remains of at least seven sloth skeletons beneath the ash that he interpreted as animals that sheltered and died in the cave (Bird, 1988: 78). Thus, he found horse bones, sloth bones, artifacts, and human burials that he interpreted as associated and unrelated with the sloth remains from the lower layer. The problem with this
interpretation is the evidence that ground sloths were using the cave before the arrival of humans and the presence of human burials. These conditions, especially humans digging to bury their dead, make it necessary to consider the hypothesis of the vertical migration of archeological and faunistic materials. Moreover, some sloth and human remains were found in the same area of the cave (Bird, 1988: 79–83). The human remains were difficult to date, and only a minimal age of 7830±60 yr BP (Beta-099066) is available (Neves et al., 1999).

The case of Cerro Sota Cave, a small lava tube located less than 1 km from Fell Cave, also involves human burials physically associated with megamammals (Bird, 1983). Bird believed that these animal bones were transported to the cave by ‘foxes or other animals’ but maintained that its use as a burial cave ‘was before the extermination of the horse and sloth’ (Bird, 1988: 205). Three samples of human bones were accelerator dated, resulting in dates of around 3900 BP (Hedges et al., 1992). The evidence suggests that the place was used by Pleistocene mammals several thousand years before it was first visited by humans. The digging related to burials may explain the mixing of human and megamammal bones that are separated by something like 6000–7000 years.

Las Buitreras Cave, in the middle Gallegos River, was excavated during the 1970s and 1980s (Sanguinetti, 1976) and defended as a site with good associations between ground sloths and humans (Sanguinetti and Borrero, 1977). It was difficult to date the sloth bones by radiocarbon because of their very low collagen content (A.C. Sanguinetti, pers. comm.). However, one guanaco (Lama guanicoe) bone found in physical association with the artifacts and the sloth remains was recently dated as approximately 3600 BP (T. Stafford, pers. comm.). The preservation of this and other guanaco bones is very good, in contrast with the sloth bones. Moreover, there is evidence of a rock fall sometime after the deposition of the sloth bones. The large blocks make it difficult to assess the stratigraphy, and small bones, such as that which was radiocarbon dated, may have migrated vertically. The position of the few flakes and the guanaco bones with cut marks in physical association with the sloth, then, is not a strong enough argument to sustain a behavioral association.

2.2. Ultima Esperanza

At Ultima Esperanza Sound, on the Pacific side of the Andean Cordillera, two important archeological sites, Cueva del Medio (Nami, 1987) and Lago Sofía 1 (Prieto, 1991), contain important evidence of associations. Even when a detailed taphonomic analysis is lacking, the role of humans is suggested by the presence of cut marks, artifacts, hearths, and discarded broken bones at or near hearths. However, at both sites, previous paleontological occupations exist. The presence of panthers at Cueva del Medio (Nami and Menegaz, 1991) suggests that agents other than humans must be taken into account. At Cueva Lago Sofía 1, the available chronology (Alfredo Prieto, pers. comm.) indicates that the site was used by sloths before the arrival of humans. In both cases, a taphonomic analysis is necessary to understand which faunal components relate to human activities.

2.3. Tierra del Fuego

Important Late Pleistocene faunal assemblages were recovered at what is today the island of Tierra del Fuego. The main evidence was recovered at Tres Arroyos 1 (TA1), a small rockshelter of approximately 70 m². A Late Pleistocene human occupation was found, including five hearths, as well as 841 lithic artifacts, red pigment, a few bone artifacts, and hundreds of bones, some with cut marks (Massone, 1987; Mengoni Gofalons, 1987; Latorre, 1998; Prieto, 1999). Charcoal and bones are dated 10,500 BP (Massone et al., 1998). The discovery of rabbit bones (Oryctolagus cuniculus) in the cave, including the Pleistocene layers, suggests that sediment and particle mixing occurred (Martin and Borrero, 1999). Because European rabbits were introduced to the island during the 20th century, their bones provide clear evidence of bioturbation. Careful excavation identified the presence of holes that initially were attributed to Ctenomys sp. (Massone et al., 1993; Jackson, 2002) but are better explained as rabbit burrows. Their size, content, and other properties are well within the range of known rabbit burrows, including several excavated in northern Tierra del Fuego (Martin and Borrero, 1999). On the one hand, this evidence provides a mechanism for the introduction of rabbit bones into the lower deposits; on the other, it suggests that other remains may have vertically migrated as well. An extinct fox (Dusicyon avus) mandible was found within Layer III, radiocarbon dated at 700±70 yr BP (Dic-2731), but a radiocarbon date from the bone itself produced a result of 10,575±65 yr BP (OxA-9245). The mandible thus was clearly associated with the filling of a tunnel, thereby providing clear evidence of redeposition (Borrero, 2003).

At Tres Arroyos 1, evidence also exists of what appears to be the downward movement of guanaco bones. Effectively, small guanaco bone fragments recovered at Layer Va in physical association with horse and sloth bones were dated 1120±40 yr BP (Beta-101054 AMS), though this date makes more sense in the overlying Layer IV, dated 1340±50 yr BP (Beta-30903), which represents a dense midden of guanaco bone fragments. The action of rabbits may explain both the downward and the upward migration of bones (Martin and Borrero, 1999).

The open air bone assemblage at TA 14 (30), in front of the Tres Arroyos 1 site (Prieto et al., 1997; Constantinescu and Contreras, 1998), contains at least two horizons with faunal remains. The upper, which includes modern faunas only, is dated 2280±60 yr BP (Beta-101055); the lower, characterized by Pleistocene megamammals, is dated
exploitation of megamammals (fauna, the evidence does not point toward their active association in the absence of taphonomic analysis. However, there is evidence of previous faunal utilization of the same places that were selected by humans. Thus, even in these cases, conditions are appropriate for the mixing of deposits.

The importance of these observations is that they strongly support the existence of several forms of bioturbation, which renders suspicion on many cultural inferences offered in the literature. What was the main human prey? Did humans scavenge recently deposited carcasses for food? Did they scavenge old carcasses for raw material? The evidence from Monte Verde, a site located not far from Puerto Montt, clearly indicates that mastodon bones were collected without meat, because dirt found embedded in some of the mastodon bones is not local (Karathanasis, 1997). This finding suggests that they were collected from an old carcass. In summary, at this time it is very difficult to understand in what way humans interacted with Pleistocene faunas in southern Patagonia.

Are we to conclude then that all of the Late Pleistocene sites used to explain the early peopling of Fuego–Patagonia are contaminated or that they provide information mostly about nonhuman species? The answer is no. Some cases, like that of Piedra Museo, are well grounded. The location, size, and morphology of the shelter, even taking into account changes in size and shape since the end of the Pleistocene, indicate that there is low potential for element mixing. The exposure of the site suggests that it probably was not very attractive for other species. The faunal analysis reinforces this impression, with an abundance of cut marks and percussion notches (Miotti et al., 1999; Alberti et al., 2001).

However, the existing chronological data about extinction clearly shows that our understanding of the length of coexistence between humans and megamammals is weak. We have good dates only for ground sloths and horses; the rest of the megamammals remain very poorly dated. It is important to keep this limitation in mind, because the discussion of the Holocene survival of *D. avus* rests on a few cases of physical association of their bones with Holocene-dated deposits (Tonni and Politis, 1981; Miotti and Berman, 1988; Borrero, 1997). The case of Tres Arroyos alerts us to the dangers of this line of reasoning. Also, the hypothesis of Pleistocene extinction of megamammals by overkill should be examined in this context. It is not the lack of a fossil record of the extinction or their presumed invisibility (Martin, 1973); rather, the existing fossil record presents good evidence of coexistence or even interaction. However, the existence of active, organized hunting is difficult to substantiate. It is the task of archeologists to pursue this evidence systematically; taphonomic analysis is one way of doing it.

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