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Cougar Predation on Black-and-Gold Howlers on Mutum Island, Southern Brazil[1]

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Researchers consider predation rates by terrestrial animals to be lower in the case of arboreal primates, particularly among large-bodied species. We recorded the consumption of black-and-gold howlers (Alouatta caraya) *by cougars* (Puma concolor) *as evidence of predation on an island of the upper Paraná River. We collected and processed fecal samples of the felid in 2004 and 2005. We identified items in the laboratory by comparison with museum specimens. We considered each species in a fecal sample as a single occurrence. Based on analysis of the cuticle scale pattern, we identified the felid as cougar. Howlers occurred in 4 out of the 8 fecal samples (40% of the occurrences). In addition to howlers, we also recorded 5 occurrences of agouti* (Dasyprocta azarae; *50%) and a small unidentified sigmodontine*

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rodent (10%). The abundance of howlers and the low forest canopy in a successional vegetation might have facilitated the predation of the large primates by a primarily terrestrial predator. The versatility of cougars is corroborated by the consumption of prey species that were abundant in the region and that were available in different forest strata, such as howlers and agoutis.

KEY WORDS: *Alouatta caraya*; *Dasyprocta azarae*; predation on primates; *Puma concolor*; regenerating forest.

INTRODUCTION

Ecologically, predation can serve as a means of population and community regulation (Reed and Bidner, 2004; Ricklefs 2003; Wolff, 1997). In primates, predation rates can be higher in terrestrial species than in arboreal ones (Anderson, 1986; Zuberbühler and Jenny, 2002), given that, in the latter, predation by terrestrial animals seems to be less frequent. Conversely, their arboreal habits cause them to be more vulnerable to flying predators (Cheney and Wrangham, 1987; Zuberbühler and Jenny, 2002).

Among the predators of neotropical primates, in addition to birds of prey such as black hawk eagles (*Spizaetus tyrannus*), ornate hawk eagles (*S. ornatus*), harpy eagles (*Harpia harpyja*), and crested eagles (*Morphnus guianensis*) (Defler, 2004; Greco *et al*., 2004; Heymann, 1990; Miranda *et al.*, 2006; Sherman, 1991; Sussman, 2000; Vasquez and Heymann, 2001) and constricting snakes such as anacondas (*Eunectes murinus*) and common boas (*Boa constrictor*) (Heymann, 1987; Kierulff *et al*., 2002; Tello *et al*., 2002), mammalian species include tufted capuchins (*Cebus apella*), tayras (*Eira Barbara*), jaguarondis (*Puma yagouarondi*), margays (*L. wiedii*), ocelots (*Leopardus pardalis*), jaguars (*Panthera onca*), and cougars (*Puma concolor*) (Chinchilla, 1997; Defler, 2004; Emmons, 1987; Jorgeson and Redford, 1993; Miranda *et al.*, 2005; Oliveira, 2002; Olmos, 1993, 1994; Peetz *et al.*, 1992; Sampaio and Ferrari, 2005; Soini, 1988).

There have been few records of primate predation by large felids in the neotropics (Emmons, 1987) because such events are rare and difficult to detect (Peetz, 1992; Standford, 2002), and indirect evidence from predator fecal analyses or carcasses is plagued by sampling problems. For instance, data from encountering prey carcasses tend to overestimate the importance of larger prey in relation to smaller ones, with the latter possibly going undetected (Oliveira, 2002), as well as being easily hidden and rapidly consumed (Crawshaw and Quigley, 2002). We recorded the consumption of black-and-gold howlers (*Alouatta caraya*) by cougars (*Puma concolor*) as strong evidence for predation in regenerating forests of the upper region of the Paraná River. We also present and discuss data on the consumption of another mammal species: agouti (*Dasyprocta azarae*).

STUDY AREA AND METHODS

During 2004 and 2005, we collected cougar fecal samples opportunistically during a census of primates along a linear transect (a total of 22.4 km carried out through multiple walks in a 1.12-km trail) in regeneration forests of the Mutum Island (22°45′59″SE 53°18′58.4″W). This is a 1050-ha riverine island that is part of the municipality of Porto Rico (Paraná state), in the upper region of the Paraná River. The vegetation in the region is classified as Alluvial Semideciduous Seasonal Forest (Campos and Souza, 1997; IBGE-FIBGE, 1992) and is located in the transition between the domains of the Atlantic Rainforest and the Brazilian Cerrado (Campos *et al.*, 2000). Studies based on aerial photographs showed that, beginning in the 1960s, the region has experienced severe human influence, with most of the forests in the river island being replaced by plantations and pastures (Campos and Souza, 2003). After creation of the Area for Environmental Protection (APA) of the Ilhas e Vrzeas do Rio Paraná in 1997 (decree without number of September 30, 1997), the areas were cleared of human settlements. The region is currently in a state of forest regeneration, forming a mosaic with undisturbed fragments and open vegetation areas.

We processed the fecal samples collected along the trails sent the different items to the laboratory for identification. We identified felid hair by comparing the cuticle scale pattern with those of jaguar and cougar specimens at the Museu de História Natural Capão da Imbuia (MHNCI). We identified fragments of bones, claws, and teeth by comparing the materials with the reference scientific collection of the Museu de Zoologia da Pontifícia Universidade Católica do Paraná (MZ.PUC.PR). We considered each species in a fecal sample as 1 occurrence.

RESULTS

After analysis of the cuticle scale pattern of the hair in the fecal samples, we identified the predator as *Puma concolor* (cougar). In addition, we confirmed cougar presence in the site where we collected the feces via footprints, tree markings (scratches), and a single direct observation.

We collected 8 fecal samples, from which we identified 2 individuals at the specific level and 1 at the familial level, amounting to 10 occurrences. In 4 samples we detected howler remains (40%) via identification of several body parts (Fig. 1). In addition to the howlers, agouti occurred 5 times in fecal samples (50%), 1 of them in the same sample as howlers and another with a small rodent (10%; Sigmodontinae *gen. et sp.*

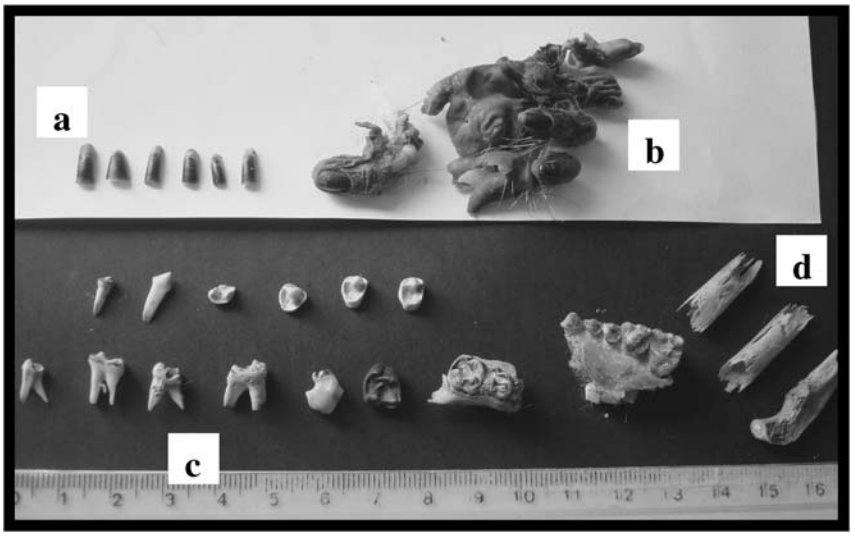

Fig. 1. Body parts of balck-and-gold howlers in 4 fecal samples of cougar: (**a**) finger nails, (**b**) hand and fingers, (**c**) teeth and fragments of mandible and maxilla, and (**d**) long bones (radius and other unidentified bones).

indet.). Though we collected fecal samples at different places along the trail, we found only 2 on the same date. However, 1 of them seemed to be fresh, whereas the other was dry, showing that we did not count the same prey >1 time (Table I).

Table I. Fecal samples of cougar (*Puma concolor*), with the date of collection, condition of the samples, identified remains and their frequencies

Fecal specimens	Dates of collection	Condition	Remains	Relative frequency (%)
I	July 22, 2004	Fresh	*Alouatta caraya*	10
II	September 8, 2004	Dry	*Dasyprocta azarae*	10
III	November 10, 2004	Fresh	*Dasyprocta azarae*, sigmodontine rodent	10, 10
IV	November 1, 2004	Dry	*Alouatta caraya*	10
V	January 14, 2005	Dry	*Dasyprocta azarae*	10
VI	April 7, 2005	Dry	*Alouatta caraya*, *Dasyprocta azarae*	10, 10
VII	May 3, 2005	Dry	*Dasyprocta azarae*	10
VIII	July 9, 2005	Fresh	*Alouatta caraya*	10

DISCUSSION

The prey selection patterns of great felids are probably influenced by the availability, vulnerability, abundance, and distribution of potential prey (Hibben, 1939; Oliveira, 2002; Polisar, 2002; Zuberbühler and Jenny, 2002). In the study area and in other environments of islands in the Paraná River, black-and-gold howlers live in high densities (Aguiar *et al*., 2007; Bravo and Sallenave, 2003; Rumiz, 1990). Using line-transect sampling, we found high density values for the riparian forests of Mutum Island: 2.16 ind./ha (L. M. Aguiar, *unpublished data*). Therefore, we can explain the high consumption rate of howlers by cougars by the high abundance of howlers there. R. C. Bianchi (*unpublished data*) observed a high frequency of predation on brown howlers (*Alouatta guariba*) by ocelots (*Leopardus pardalis*; in 25% of the samples) in a site where, according to Mendes (1989), they occur in an unusually high density. Using the same factor—prey abundance—we can also explain the consumption of agoutis by cougars, given that the former commonly occur along transects in Porto Rico, which indicates their abundance (L. M. Aguiar and G. Ludwig, *pers. obs*.).

Owing to the recent successional state of a great portion of the Mutum Island, most of the emergent and canopy trees do reach a mature height, which might have increased the chance of predation on the primates. Howlers are among the largest primates in the neotropics (Rylands *et al.*, 1996). Predation rates of large-bodied primates are generally low compared to small-bodied species (Cheney and Wrangham, 1987, Kierulff *et al*., 2002; Standford, 2002; Zuberbühler and Jenny, 2002). The shift in the original physiognomy of the original forest—decrease in canopy height—might have facilitated great felids to reach and to consume howlers more frequently. For instance, Peetz *et al.* (1992) reported a case of predation of 5 red howlers (*Alouatta seniculus*) by jaguars after the forest fragmentation resulting from the formation of a lake in Venezuela. Stanford (2002) pointed out that large-bodied primates living in anthropogenically altered environments can present low predation pressure. However, our data suggest that environments modified by humans favor predation of arboreal large-bodied primates by terrestrial opportunistic predators, such as cougars.

Though little is known of cougar ecology on the islands of the Paraná River, data on their home ranges in the upper Paraná River (6300–10,700 ha, D. A. Sana, unpublished data) and in the Brazilian Pantanal (3200–15,500 ha, Crawshaw and Quigley, 1984; 8200 ha, Fonseca *et al*., 1994) indicate areas that are larger than Mutum Island (1050 ha). Therefore, one or more transient cougars (in this case, by overlapping adjacent home ranges) could be using the area to obtain food. Therefore, our data are not

conclusive with respect to the number of individuals from which the samples originated. However, our data confirm the fact that cougar, a species often classified as a terrestrial predator, is a consumer and a predator of a large-bodied arboreal primate in the region. Cougars could also feed on abundant prey species that live in different forest strata, such as howlers and agoutis, confirming their great versatility. They possess great cursorial capacity and jumping adaptations (Aranda, 2002).

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