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Taphonomy and the role of pumas (*Puma concolor*) in the formation of the archaeological record

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ABSTRACT

Puma transport of prey remains to dens located in overhangs, rockshelters or caves lead to conditions of potential mixing with archaeofaunas. The evidence for puma use of places which before or after were also selected by humans is reviewed, as well as results of taphonomic studies. These studies include not only naturalistic observations, but also excavations of puma dens, and serve to highlight some of the research areas needed in order to understand the role of pumas as active agents in the accumulations of bone assemblages.

1. Introduction

Pumas (*Puma concolor)* are highly adaptable felines which are distributed along most of America (Redford and Eisenberg, 1992). They are the largest terrestrial carnivores in Patagonia, with weights over 80–60 kg (Sunquist and Sunquist, 2002: 270). They are mostly solitary, nocturnal hunters that hunt large prey such as guanacos (*Lama guanicoe*) and domestic animals which weight up to 350 kg (Redford and Eisenberg, 1992; Prevosti and Vizcaíno, 2006: 414), although in many areas they live off small prey such as European hares (*Lepus europaeus*), sigmodontine rodents or intermediate size prey such as *Pseudalopex* or *Galictis* (Montalvo et al., 2007; Elbroch and Wittmer, 2013).

As top carnivores of the Patagonian ecosystems, pumas are important agents of bone deposition and, sometimes, bone accumulation. Occasionally, pumas constituted a resource for historic and prehistoric Patagonian peoples who consumed their meat and used their hides (Musters, 1964 [1871]: 105; Greenwood, 2015). Also, pumas sometimes selected the same places chosen by human for their activities, producing an impact in archaeological assemblages, and creating complex palimpsests. It is for this reason that it is important to understand the conditions under which puma bones find their way into archaeological assemblages.

Our knowledge of pumas as depositional agents in Patagonia is very limited, and sometimes it is difficult to separate bones deposited by pumas from those deposited by humans. There are cases -especially in caves-where there is interdigitation between puma and human occupations that complicates interpretation (Borrero, 1981; Martin, 2013). For that reason the interaction between humans, carnivores and their prey is relevant to our understanding of the archaeological record.

Taphonomic studies are one way to increase our knowledge about pumas as agents in the deposition of bones or as disturbing factors of previously deposited remains. Naturalistic observations, including longitudinal studies and excavations of modern puma dens, resulting from our taphonomic research are presented here. We especially use some taphonomic results from our studies at Torres del Paine (Borrero et al., 2005) to discuss aspects of the interaction between free ranging pumas and guanacos. These and other research lines, especially the study of fossil samples, help in the discussion of the importance of pumas in the formation of bone assemblages in general, and archaeofaunas in particular. By using naturalistic observations, including the study of modern sites, we show that under some circumstances pumas use overhangs, rockshelters or dark chambers. This has significant implications for interpretation of deposits in shelters.

2. Antecedents

Most of the few relevant taphonomic studies related with puma behavior were produced in the 1990s, including observations of

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marks on sheep bones and the excavation of a puma maternal den (Borrero and Martin, 1996; Martin and Borrero, 1997). A long-term taphonomic project at Torres del Paine National Park -a Biosphere Reserve in South Chile-studied the interaction between pumas and guanacos, with a focus on the material correlates of hunting and feeding episodes. More than 70 guanaco carcasses were studied. Transects and longitudinal observations on carcasses resulting from puma predation were used to understand the spatial distribution of puma activities and its long-term visibility (Borrero, 2001; Borrero et al., 2005). Our work at Torres del Paine took advantage of previous local predator-prey research (Wilson, 1984; Iriarte et al., 1991; Bank and Franklin, 1998; Bank et al., 2002).

Nasti (1996, 2000) published studies of damages produced by pumas on two vicuña skeletons (*Vicugna vicugna*) in the highlands of the Puna in Northwest Argentina. More recently Muñoz et al. (2008) presented a study of one guanaco killed by pumas at the Reserva Laguna del Diamante, Mendoza, Argentina, and Mondini and Muñoz (2007) offered a synthesis of studies involving pumas. Kaufmann (2009) reported the presence of puma marks on nine guanaco carcasses at Cinco Chañares, Río Negro, and discussed their significance.

Scats were also considered in efforts to study the diet of pumas (Yañez et al., 1986; Iriarte, 1988; Iriarte et al., 1991). More specific studies by Gómez (2007), Montalvo et al. (2007) and Labarca et al. (2014) also provided information on the content of puma scats, and used it to discuss their role in archaeological settings.

On the other hand, an actualistic study by Stiner et al. (2012) in Texas and New Mexico, U.S.A. examined the taphonomic signatures of pumas at prey skeletal remains left at four kill sites and digested bone fragments in scats.

3. Puma characteristics

Pumas are solitary predators that hunt by ambush, jumping and breaking the neck of their prey, with a bite of the skull or the throat (Crawshaw and Quigley, 2002: 230). As a result they produce distinctive marks with their large canines on the cervical vertebrae or the skull.

Pumas have large home ranges and spend most of their time in open terrain. It is generally observed that pumas "do not usually have fixed dens, except during the breeding season" (Guggisberg, 1975: 111), and spend most of their time in the open. Caves are not among their favourite places to live (Shaw, 1989; Hansen, 1991; Cox and Grambo, 1999; Nasti, 2000; Sunquist and Sunquist, 2002), but they use them as maternal dens or under other circumstances, including heightened competition. Sarno et al., (1999: 939) found cases of radio collared infant guanacos (*chulengos*) killed and dragged back to dens by pumas. These dens were probably discontinuously used, but in some cases evidences of redundant use were found (Martin and Borrero, 1997).

There are evidences for puma intra-specific interaction to the point that intraspecies killing is the most important cause of death in pumas beyond human hunting. Males kill and eat cubs for nourishment or to enhance male's fitness (Logan and Sweanor, 2001: 139–140). During our taphonomic study at Torres del Paine we uncovered evidence of puma cubs with punctures that resulted from intraspecies killings (José Vargas, personal communication) (Fig. 1). On the other hand, because of the puma preference for sheep they are hunted systematically in most Patagonian ranches (Greenwood, 2015).

Since Late Pleistocene pumas were probably larger (Prevosti and Martin, 2013), and remembering that "larger pumas tend to kill larger animals" (Logan and Sweanor, 2001: 301), it is possible to maintain that in the past they were able to kill extinct fauna such as *Hippidion saldiasi*, extinct camelids or juveniles of larger prey (Prevosti and Martin, 2013: 80). However, competition with *Panthera onca mesembrina* and *Smilodon* must also be taken into account, although damages produced on the bones should have been comparatively greater.

4. The fossil record of Southern Patagonia

Analysis of archaeological samples suggests that felids visited sites, introducing mesomammal remains and modifying bones (Borrero, 1981; Gutiérrez and Gómez, 2007). The evidence is not abundant, but we believe that this is because the attention was concentrated in the faunas clearly associated with human activities, such as guanacos or pinnipeds. The presence of puma bones at Late Pleistocene archaeological or paleontological sites is minimal and limited to two sites, Cueva del Milodon and Cueva Fell. Reports from collections stored in Europe mention the presence of pumas at Cueva del Milodón (Mol et al., 2003; Barnett and Sylvester, 2009) and some remains of one individual were found at the lower Late Pleistocene layers of Cueva Fell (Poulain-Josien, 1963: 235, 237).

The presence of puma is more important during the Holocene, with at least two sites for the Early Holocene, Cueva de las Manos (Mengoni Goñalons and Silveira, 1976) and Los Toldos 3 (Miotti, 1998). There are several Late Holocene sites with puma remains, such as Cerro Sota (Bird, 1988), Cueva de los Chingues (San Roman et al., 2000), La Martita (Horovitz, 2003), El Ceibo 7 (Miotti, 1998), Alero Cárdenas (Horovitz, 1994), El Rodeo (Aguerre and Pereda, 1994), Don Ariel (Nami, 1993) and Cerro de los Indios (Mengoni Goñalons, 1999). The bones recovered at most of these sites are tarsals, carpals, phalanges and metapodials, in other words, bones that may be transported to habitation sites accompanying puma hides. A phalanx with cut marks was recovered at Los Toldos 3 (Miotti, 1998: 113). The presence of two fragments of tibia and one fragment of femur at El Rodeo (Aguerre and Pereda, 1994) invites a different explanation, perhaps related with subsistence.

At most of these sites only the presence of one or two bones is recorded, and rarely archaeologists were interested in relating them to the rest of the faunas. Junius Bird (1983, 1988) found more than 700 guanaco and horse bone chips and splinters at Cerro Sota, associated with ground sloth and human remains. He assigned all these materials to the Late Pleistocene, and suggested that some of the horse and guanaco splinters were too big and strong to be the result of the action of pumas (Bird, 1983: 63). Since he had no

Fig. 1. Torres del Paine National Park. Femur-innominate of a young puma that was killed and consumed by pumas. Note that the trochanter major of the femur is removed and there is a puncture at the innominate.

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