

SHORT COMMUNICATION

Lethal biting behaviour of pumas (Carnivora, Felidae) interpreted from fractured skull of prey

Mordida fatal de puma (Carnivora, Felidae) interpretado por fraturas no crânio da presa

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Abstract

Biting behaviour of pumas at the moment of killing their prey is mentioned in the literature as being delivered either to the throat, nape of the neck and base of skull. Detailed anatomic descriptions of it are, however, largely absent in literature. In this article, the biting behaviour of a puma while attacking a peccary is described based on the perforations found on the skull of the prey. An observer looking at the prey-predator struggle would mistakenly conclude that the bite was meant to reach the throat region with the intent of suffocation, when in fact the bite reached and damaged the ventral and posterior region of the skull, and the spinal cord. According with the most likely hypothesis derived from matching a puma skull with that of the collared-peccary, the predator grasped it with its forepaws from behind, and bit at the upper throat region while the peccary held its head back exposing the throat region, allowing the upper canines to reach and damage the occipital bone and auditory bulla. Although there are no marks on the vertebrae, the evidence from the skull match indicate that the penetration of the upper canines into the skull allowed the top incisors to reach exactly where the atlas vertebrae and the occipital condyle connect. The lower canines held the upper part of the cranium, puncturing slightly at the postorbital process. The unusual behaviour of biting the skull from below may be partially due to the presence of an extended nuchal crest in collared-peccaries, which prevent predators to reach the spinal cord from above.

Key words: killing behaviour, *Pecari tajacu*, predation, *Puma concolor*.

Resumo

O comportamento de mordida do puma no momento de matar sua presa é mencionado na literatura como sendo na garganta, na nuca ou na base do crânio. Descrições anatômicas deste fenômeno são, entretanto, praticamente ausentes da literatura. Neste artigo o comportamento de ataque e mordida ao atacar um cateto é descrito baseado nas perfurações encontradas em um crânio da presa. Um observador da luta puma-cateto poderia facilmente concluir tratar-se de uma mordida dirigida à garganta da presa, com a intenção de sufocamento, quando na realidade a mordida atingiu e danificou a parte posterior e ventral do crânio e a medula espinhal. De acordo com a hipótese mais provável derivada do encaixe de um crânio de puma com o do cateto abatido, o predador abraçou a presa por trás com as patas dianteiras, mordendo na região alta da garganta. No momento do ataque, o cateto teria erguido sua cabeça para trás expondo a região da garganta, o que possivelmente permitiu aos caninos superiores alcançarem e danificarem a região do osso occipital e a bula timpânica. Apesar de não haverem marcas comprovatórias de danos na coluna vertebral, as evidências do encaixe mostram que a penetração dos caninos superiores no crânio permite que os incisivos superiores encostem exatamente na

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espinha dorsal na junção da vértebra atlas com o côndilo occipital. Os caninos inferiores seguravam a parte superior do crânio do cateto, perfurando ligeiramente o processo pós-orbital. O comportamento incomum de morder o crânio ventralmente talvez possa ser em parte explicado pela presença da crista nuchal, estendida em catetos, impedindo que a medula espinhal possa ser alcançada dorsalmente pelo predador.

Palavras-chave: comportamento de ataque, *Pecari tajacu*, predação, *Puma concolor*.

The method by which the puma, *Puma concolor* (Linnaeus, 1771) kills their prey, invariably involves either a bite at the throat region or at the rear cranium or cervical vertebrae. In North America animals such as large deer are usually killed using the first approach, whereas smaller animals such as coyotes and dogs with the latter approach (Shaw *et al.*, 2007; Murphy and Ruth, 2010). In North America it is known that deers are killed by either a bite at the nape of the neck or bites on the throat (Robinette *et al.*, 1959). None, however, show the actual details of the bites. In South America it was found that sheep are most commonly killed with a throat bite, as pumas will feed on the blood that ‘gushes’ from the jugular (Graipel *et al.*, 2004), and that species as large as maned wolves may be killed with a bite at the rear of the cranium (Mazzolli, 2009).

Among the Carnivora, only the cats use their forepaws to restrain prey with a clasping motion prior to the delivery of a killing bite (Sunquist and Sunquist, 2002). Pumas, in particular, strike, grasp, and hold prey typically about the shoulders, neck, or face, while a killing bite is directed typically to the throat or nape of the neck (Murphy and Ruth, 2010).

The canines are used for stabbing and delivering the killing bite (Sunquist and Sunquist 2002). Leyhausen (1979) mentions that canine teeth fit between the neck vertebrae of a prey like a ‘key in a lock’. As the cat bites, the teeth insert themselves between the vertebrae like a wedge, forcing them apart and breaking the spinal cord (Leyhausen, 1979; Sunquist and Sunquist, 2002). The literature invariably describe that bites to the skull region are delivered

from above (Robinette *et al.*, 1959; Schaller and Vasconcelos, 1978; Sunquist, 1981; Branch, 1995; Mazzolli, 2009). Detailed anatomic descriptions of it are, however, largely absent in literature. Seindensticker and McDougal (1993), however, systematically describe a number of killing situations by tigers in which the predator damages the vertebrae of buffalo and the trachea (throat) at the same time. They describe a single situation of the canine teeth reaching the skull, behind the foramen magnum (the posterior end of the skull), but the lethal damage seem to have been delivered by the crushing of a vertebrae. Schaller and Vasconcelos (1978) examined in detail the particular way in which jaguars bite the

skull of capybaras from above, perforating the temporal region at both sides of the skull. This article describes how a collared-peccary *Pecari tajacu*, also known as javelina, was killed by a puma with a bite aimed at the rear and ventral region of the skull.

A collard-peccary was found dead in 2005 with much of its carcass already reduced to bare bones, and with its characteristic striped hair spread around the body. The peccary was fully adult with tooth wear evident. The bones were examined for fractures, which were present only in the skull. The skull was collected in southern Brazil, at coordinates 27°57’45”S and 50°53’56”W. It was stored in the Laboratory of Ecology of the Universidade

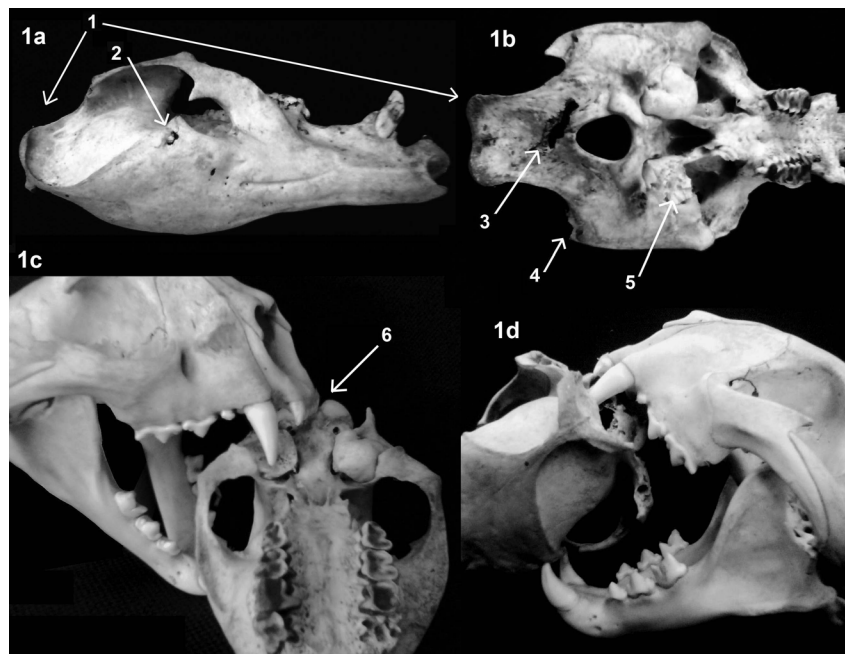


Figure 1. 1a and 1b: highlighted structures of a collared peccary skull damaged by a puma bite, 1-Nuchal crest, 2- Postorbital process, 3- Occipital, 4- Jugular process, 5-Auditory bulla; 1c and 1d: different views of the same bite. 1c: upper right canine reaching the auditory bulla, 6- incisors reaching the spinal cord at the occipital condyle; 1d: peccary skull from a posterior view, highlighting the fracture at the occipital bone inflicted by the upper left canine.

do Planalto Catarinense. A skull from a puma was used to find a fit for the tooth marks or bite found upon examining the collared-peccary skull. Two antagonist hypotheses emerged to describe the battle, a dorsal bite and a ventral bite. The problem was solved by finding the best fit, and searching for information in the literature (e.g. Robinette *et al.*, 1959; Schaller and Vasconcelos, 1978; Sunquist, 1981; Seidensticker and McDougal, 1993; Branch, 1995; Mazzolli, 2009).

The examined peccary skull had four damaged structures, one on the dorsal (Figure 1a) and three on the ventral part of the skull (Figure 1b). The fractures indicate that the bite gripped the upper and lower regions of the skull simultaneously. The upper right canine broke the left auditory bulla (Figure 1c), and a large perforation was found in the occipital bone, presumably inflicted by the upper left canine (Figure 1d). At this position, the upper canines were wide enough not to be obstructed by the protruding occipital condyle. They penetrated deeper to damage skull bones while allowing the upper incisors to reach the atlas vertebrae at the junction with the occipital condyle. This enabled the incisors to possibly damage the spinal

cord (Figure 1c). The lower canines must have grabbed the top of the skull at the postorbital process (Figures 1a and 1d).

The bite was delivered from below, in the upper throat region by the pharynx. A bite from above would be prevented by the nuchal crest of the peccary, which extends over the occipital bone, protecting it from a bite delivered from above. Dogs and wolves, instead, may be killed with a grip from the top (Murphy and Ruth, 2010), much like the bite delivered to a maned wolf described in detail by Mazzolli (2009), which damaged the left and the right sides of the occipital bones.

An alternative hypothesis for the bite position would have the puma grabbing the peccary head from behind and below at about 45 degrees of the prey anteroposterior axis (Figure 2a). This is a very unlikely position of attack from the behavioural standpoint. In this position, the lower canines would be impaired in reaching the spinal cord because the breadth between them, unlike those of the upper canines, is not wide enough to bypass the protuberant occipital condyle (Figure 2b). At this position, moreover, the lower canines would not fully reach the skull bones for the same reason. Further, in

this scenario, the lower canines would not have been able to inflict the deep fractures at the occipital bone. These fractures are more likely to have been caused by the upper canines, which are longer and are aided by the pulling strength of neck muscles.

During an attack, the bite may be adjusted more than once before the final killing bite (Robinette *et al.*, 1959). Deep perforations such as those found in the peccary skull are very likely to represent the final, adjusted bite. The first hypothesis described a more realistic scenario, one that would minimize repetitive deep bites and is compatible with the usual neck-grabbing position seen during attacks of large felids on prey the size of peccaries. Attacks of pumas are rarely witnessed in the wild, indirect evidence such as the one described here often being the only source of information on the predatory behaviour of pumas.

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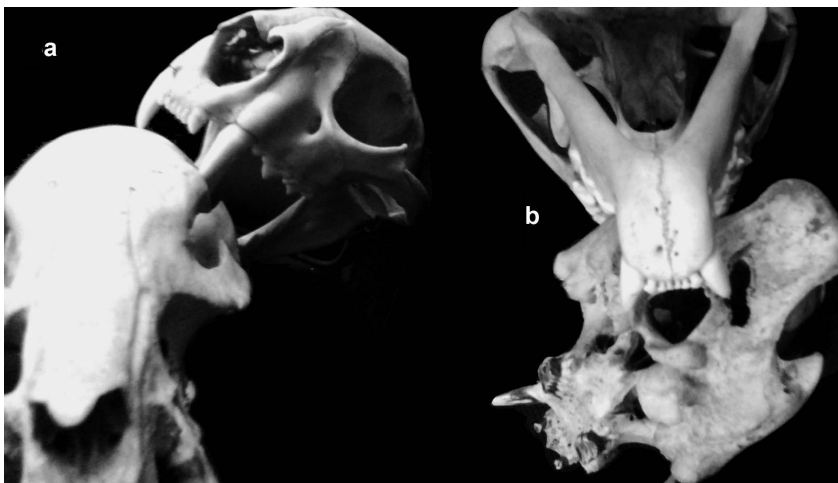


Figure 2. Alternative hypothesis for the killing bite. 2a: the puma would have to grab from behind at about 45 degree angle; 2b: ventral view of the same bite, the lower canines would be obstructed by the occipital condyle and unable to reach the spinal chord or the skull bones.

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