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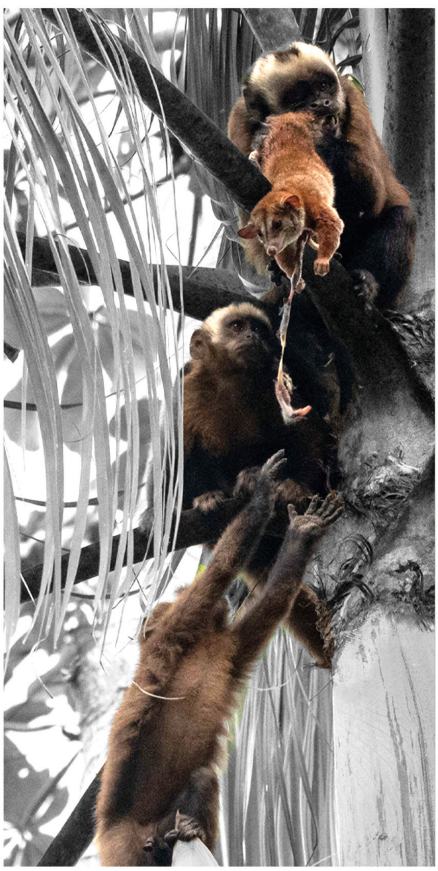

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Front Cover: Designed by Amisha Gadani. Top: Juvenile *Sapajus apella* inspecting palm spines on Ile Royale, French Guiana. Photo by Carlos Navarro. Middle: *Sapajus cay* alpha male (left) holding a *Rhipidomys* rodent, with an estrous female sitting in contact (right), in Mato Grosso do Sul, Brazil. Photo by Oscar Fernandes Júnior. Bottom: An alpha male *Sapajus macrocephalus* feeding on *Caluromys lanatus*, while a female with a baby on her back observes and a juvenile tries to grab the internal organs, in Manu Learning Centre Biological Station, Peru. Photo by Daniel Ash.

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Articles

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TERRESTRIAL BEHAVIOR OF A SOLITARY FEMALE SPIDER MONKEY (*ATELES CHAMEK*) ON A BEACH IN MANU NATIONAL PARK, PERU

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Abstract

While predominantly arboreal, spider monkeys of various species sometimes have been observed descending to the ground. Individuals of *Ateles chamek* have been reported to access some kind of food resources (rotten wood or salt licks) on the ground. We describe the terrestrial behavior of an adult female *Ateles chamek* (Peruvian spider monkey) on a sandy bank of the Pinquén River, Manu, Peru. This behavior lasted several minutes, with sequences of walking on four legs, pausing, and standing upright on the hind legs. The probability that she was a pet is very low due to the location being remote from population centers. The possibility of the individual looking for water to drink directly from the river is not discarded but due to the low water level and short distance between the two banks of the river, it is believed that this solitary adult female (migrant sex in the species) had intentions to cross the river, and that our presence ultimately influenced her decision not to cross.

Keywords: Atelidae, beach, bipedalism, terrestrial behavior, Pinquén River

Abstract

Aunque predominantemente arborícolas, a veces se han observado a monos araña de varias especies descender directamente al suelo. Se han reportado individuos de *Ateles chamek* bajarse para acceder a algún tipo de recursos alimenticios (madera podrida o lamederos de sal). Reportamos y describimos el comportamiento terrestre de una hembra adulta *Ateles chamek* (mono araña peruano) en una orilla arenosa del río Pinquén, Manu, Perú. Este comportamiento duró varios minutos, con secuencias de caminar sobre cuatro patas, hacer pausas y ponerse de pie sobre las patas traseras (postura similar a la humana). La probabilidad de que fue mascota es muy baja debido a la lejanía de los centros poblados. La razon de buscar agua para tomar directo del rio no se descarta pero creemos que debido al nivel bajo del agua, distancia corta entre extremos del rio se cree que esta hembra adulta solitaria (sexo migrante en la especie) tuvo intenciones de cruzar el rio, pero que nuestra presencia al final influyo en su decisión de no cruzar.

Palabras clave: Mono araña, playa, comportamiento terrestre, río Pinquén

Introduction

The Black-faced Spider Monkey (*Ateles chamek*), also known locally in Peru as *Maquisapa* (Primates: Atelinae), is an Endangered species (Cornejo et al., 2018) whose population size is decreasing through loss of area of occupancy and extent of occurrence due to habitat loss and degradation, in addition to threats faced from hunting (van Roosmalen and Klein, 1988; Peres, 1990; Parry et al., 2007). It is a relatively common species in areas where it is not hunted for its meat (Konstant and Rylands, 2013). This species inhabits the canopies of Neotropical forests in Bolivia, Brazil and Peru and primarily consumes ripe fruit (Di Fiore et al., 2008). Primates from the *Ateles* genus prefer to use high strata such as the canopy and emergent layer (van Roosmalen, 1985; Mendes Pontes, 1997; Wallace, 2008). Terrestrial behavior in *Ateles* is aimed at obtaining mineral resources from the clay lick and drinking water (Izawa, 1993; Campbell et al., 2005; Blake et al., 2010; Link et al., 2011). Previous studies report terrestrial behavior of *Ateles chamek* in Cocha Cashu (Campbell et al., 2005). However, in a study on the reintroduction of spider monkeys, land use represented 2.7% of the activity pattern during the adaptation period due to the fact that during the first weeks they are learning to use the forest, climbing up progressively to the higher canopy (Bello, 2018).

Here, we report and describe the terrestrial behavior of a female individual of *Ateles chamek* on a sandy beach

in the river bank of the Manu National Park in Madre de Dios region, Peru. During an excursion in September 2021, at the intersection between the Pinquén River and Manu River in Manu National Park, Manu, Madre de Dios, Peru (-12.182, -71.019) (Fig. 1) we observed an individual spider monkey descending to the ground and exhibiting terrestrial behavior. Using a camera with a 500mm lens + a smartphone, pictures and videos have been recorded. Analysis of the collected material was carried out to describe this event, and to discuss the possible causes of this behavior. We considered the proximity of population centers or communities, seasonality, river width and water level.

We analyzed a video of 244 seconds (approximately 4 minutes) taken on September 14th 2021 of an adult female on the left bank of the Pinquén River. The video records the major part of the terrestrial behavior of the animal.

The individual was first spotted by the group from the boat at 16:42. She was in the trees at the edge of the forest on the left side of the river. She was apparently on her own (no other individual seen). She took time scanning the environment, shaking the branches, perhaps making sure that there were no predators nearby; similar behavior for spider monkeys has been described (Campell et al., 2005). The river current was very slow at this location, therefore the boat driver switched the engine off to better observe with as little noise as possible to minimize disturbance of the individual. Four minutes after the beginning of the observation, the spider monkey decided to descend from the trees. First hidden behind trees, she then reappeared on the beach. At this point a video was recorded. During this period the animal walked on all four legs at a medium pace with her tail rolled up (Figure 2), paused several times and stood up several times on her back legs (Figure 3), then continued to walk on all four legs. The duration of the terrestrial behavior recording was of 244 seconds and consists of 63.5% walking on four legs, 20% standing on four legs and 16.5% standing up on her back legs. In Table 1, we provide the minimum and maximum duration of each of the events that were part of this sequence of terrestrial behavior. Even though bipedal locomotion has already been reported (Machnicki et al., 2016), in our case, the female never walked bipedally. When standing in bipedal posture, she almost always used her tail as a support for standing upright.

Based on data provided by the World Bank (2023) on their Climate Change Knowledge Portal, the precipitation for July, August and September had been very low in the Madre de Dios region in 2021. The levels of precipitation for those months were respectively 17.08, 35.94 and 58.53 mm, as compared to mean values of 73.35, 70.45 and 92.15 mm (for those months, from data collected by the World Bank (2023) from 1991 to 2020).

Using freely available satellite imagery for this period (Planet.com, 2022), the approximate distance from the monkey to the other side of the Pinquén River was

Figure 1. Field location of the sighting of *Ateles chamek*, walking on a beach in Parque Nacional del Manú - Madre de Dios, Perú.

estimated to be 70 m and from that point to the other side of the Manu River to another, larger beach was 400 m.

Table 2 provides details of the distances and hours of travel by boat (with a 60hp engine) from the location where the monkey was spotted to the populated areas, lodges or camp sites.

Although spider monkeys are highly arboreal, when needed, they can use the ground for eating soil or drinking water, and to escape attacks from conspecifics or play a chase game (Campbell et al., 2005, Machnicki et al., 2016). Even reintroduced spider monkeys have been observed on the ground only 2.7% of the time, and this behavior was more frequently observed in individuals who showed difficulties in adaptation during the initial weeks after their release (Bello, 2018). The animal we observed on the open beach was significantly more exposed than it would have been on the ground in the forest where it would have been able to climb trees quickly. Descent to the ground increases risks of predation, and there have been documented attempted predation events by large felines on primates at clay licks (Matsuda and Izawa, 2008), but other terrestrial animals like peccaries are also a threat (Bello et al., 2021). In our observations, the animal was vigilant but quiet at all times: walking back and forth, but occasionally pausing and eventually standing on her hind legs to observe her surroundings.

Table 1. Duration (in seconds) of the different types of the terrestrial behavior. The monkey left the beach and returned to the forest at 16:52 at the same location she had first been spotted.

0	Four-legged Stance	Bipedal Stance	Walking on Four Legs
N	11	5	16
Min	1	2	1
Max	10	13	32
Sum	49	40	155
Mean	4.454545	8	9.6875
Std. Dev.	2.876235	5.147815	7.726308

Despite our presence, the animal did not appear to feel threatened, and when she emerged onto the beach we considered the possibility that she was or had been a pet. However, when analyzing the distance between the lodge and the village centers, the closest area of human habitation was Romero Lodge (not permanently occupied), which is 6 km away in a straight line, but on the other side of the Manu River. In the Peruvian Amazon, it is common but illegal for tourism companies to use wild animals as attractions (Shanee and Shanee, 2021; Bello, pers. obs.). None of the tourism companies within Manu National Park are likely to have wild animals as pets. It is illegal and the penalties are dissuasive (SERNANP, 2019). Some Indigenous communities do keep wild animals as pets and also consume spider monkey meat (Rosin and Swamy, 2013). After hunting a mother, they may keep her young as a pet, but when the animal matures it may be "released or abandoned in the forest" when it becomes too large and annoying. However, the probability of survival in the wild for spider monkeys that have been kept as pets for several years is very low (Bello, 2108).

Figure 2. Spider monkey, *Ateles chamek*, in a four-legged stance on a beach in Parque Nacional del Manu, Madre de Dios, Peru.

Figure 3. Spider monkey, *Ateles chamek*, standing bipedally, in Parque Nacional del Manu, Madre de Dios, Peru.

Table 2. Distance from spider monkey sighting to communities and lodges.

Community / Lodge	Dist. as the crow flies (km)	Dist. along river (km)	Travel time by boat (hours)
Boca Manu	15	45	3
Romero Lodge	6	20	1
Limonal (Park Ranger Post)	10.5	33	2
Aguaje Tented Camp (Cocha Salvador)	29	50	5
Camp Paujil (Cocha Otorongo)	24	42	4

A second explanation could be that the monkey was looking for water. The event occurred during the dry season, and the region was particularly dry at the time of the observation. The lack of rain could have pushed the monkey to seek water from the river. It is unusual that the monkey would choose a water source so far from the protection of the trees. However, in Bolivia *Alouatta* sp. was observed drinking from the beach at the edge of the forest on the Intenez River during the dry season (Wallace et al., 1999). Perhaps the monkey did not feel safe enough to approach the water's edge because of our presence, and instead went back and forth on the beach.

Another reason this adult female was found alone may be that, in the genus *Ateles*, young adult females often migrate in search of other groups (Link et al., 2018), even traveling long distances looking for a new group to join (Shimooka et al., 2008). Although we can't be certain, she appeared to be a nulliparous female. Perhaps she walked along the beach because she was trying to cross the river in order to search for and join another group of spider monkeys. The distance from the beach to the other side of the river was about 70 m. Spider monkeys are able to swim and cross slow-moving rivers (Collins and Dubach, 2000; Goldani et al., 2006; Chavez and Stoner, 2010; Valle, 2014; dos Santos-Filho et al., 2017), and larger species like *Ateles chamek* are less affected by ecological barriers (Ayres and Clutton-Brock, 1992). The emergent beach, slow current, and short distance between both edges of the river during the dry season may have allowed a river crossing, but the presence of the boat may have influenced her decision not to cross.

Acknowledgments

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Video

The video showing the behavior is available online: https://tinyurl.com/ateles-beach.

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PREY TRANSFER THROUGH DELAYED SCROUNGING OF A *RHIPIDOMYS* RODENT HUNTED BY AN ALPHA MALE *SAPAJUS CAY*

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Abstract

Cebines' unique foraging strategies, including opportunistic hunting, allow them to access food sources unavailable to other primates. Although instances of mammal predation have been documented in Sapajus species, reports of spontaneous food sharing and meat interaction remain rare. This study, using ad libitum observations, reports opportunistic hunting and delayed scrounging in a group of *Sapajus cay* in Mato Grosso do Sul, Brazil. An alpha male was recorded capturing and consuming a rodent (*Rhipidomys* sp.). While consuming the prey, he dropped scraps that were collected by other group members through delayed scrounging. An estrous female followed the alpha male, exhibiting courtship behaviors but showing no interest in the prey. This event represents a rare observation of vertebrate consumption and passive food transfer in *S. cay*. These findings highlight the need for further behavioral studies on geographically restricted primate species like *S. cay*.

Keywords: Capuchin, group behavior, social hierarchy, interaction

Introduction

Cebines live in social groups consisting of multiple males and females (Carosi et al., 2005; Tiddi et al., 2011) in a linear social hierarchy, where the alpha male is the dominant and often largest individual (Izawa, 1980; Janson, 1984). They have hunting behavior characterized by hand dexterity (Christel and Fragaszy, 2000; Torigoe, 1985), exploratory behavior (Perry et al., 2017), and spontaneous food interaction (de Waal et al., 1993; Perry and Rose, 1994). These behaviors and their size allow them to explore food sources unavailable to other primate species. Among foraging strategies in the genus *Sapajus*, opportunistic hunting and consumption of small mammals are well known, such as *Sapajus* sp. hunting a common marmoset (*Callithrix jacchus*) (Albuquerque et al., 2014), a black-horned capuchin (*S. nigritus*) attempting to consume a Caluromys lanatus that was hit by a car (Palmeira and Pianca, 2012), *S. cay* hunting *Rhipidomys* sp. that were just released from a live trap (Milano and Monteiro-Filho, 2009), and a black-capped capuchin (*S. apella*) hunting an *Oecomys* sp. (Lee and Huang, 2021). Predation of larger mammals were observed in black-horned capuchin (*S. nigritus*) hunting an infant howler monkey (*Alouatta guariba*) (Genty and Cäsar, 2014) and Kerodon rupestres hunted by a group of black-striped capuchins (*S. libidinosus*), followed by a tolerated scrounging interaction between the alpha male and the other males in the group (Filho et al., 2021). While these reports show that capuchin monkeys hunt other mammals, events of spontaneous meat interaction are rare and have been observed in *S. cay* only once, while consuming a marmoset, *Mico melanurus* (Costa et al., 2020). In this case, two adult *S. cay* individuals were observed feeding, while other members of the group were vocalizing close to them. After consumption, pieces of the carcass were discarded on the ground and other individuals of *S. cay* picked them up and disappeared into the forest (Costa et al., 2020).

The most common prey transfer in primates is termed delayed scrounging; it occurs when one individual eats

the leftovers of another already out of that individual's possession, after being dropped or discarded. Other types of prey transfer described for primates include tolerated scrounging—the possessor allows another individual to come near and retrieve dropped scraps; facilitated scrounging—the possessor moves towards an individual, drops food scraps and allows the other to retrieve them; passive food-sharing - the possessor permits another to retrieve food items from his/her hands or mouth; and theft—one individual seizes the food directly from another (de Waal et al., 1993; Ferreira et al., 2002). Here we report a case of hunting by a *S. cay* alpha male followed by the delayed scrounging of prey leftovers by group mates.

Materials and methods

The behavior of a group of *Sapajus cay* was recorded from January to July 2012 in a private 286-ha forest fragment (21°21'42.62"S, 56°09'20.58"W) in Mato Grosso do Sul, Brazil. The dominant vegetation was deciduous and semi-deciduous forest (Klink and Machado, 2005).

We used *ad libitum* observations (Altmann, 1974) to record the event of opportunistic hunting and food transfer reported in this work, within observations carried out for a larger behavioral study of the capuchins using Nikon Monarch 10 × 42 binoculars, a Canon t2i camera with a 100–400 mm interchangeable lens, and field logs, totaling 255 h of direct observations. The group consisted of 21 individuals (nine adult females, eight adult males, one sub-adult male, one sub-adult female, and two young males), all identifiable through natural characteristics such as tuft size and shape, scars, age, sex, and fur color. We followed the ethical standards in the guidelines of the American Society of Mammologists.

Results

The episode occurred on July 17, 2012, at 10:45 a.m. The group of *Sapajus cay* was foraging in a stratified manner with adult females and juveniles foraging only in the understory, and other individuals (adult males and sub-adults) foraging on the ground in the riparian forest. The vegetation structure was composed of branches, logs, litter, and lianas around "acuri" palms (*Attalea phalerata*). The alpha male foraged among the leaf litter near a burrow and pulled out a rodent of the genus *Rhipidomys* (Figures 1 and 2) with his hands. The burrow where the rodent was found was composed of a dead "acuri" palm suffocated by a fig tree, forming an environment like a "den." Due of the difficulty in identifying rodents to the species level, we only categorize the rodent as belonging to the genus *Rhipidomys* (characterized by darker fur in the hind paw) (Figure 1). The visible scrotum of the rodent helped to identify it as an adult male (Figure 2).

The alpha male bit the rodent's skull and killed it at 10:46 a.m. By 10:48 a.m. the head was separated from the prey's body. Then, the male moved to a larger and taller tree with the prey, sat down, and started feeding by tearing the forelimbs with his teeth. During capture and eating of the prey he emitted a "huh" call, a vocalization associated with feeding-related behaviors (Bastos et al., 2015). The alpha male moved with the prey between 10:49 and 11:07 a.m., during which time an estrous female followed him while displaying courtship behavior, as described by Janson (1984); however, she was not begging for food but rather only focused on soliciting sex (Figure 2). The male start eating the prey at 11:07 a.m. and kept moving through the trees. He repeatedly looked down and dropped different body parts (viscera, ribs, head, and limbs) one at a time while he moved through the forest. About five groupmates descended to the ground and collected prey remains to eat in neighboring trees. Different pieces of the remains were dropped between 11:07 a.m. and 12:30 p.m. and the participants who consumed the scraps produced "huh" vocalizations and remained close to the alpha male throughout the entire period.

Discussion

In our observations of a unique hunting episode by the *Sapajus cay* alpha male, he ate most of the carcass and dropped some of the leftover scraps, which other group members retrieved from the ground and ate in nearby trees. We consider this interaction to be tolerated, delayed scrounging as the male watched the others retrieve the food from below him (Ferreira et al., 2002). However, the estrous female sitting next to the alpha male did not eat any of the meat; she appeared to be sex-motivated and not food-motivated, as she followed the male, and approached the male with grimaces and vocalizations, as has previously been described in courtship behavior for female *Sapajus* species (Janson, 1984; Lynch Alfaro, 2005).

In a previous study of the same *Sapajus cay* group, vertebrate prey was the rarest component in the food budget, and only the alpha male was observed to consume these vertebrates, which included small rodents (Júnior et al., 2020). For *S. cay*, there is only one previous publication documenting predation of *Rhipidomys* sp. individuals, one by a sub-adult and another by an adult female capuchin during an opportunistic release of small mammals, but there was no food transfer in these cases (Milano and Monteiro-Filho, 2009).

In *Sapajus*, alpha males have a higher daily energy requirement because of their morphological and physiological characteristics (Agostini and Visalberghi, 2005; Fedigan, 1990; Perry, 2011). Delayed scrounging was previously described in *S. cay* (Costa et al., 2020), but

Figure 1. An estrous female (left) and the alpha male (right) of a *Sapajus cay* group; the male hunted and caught the *Rhipidomys* sp. rodent. Circle indicates the dark fur on the rodent's hind paw, helping to identify it as *Rhipidomys*. Photo by Oscar Fernandes Júnior.

Figure 2. The alpha male of the *Sapajus cay* group (on the right) eating the *Rhipidomys* sp., with an adult estrous female (on the left) sitting by his side; the prey item was not shared with the female. Circle indicates the genitals of the rodent, identifying it as an adult male. Photo by Oscar Fernandes Júnior.

it is a rare event. As this record refers to an alpha male hunting, his position at the top of the hierarchy might mean that he tolerates delayed scrounging to help maintain his position in the group, as observed by Ferreira et al. (2002). Previous reports on *S. cay* hunting referred to two individuals that ate their prey 5 m away from other group members (Milano and Monteiro-Filho, 2009) and to two adult males that performed delayed scrounging subsequent to a dispute over the carcass within the group (Costa et al., 2020). This new finding highlights the importance of collecting data on this geographically restricted cebid species that still remains poorly studied for behavior.

Acknowledgments

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FIRST RECORD OF PERUVIAN SPIDER MONKEYS (*ATELES CHAMEK*) FEEDING ON A KNOWN MUSHROOM SPECIES, *OUDEMANSIELLA CANARII* (PHYSALACRIACEAE)

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Abstract

A large group of Peruvian spider monkeys, *Ateles chamek*, was recorded feeding on *Oudemansiella canarii* mushrooms in Madre de Dios, Peru. The observed spider monkeys were seen foraging for mushrooms on the forest floor where they grew on downed logs. Spider monkeys are ripe fruit specialists that rarely venture to the forest floor, suggesting that these mushrooms could represent an important though seldom consumed food source. Previous accounts of spider monkeys consuming mushrooms are sparse and do not include identification of the fungi. *O. canarii* mushrooms have a relatively high protein content, possible immunological benefits, and are present during times of relative fruit scarcity in the region. These reasons could explain why the spider monkeys risked a visit to the forest floor to forage for *O. canarii* mushrooms.

Key words: mycophagy, primate, diet, Amazon, terra firme

Resumen

Un grupo de monos araña peruanos, *Ateles chamek*, fue grabado consumiendo hongos de la especie *Oudemansiella canarii* en Madre de Dios, Perú. Estos monos fueron observados forrajeando en el suelo del bosque, donde los hongos crecían en troncos caídos. Los monos araña se especializan en comer frutas maduras y raramente bajan de los árboles para caminar en el suelo. Ésto sugiere que dichos hongos pueden representar un importante, aunque poco consumido alimento. Los registros que existen de monos araña comiendo hongos son pocos y no incluyen la identificación de las especies de estos hongos. Los hongos de *O. canarii* tienen una cantidad de proteína relativamente alta, posiblemente tienen beneficios inmunológicos, y están presentes en el bosque durante tiempos de escasez de frutas. Esas razones podrían explicar por qué los monos araña se atreven a visitar el suelo del bosque para consumir *O. canarii*.

Palabras claves: micofagia, primate, dieta, Amazonía, terra firme

Introduction

Many species of primates are known to occasionally feed on mushrooms, with fungi generally estimated to comprise 1-10% of the diet. The analysis of both stomach contents and direct observations has led to similar conclusions about the relative importance of these fungal food sources (e.g. Gautier-Hion et al., 1980; Guillotin et al., 1994; Castellanos and Chanin, 1996; Simmen and Sabatier, 1996; Hanson et al., 2003; Suarez, 2006). However, mushrooms serve as a more important food source for some monkeys, such as *Callimico goeldii* which spends up to 63% of its feeding time consuming mushrooms (Porter, 2001). Spider monkeys, genus *Ateles*, are highly frugivorous ripe fruit specialists that have diets generally consisting of 70-90% fruit, with the rest of the diet coming mostly from leaves, invertebrates, bark, soil, flowers, aerial roots, palm hearts, and fungi (Di Fiore et al., 2008).

Fruit pulp is typically rich in sugars but contains low amounts of protein, meaning spider monkeys need to feed on other food sources to meet their protein requirements. One study by Felton and colleagues (2009) found that the Peruvian spider monkey, *Ateles chamek*, had a stable daily protein intake despite having a variable total energy intake, suggesting that these monkeys prioritize protein-rich food sources while foraging. Young leaves, insect-infested fruits, and figs (which house protein-rich mutualist wasps) have been suggested as principal sources of protein for these monkeys, but mushrooms offer another, often overlooked but potentially significant source of protein (Simmen and Sabatier, 1996; Felton et al., 2009; dos Santos-Barnett et al., 2022). However, observations of non-human primates consuming mushrooms are rare, and the mushrooms in question are almost never identified to species, though sometimes the genus or the local common name is given (e.g. Castellanos and Chanin, 1996; Hanson et al., 2003). Individuals of *A. chamek* have previously been observed consuming mushrooms (Wallace, 2005), but as with many other observations of monkey mycophagy, the mushrooms being eaten were not identified. A significant amount of work

has been done to characterize spider monkey foraging habits and dietary needs, but this work overwhelmingly focuses on the consumption of ripe fruit. Though ripe fruit represents the majority of the spider monkey diet, identification of the mushrooms that spider monkeys consume can provide further insight into the habits and needs of these endangered primates. I present herein the first record of *Ateles chamek* consuming a known species of mushroom, *Oudemansiella canarii* (Jungh) Höhn, with photo and video footage (Figure 1 and Supplemental Material).

Results

I observed a group of approximately 20 individuals of *Ateles chamek* on the forest floor foraging for mushrooms on decomposing logs. This observation took place at geographical coordinates -12.565068, -70.091767 in a primary terra firme rainforest at Los Amigos Biological Station in Madre de Dios, Peru (Figure 2a) on October 24, 2021 at 9:50 a.m. local time. I recorded photo and video footage of the spider monkeys eating the mushrooms (Figure 1 and Supplemental Material). After picking a mushroom from a downed log, the monkeys retreated from the ground to a higher position in a tree before consuming the mushroom. The monkeys would typically not eat the entire mushroom, and I observed them dropping the uneaten remains to the ground in a manner similar to that seen during frugivory. The monkeys seemed to prefer to consume the mushroom cap while leaving the mushroom stipe untouched. I watched the spider monkeys forage near the mushrooms for 15 minutes before they left the area.

I identified the mushrooms (Figure 2b–c) as *Oudemansiella canarii* (Physalacriaceae) through the use of a field guide (Roca, 2016), and the identification was confirmed by the field guide author through photos (M. Roca, pers. comm.). *O. canarii* is a saprotrophic species native to tropical America and Southern Asia, where it is consumed by humans in parts of its range (Petersen and Hughes, 2010). It has also been investigated for its

Figure 1. An adult female *Ateles chamek* individual feeding on an *Oudemansiella canarii* mushroom. The spider monkey picked the mushroom from a log on the forest floor before climbing into the understory to eat it. See Supplemental Material for the full video of the spider monkey consuming the mushroom.

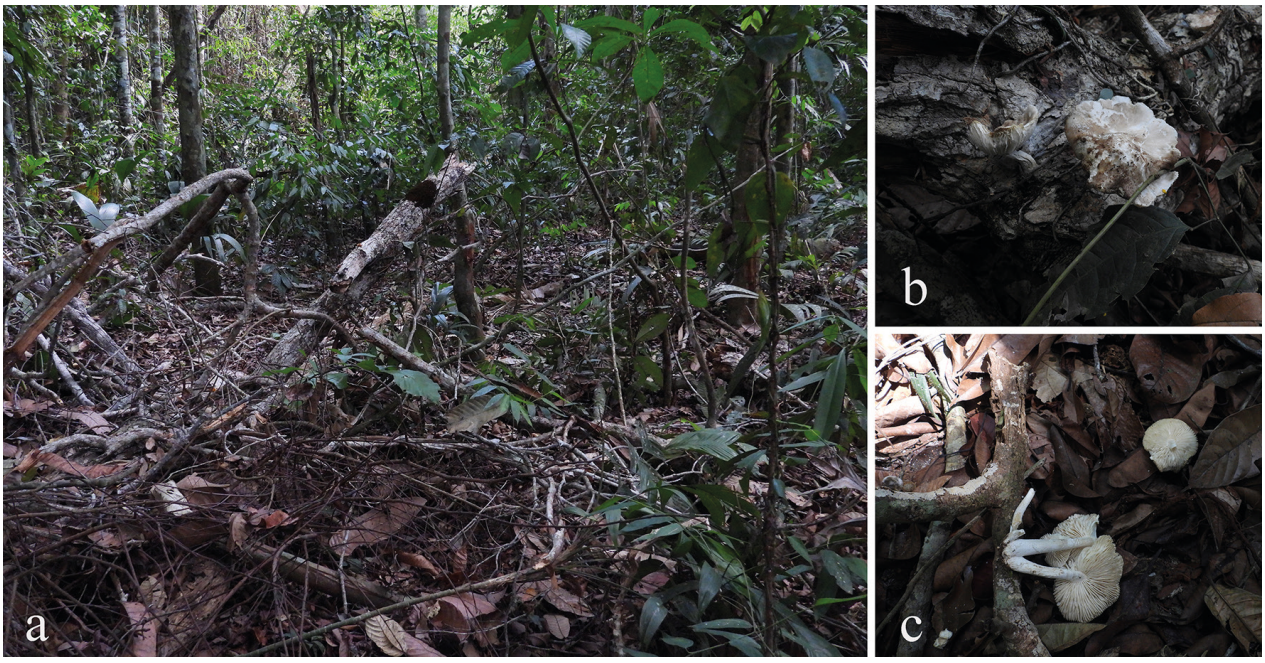

Figure 2. a) The area of terra firme forest (-12.565068, -70.091767) where the *Oudemansiella canarii* mushrooms were growing and the spider monkeys were observed foraging; b) *O. canarii* mushrooms growing on a log on the forest floor; c) the undersides of *O. canarii mushrooms.*

potential to be cultivated on a large scale for food production (see Ruegger et al., 2001; Xu et al., 2016; Acharya et al., 2019).

Discussion

Ateles chamek individuals prefer to stay high in the rainforest canopy, rarely venturing to the forest floor in search of high-quality resources (Di Fiore et al., 2008). A study of another spider monkey species in Suriname, *Ateles paniscus*, observed these monkeys in the forest understory (between 3-15 m above the ground) only during 0.8% of sightings, and the spider monkeys were never seen below 12 m (van Roosmalen, 1985). This preference is likely explained by the necessary shoulder joint and forelimb adaptations required to swing through the forest canopy in a form of suspensory locomotion known as brachiation. These same adaptations for brachiation have resulted in spider monkeys being slow and vulnerable while on the forest floor (Campbell et al., 2005). Most of the observations of spider monkeys on the ground are at mineral licks, where many different animals gather to consume soil rich in hard-to-find minerals, such as sodium (Emmons and Starck, 1979; Campbell et al., 2005; Griffiths et al., 2023). Spider monkeys that regularly visit these mineral licks are observed to be especially cautious and vigilant while in the area, often scanning for predators and resting in the forest canopy near the mineral licks for long periods of time before venturing down to the forest floor (Di Fiore et al., 2008; Link et al., 2011). Observations of *Ateles* species in Ecuador and Peru found that these spider monkeys only went down to the forest floor to feed at mineral licks or on rotten wood, although a Central American species, *A. geoffroyi*, was also observed drinking directly from water sources on the ground during the dry season (Campbell et al., 2005). This suggests that foraging on the forest floor for mushrooms presents a significant but worthwhile risk, similar to feeding at a mineral lick.

Spider monkeys may eat *Oudemansiella canarii* mushrooms for both nutritional and immunological reasons. *O. canarii* cultivated in a lab contained roughly 20% protein by mass, which is much higher than most fruits consumed by spider monkeys (Ruegger et al., 2001). Typical fruits eaten by spider monkeys contain less than 5% protein by mass, though some of the most protein-rich fruits they are known to consume have a protein content similar to that of *O. canarii* (Castellanos and Chanin, 1996; dos Santos-Barnett et al., 2022). In addition, many of the mushrooms in the genus *Oudemansiella*, including *O. canarii*, contain bioactive oudemansins which have been shown to inhibit fungal growth of pathogenic dermatophytes at very low concentrations, suggesting a potential medicinal utility for these mushrooms (Anke, 1997; Rosa et al., 2005). *O. canarii* is also a good source of bioactive phenolic compounds, which indicates that the mushrooms have antioxidant properties (Acharya et al., 2019).

The availability and distribution of fruit is the most important factor influencing the ranging behavior and habitat use of spider monkeys, with monkeys having a clear preference for areas with more fruit resources (Wallace, 2005). In times of low fruit abundance, spider monkeys are known to travel farther through their home ranges and also supplement their diet more often with alternative food sources, such as invertebrates, leaves,

and flowers (Chapman, 1987; Symington, 1987; Wallace, 2005). I observed the *Ateles chamek* individuals feeding on *Oudemansiella canarii* mushrooms in the late dry season during the transition to the rainy season, which is when ripe fruit is less readily available in the region (Symington, 1987). It is therefore possible that these mushrooms presented a more attractive food resource during that time of relative fruit scarcity.

Spider monkeys have highly variable group sizes due to their fission-fusion social structure, which is thought to be partly a result of patterns in ripe fruit availability (Klein and Klein, 1977; Aureli and Schaffner, 2008). Though spider monkeys typically forage in small groups to limit intraguild competition for resource patches, they will gather in larger numbers to rest, to feed on a limited resource such as at a mineral lick, or when there is a large amount of ripe fruit in a small area (Klein and Klein, 1977; Symington, 1987; Shimooka, 2005). In addition, the larger group size observed at mineral licks may reduce the risk of predation to the monkeys consuming soil on the forest floor (Symington, 1987; Link et al., 2011). The group of approximately 20 individuals I observed near the *Oudemansiella canarii* mushrooms was much larger than the usual foraging group size of around 5 individuals that I had observed while following spider monkey groups on numerous other occasions at Los Amigos Biological Station. This suggests that the *O. canarii* mushrooms represented a relatively important resource, as a large number of individuals were grouped together to consume them. However, the spider monkeys did not consume the entirety of the mushrooms present, which could have been due to my presence in the area being perceived as a threat, or due to the poor quality of the remaining mushrooms (see Figure 2b–c).

Overall, spider monkeys that venture to the forest floor in order to forage for *Oudemansiella canarii* mushrooms are putting themselves into a vulnerable position, though it is evidently worth the risk. *O. canarii* mushrooms may represent an attractive food source because they have a relatively high protein content, they can be present during times of relative food scarcity due to patterns in ripe fruit phenology, and they could provide immunological benefits due to their antioxidant properties and oudemansin content (Chapman, 1987; Symington, 1987; Anke, 1997; Ruegger et al., 2001; Rosa et al., 2005; Wallace, 2005). Though the significance of mycophagy in the diet of spider monkeys is still poorly understood, this rarely observed behavior could represent a small yet important part of their diet and foraging habits.

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Supplemental Material. A video of an adult female *Ateles chamek* individual feeding on an *Oudemansiella canarii* mushroom.

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PREDATION ON TWO BROWN-EARED WOOLLY OPOSSUMS (*CALUROMYS LANATUS*) BY A GROUP OF LARGE-HEADED CAPUCHIN MONKEYS (*SAPAJUS MACROCEPHALUS*) AND NOTES ON THEIR HIERARCHICAL FEEDING BEHAVIOUR

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Abstract

The large-headed capuchin monkey (*Sapajus macrocephalus*) is a generalist omnivore known for its dietary flexibility and opportunistic feeding strategies. In September 2022, at the Manu Learning Centre Biological Station in southeast Peru, a group of seven monkeys was observed preying on two brown-eared woolly opossums (*Caluromys lanatus*). The feeding followed a hierarchical order, with the alpha male and a female with an infant feeding first, followed by a juvenile. There was no aggressive behaviour towards juveniles, suggesting adults may facilitate their feeding. This observation adds a new prey item to the capuchin's diet and highlights their diverse dietary habits.

Key words: Diet, opportunistic predation, Neotropical primates, Peruvian Amazon, Manu Biosphere Reserve

Resumen

El mono capuchino de cabeza grande (*Sapajus macrocephalus*) es un omnívoro generalista conocido por su dieta flexible y estrategias de alimentación oportunista. En septiembre del 2022, en la Estación Biológica Manu Learning Centre al sureste de Perú, se observó un grupo de siete monos depredando a dos zarigüeyas lanudas de orejas marrones (*Caluromys lanatus*). La alimentación siguió un orden jerárquico, con el macho alfa y una hembra con un infante alimentándose primero, seguidos por un juvenil. No hubo comportamiento agresivo hacia los juveniles, lo que sugiere que los adultos pueden facilitar su alimentación. Esta observación agrega un nuevo ítem a la dieta de los capuchinos y resalta sus diversos hábitos alimenticios.

Palabras clave: Dieta, depredación oportunista, primates neotropicales, Amazonía peruana, Reserva de Biósfera del Manu

Introduction

The large-headed capuchin monkey (*Sapajus macrocephalus*), sometimes considered a subspecies of *Sapajus apella*, is a platyrrhine primate (2.9-4.6 kg males and 1.3-3.4 kg females) that inhabits almost all types of Amazonian lowland and submontane forests and lives in groups of six to more than 20 individuals, with the number of females exceeding the number of males (Mittermeier et al., 2013; Boubli et al., 2021). It is considered a generalist omnivore since it possesses dietary flexibility, cognitive and manipulative ability, and opportunistic feeding strategies (Mittermeier et al., 2013; Watts, 2020). Capuchin monkey diets can include plant parts, invertebrates, and small vertebrates (Fedigan, 1990; Rose, 1997; Watts, 2020; Boubli et al., 2021; Rylands et al., 2024). Vertebrate prey items include frogs, lizards, birds and their eggs, bats, opossums, rodents, and other monkeys (Izawa, 1978; Ferreira et al., 2002; Resende et al., 2004; Sampaio and Ferrari, 2005; Carretero-Pinzón et al., 2008; Gómez-Posada, 2012; Watts, 2020; Lee and Huang, 2021).

The brown-eared woolly opossum (*Caluromys lanatus*) has a wide distribution and can be found in various habitats, including secondary forests of the Amazon lowland forest (Wilson and Mittermeier, 2015). This nocturnal, solitary, and arboreal species rarely descends to the

ground, occupying mainly the canopy and sub-canopy, between 5 to 15 m high (Lambert et al., 2005; Cáceres and Carmignotto, 2006; Vieira and Camargo, 2012; Wilson and Mittermeier, 2015).

Here, we report a predation event by a group of large-headed capuchin monkeys on two brown-eared woolly opossums and provide some comments on the hierarchical feeding behaviour of this monkey species.

Observations

This chance event was observed in the Manu Learning Centre (MLC) Biological Station (12°47'21" S, 71°23'28" W; 460 m.a.s.l.) located in the buffer zone of the Manu National Park in south-east Peru, a 643 ha area of lowland tropical secondary-growth rainforest that has historically experienced different human disturbances at different levels including cattle ranching, agriculture and selective logging (Whitworth et al., 2016). Large-headed capuchin monkey groups are observed at the MLC Biological Station basecamp throughout the year. This is the third record of predation by *Sapajus macrocephalus* on a vertebrate in this area. Previously, Lee and Huang (2021) recorded the predation of the eggs of the russet-backed oropendola (*Psarocolius angustifrons*) and a rodent (*Oecomys* sp.) by a pair of individuals of this species.

On 25th September, 2022 at 14:32, through audio detection, one adult male of *Sapajus macrocephalus* (which henceforth will be called "alpha male") was spotted in an aguaje palm (*Mauritia flexuosa*) at approximately 15 m height, next to the facilities of the MLC basecamp. This individual was eating a juvenile opossum (*Caluromys lanatus*) while at the same time holding a seemingly dead adult opossum by the tail with his left foot. Once the alpha male finished eating the juvenile opossum, he dropped the carcass on the vegetation. Then he proceeded to feed on the adult opossum, starting from the tail, followed by the groin, tearing the stomach fur and skin, and eating some internal organs from the body. None of the other capuchin monkeys that were around attempted to feed on the carcass of the juvenile opossum.

While the alpha male was still eating, a female capuchin with a baby on her back approached and observed the alpha male. A third capuchin, a small juvenile, also came and tried to grab some pieces of internal organs that were hanging from the body (Figure 1). At 14:40, the alpha male left the adult opossum's body on one of the aguaje's branches and at 14:43 the female carrying the infant started to feed on it. At 14:52, this female left the carcass and the small juvenile capuchin took the opossum to eat it in the same aguaje palm. At 14:58, we observed a fourth capuchin, another juvenile, waiting at a distance of 50 cm from the third capuchin who was eating the remains of the opossum carcass.

The fourth capuchin attempted to approach the carcass to feed, but failed because the third capuchin did not let him. Subsequently, the fourth capuchin left to feed on fruits in a Pacay tree (*Inga* sp.). At 15:08, the third capuchin moved with the opossum in its hands to other branches out of sight. The next time we observed the adult opossum's body, at 15:11, it had been re-obtained by the first female, who started to feed on it again. Soon after, the female left the opossum on a branch and moved away. At 15:17, a fifth capuchin, another juvenile, took the adult opossum's body, but was not observed attempting to eat it. It dropped the carcass, which fell onto a termite nest. At 15:39, another juvenile approached the carcass, but did not feed from it. At 15:42 the entire group left the area, with the discarded carcass remaining in the tree on a termite nest. Both opossums were identified first from a distance and then confirmed within close proximity of the carcass, based on a field guide (Emmons and Feer, 1997).

Discussion

We are unsure when exactly the opossums were killed, or what was the cause of death. At the beginning of the

Figure 1. An alpha male *Sapajus macrocephalus* feeding on *Caluromys lanatus*, while a female with a baby on her back observes and a juvenile tries to grab the internal organs. Photograph by Daniel Ash.

observation, the adult opossum appeared to be dead, although it is possible that it was still alive and in a state of thanatosis. Monkeys are commonly reported to kill their prey with craniocervical bites (Steklis and King, 1978; King and Steklis, 1984; Milano and Monteiro-Filho, 2009; Lee and Huang, 2021). According to Steklis and King (1978), the function of the craniocervical bite is the rapid and complete immobilization of the prey, but it could be unnecessary if the predator already has it under control. The fact that the prey is still alive does not always prevent its consumption by the primate. Palmeira and Pianca (2012) observed an adult male black-horned capuchin monkey (*Sapajus nigritus*) eating a brown-eared woolly opossum (*Caluromys lanatus*) that was still alive after being hit by a car.

In total, we recorded a mixed group of seven individuals. There was a hierarchical order when feeding on the adult opossum. First, the alpha male and the female carrying an infant fed, followed by a juvenile. According to di Bitetti and Janson (2001), the alpha male and alpha female, who tend to occupy central-forward positions of a foraging group, are able to monopolize newly discovered food sources and thus obtain a major share of them, even when the food was found by other individuals.

In large-headed capuchin monkeys hierarchical feeding behaviour can be due to different causes: dominance through physical superiority (size, strength, and agility) or avoidance of aggression which can be achieved by maintaining close kinship or alliance with dominants (Janson, 1985; Kurland, 1977). These strategies may have happened in our observation, given that only one juvenile ate the adult opossum after the alpha male and female had finished, and two more were nearby but did not interact with the carcass and one transported it without eating it.

We did not observe aggressive behaviour by adults towards juveniles when they tried to grab pieces of the opossum. Tolerance towards juveniles during feeding has been previously recorded in *Sapajus* and *Cebus* (Izawa, 1980; Perry and Rose, 1994; Coelho et al., 2015), and could be related to the lack of skill in the management and acquisition of food by juveniles, as occurs in other primate species when they are choosing leaves and soft fruits rather than hard ones (Janson and van Schaik, 1993; Riveros and Ferreira, 2001). In our observations, the adults may have been facilitating the consumption of the opossum for the juveniles, since the adults fed first and left the carcass, when it was already open and internal organs and tissues were easily accessible. This facilitation could be a third cause for the observed order of feeding during the predation event.

According to Watts (2020), the main reason why primates may feed on vertebrates may be to supplement their diet with micronutrients that are scarce in plant material, rather than for protein consumption. In terms of seasonality, events of vertebrate predation have been reported in *Sapajus* in both dry and wet seasons with the same frequency (Ferreira et al., 2002; Palmeira and Pianca, 2012; Watts, 2020; Lee and Huang, 2021), but the small sample size for this type of event limits the ability to draw conclusions about seasonality. The foraging behaviour of capuchin monkeys is flexible and exploratory, adjusting their feeding based on resource availability (Sabbatini et al., 2008).

Our observation adds a novel prey item to the known diet of large-headed capuchin monkeys and reinforces their opportunistic and diverse dietary behaviour. This observation also provides an example of hierarchical order in feeding behaviour in this primate species.

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Short Articles

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COMPORTAMIENTO DE FROTAMIENTO SOBRE EL PELAJE DE MONOS ARAÑA CENTROAMERICANOS (*ATELES GEOFFROYI* KUHL, 1820; ATELIDAE) EN ENTORNO DE CAUTIVERIO EN HONDURAS

Manuel Alejandro Paz-Sánchez

Resumen

Se realizó un enriquecimiento ambiental mediante el uso del fruto maduro de lima limón (*Citrus* sp.; Rutaceae) a una tropa de monos araña cautiva en el Centro Nacional de Conservación y Recuperación de Especies/Zoológico Rosy Walther, Tegucigalpa, Honduras. Ésto con el objetivo de estimular las funciones biológicas en los primates. Todos los individuos interactuaron con el fruto; sin embargo, las frotaciones del pelaje (esternal y axilar) con el cítrico fueron realizadas específicamente por los machos adultos y juvenil. La función a este comportamiento que excluyó a las hembras puede radicar en algunas de las hipótesis planteadas para la especie como el rol del marcado del olor y su relación con la comunicación olfativa.

Palabras clave: *Citrus* sp., comunicación olfativa, enriquecimiento ambiental, zoológico

Abstract

We provided environmental enrichment by offering ripe limes (*Citrus* sp.; Rutaceae) to a troop of captive spider monkeys at the National Center for Conservation and Recovery of Species/Rosy Walther Zoo, Tegucigalpa, Honduras. The aim of the study was to stimulate biological functions in these nonhuman primates. All individuals interacted with the fruit; however, fur rubbing (sternal and axillary) with the citrus fruit was performed specifically by adult and juvenile males. The function of this behavior may relate to scent marking for olfactory communication, a hypothesis already proposed for the species.

Keywords: *Citrus* sp., olfactory communication, environmental enrichment, zoo

Introducción

Reportes indican que una gran cantidad de mamíferos se frotan a sí mismos con determinadas plantas (Jarman, 1979), algunos invertebrados (Carroll et al., 2005) así como sustancias manufacturadas que contengan olor (aceite de motor y perfume) (Ryon et al., 1986). Se ha propuesto que este comportamiento -que recibe varias nominaciones: frotamiento sobre el pelaje o auto-unción (Gosling y McKay, 1990)-, puede tener diferentes funciones como el camuflaje de otros olores, la familiarización del sujeto con olores nuevos y el aumento del atractivo social (Rieger, 1979; Ryon et al., 1986). Este comportamiento de frotación con plantas e insectos se ha observado en diferentes especies de primates neotropicales silvestres como *Cebus imitator* (Baker, 1996), *Sapajus* spp. (Paukner y Suomi, 2008), *Ateles geoffroyi* (Campbell, 2000; Laska et al., 2007), *Cheracebus* sp. (Defler, 2010) y *Aotus* sp. (Evans et al., 2003; Zito et al., 2003).

El objetivo de este estudio es describir el comportamiento de frotamiento de pelaje en monos araña centroamericanos (*Ateles geoffroyi*) en cautiverio en Honduras.

Método

El 27 de mayo de 2020 se realizó un enriquecimiento ambiental táctil/olfativo al grupo de monos araña (*Ateles geoffroyi*) ubicados en el área de excedentes del Centro Nacional de Conservación y Recuperación de Especies/Zoológico Rosy Walther, localizado en Tegucigalpa, Honduras. La tropa de monos araña está conformada por cuatro machos (dos adultos, un juvenil y un infante) y siete hembras adultas. Esta composición de grupo se basa en función del arribo de los animales al centro en diferentes años. Estos individuos llegaron en calidad de donaciones, rescate y decomisos. La función principal del centro es albergar y rehabilitar a animales silvestres a nivel nacional bajo estas tres modalidades siendo uno de los propósitos para la creación de esta institución.

Durante todo el enriquecimiento se realizó un registro de comportamientos mediante el muestreo *ad libitum* (Altmann, 1974), anotando la duración en minutos de cada evento de roce de pieles realizado por los monos. En el estudio se utilizó el fruto maduro de lima limón (*Citrus* sp., Rutaceae), el cual se cortó a la mitad y ambas porciones se le entregaba a cada miembro desde afuera del recinto por los agujeros de la malla. La acción se repetía cuando alguno de los animales pedía más fruta o dejaba caer el fruto al suelo. La observación en el enriquecimiento ambiental fue aproximadamente de 30 minutos y se aplicó después que los monos se habían alimentado.

La idea y el concepto de este enriquecimiento ambiental fueron tomados como referencia del manual de enriquecimiento ambiental para mamíferos en cautiverio elaborado por Khoshen (2013).

Resultados y discusión

Antes de aplicar el enriquecimiento ambiental, los monos estaban descansando en sus dormitorios aéreos dentro del recinto. Al momento que nos acercamos (10:30 a.m.) con las porciones de los frutos, los ejemplares se desplazaron a la malla que limitaba el contacto directo

con nosotros. Todos los individuos tomaron las dos porciones iniciales de lima limón (Fig. 1) y se desplazaron por separado a determinados lugares del recinto. Los comportamientos observados en toda la tropa de monos araña al interactuar con las porciones del fruto se basaron en cuatro categorías conductuales; el olfateo, lamidas, raspado con los dientes y frotamiento del pelaje.

De los 11 individuos solo tres machos (dos adultos y un juvenil) realizaron las cuatro categorías enunciadas anteriormente, las hembras y el infante macho sólo olfatearon y lamieron el fruto (interacción que duró ~15 segundos en ambas porciones del fruto), luego lo tiraron. Se repitió el evento una vez más y se les entregaron a estos mismos individuos otras dos porciones (1 fruto completo). Se obtuvieron resultados similares en comportamientos emitidos y consumo de tiempo al evento inicial, posterior a esta interacción se desplazaron a otros sitios del recinto.

Para los tres machos (adultos y juvenil) en el primer evento olfatearon y lamieron las porciones por ~15 segundos y posterior procedieron a frotarse el pelaje. Los individuos tomaron las porciones del fruto con ambas manos, pero sólo utilizaban una a la vez mientras se frotaban simultáneamente el pelaje del pecho y zonas axilares hasta empaparse bien. Luego de absorber el zumo inicial del cítrico, raspaban con sus dientes en repetidas ocasiones la misma pulpa hasta liberar más líquido y continuaron con las frotaciones. Estos eventos duraron ~3 minutos; finalmente dejaron caer las cáscaras e hicieron una pausa de ~10 segundos a la par de acercarse a la malla del recinto para pedir otro fruto (o porciones).

En el segundo evento los mismos machos tomaron el fruto y se desplazaron a lugares separados dentro del recinto, olfatearon y lamieron las porciones por ~10 segundos. Luego se frotaron simultáneamente con ambas manos el pelaje de las mismas zonas del cuerpo del evento inicial, posterior rasparon la pulpa del fruto para frotarse nuevamente el pelaje de las áreas anteriormente estimuladas, y por último, tiraron las cáscaras del fruto concluyendo de tal manera así las frotaciones para los dos machos adultos al no solicitar más porciones. Esta actividad de frotación y raspado de fruto duró ~3 minutos. Sin embargo el macho juvenil (Fig. 2), se acercó nuevamente para pedir otro fruto, olfateó y lamió por ~10 segundos ambas porciones y realizó las frotaciones del pelaje. No obstante con este último fruto se frotó específicamente más el pecho que las zonas axilares, el tiempo consumido en estas últimas acciones para este individuo fue ~2 minutos.

Como se indicó en la introducción, el frotamiento en el pelaje de Platyrrhini ha sido documentado en varios géneros. En *Cebus* se reporta que este comportamiento puede funcionar como repelente de insectos o tratar infecciones y hongos, ya que estos monos seleccionan y usan intencionalmente algunas plantas con dichas

Figura 1. Porciones de *Citrus* sp., entregadas a la tropa de monos.

propiedades y obtienen estos beneficios frotando e impregnando el pelaje de su cuerpo (DeJoseph et al., 2002).

En Panamá se registró que los monos araña en libertad utilizan tres especies de Rutaceae (Campbell, 2000), todas con características y propiedades que funcionan como repelentes de insectos (Morton, 1981; Downum et al., 1993). El registro en el que los machos realizaban el frotamiento más a menudo que las hembras, y que sólo se impregnaron con la mezcla de hoja y saliva en las zonas esternales y axilares de sus cuerpos, llevaron a Campbell (2000) a concluir que la frotación en los monos araña tiene una función diferente a un medio repelente, y propone que puede funcionar en la marcación olfativa.

En este estudio sólo los machos mostraron mayor interés que las hembras al interactuar con el cítrico, -similar a los *Ateles* estudiados por Campbell (2000) y Laska et al., (2007)- expuestos a situaciones parecidas. Los machos se frotaron únicamente zonas axilares y esternales obviando las otras partes de su cuerpo (Fig. 3, existe evidencia de

Figura 2. *Ateles* macho juvenil.

video como material suplementario), igual a los monos araña en cautiverio observados por Klein y Klein (1971).

Considerando lo anterior, aunque no se puede descartar por completo la posibilidad de que este grupo de monos cautivos hayan utilizado el fruto *Citrus* sp., para repeler insectos o tratar infecciones cutáneas, la idea parece improbable debido a lo siguiente; (1) sólo los machos fueron los participativos; (2) en la limpieza diaria del recinto antes y durante de la aplicación del enriquecimiento ambiental no se reportó la presencia de insectos o monos con piel lastimada. Adicionalmente, Campbell (2000) y Laska et al. (2007) propusieron que el frotamiento del pelaje en los monos araña estudiados puede funcionar en el marcado del olor y la comunicación olfativa.

En conclusión, el poco tiempo de observación dedicada a la tropa de monos, y haber utilizado solamente un material aromático (cítrico) para esta interacción, imposibilita determinar causas específicas (a parte de las ya conocidas para la especie) sobre el motivo de este comportamiento. Sin embargo, en este caso de cautiverio, la función a esta frotación puede radicar bajo la luz de las hipótesis planteadas por Campbell (2000) y Laska et al. (2007).

No obstante, la aplicación a futuro de programas de enriquecimientos ambientales táctiles y/o olfativos en monos araña cautivos, en los cuales se utilicen diferentes cítricos en ambas épocas del año (esto por la presencia de insectos irritantes en época de invierno o el factor

Figura 3. *Ateles* macho adulto frotándose el cuerpo con el fruto.

reproductivo en verano) podrían arrojar datos que sean estadísticamente representativos para este comportamiento, y así poder comprobar de manera experimental las hipótesis señaladas.

Es necesario mencionar lo relevante de haber aplicado este tipo de enriquecimiento ambiental, ya que estimuló en la tropa de monos la convivencia rutinaria en su recinto al interactuar con un fruto ácido, fuera de su dieta cautiva, lo cual resultó novedoso a su paladar y pelaje, y por consecuente registrar los resultados para fines científicos poco explorados de este primate centroamericano.

De igual manera es importante señalar que no hay registro de investigaciones de monos araña en cautiverio realizados en Honduras. Por lo tanto, este estudio debe sentar las bases para continuar con la ejecución y aplicación de enriquecimientos ambientales a primates cautivos no solo para estimular las funciones biológicas de los animales, sino también para incentivar la raíz investigativa en el ámbito primatológico en otros centros de conservación o zoológicos de Honduras.

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Material Suplementario. Un video de los machos *Ateles geoffroyi* en el Zoológico Rosy Wather en Honduras. Se frotan con lima limón únicamente zonas axilares y esternales obviando las otras partes de su cuerpo.

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PREDATION ATTEMPT BY MARMOSETS (*CALLITHRIX* SPP.) ON A PICAZURO PIGEON'S NEST (*PATAGIOENAS PICAZURO*) IN AN URBAN ENVIRONMENT

Isabela Viotto Conti

Abstract

The introduction of exotic species is one of the greatest threats to biodiversity, with hybridization a major consequence. The species *Callithrix jacchus*, introduced to the Atlantic Forest, has established populations in urban areas and has been hybridizing with *C. penicillata*. Its generalist diet includes nest predation on birds, a potential threat to native bird populations. However, much of the data comes from more preserved areas, leaving a gap in our understanding of the impact of these primates on urban bird populations. Here, I describe an attempted predation of eggs in a picazuro pigeon (*Patagioenas picazuro*) nest by two *Callithrix* sp. individuals observed in a residential urban area in Campinas, São Paulo, Brazil. During the incident, the animals seemed unbothered by traffic or pedestrians, but were alert to the call of a raptor. While the significant impact of introduced predators on bird populations is well-studied, data on this behavior in invasive primates remains scarce. Further research is needed to better understand the ecological relationships in anthropogenic environments and their impacts on urban biodiversity.

Keywords: Callitrichidae, urban primates, invasive primates

Resumo

A introdução de espécies exóticas é uma das maiores ameaças a biodiversidade, sendo a hibridização uma de suas maiores consequências. A espécie *Callithrix jacchus*, introduzida na mata atlântica, estabeleceu populações em áreas urbanas, e vem hibridizando-se com *C. penicillata*, produzindo híbridos com diferentes características. Sua dieta generalista inclui a predação de ninhos de aves, e estudos apontam que esse hábito pode representar uma ameaça a populações de aves nativas. Porém, grande parte desses dados são provenientes de áreas mais conservadas, havendo uma lacuna de informações sobre o impacto desses primatas em populações de aves urbanas. Aqui descrevo a tentativa de predação de ovos em um ninho de uma pomba-asa-branca (*Patagioenas picazuro*) por dois indivíduos de *Callithrix* sp., observada em uma área urbana residencial em Campinas, são Paulo, brasil. Durante o ocorrido, os animais aparentemente não se incomodaram com o trânsito ou pedestres, mas ficaram em estado de alerta com a vocalização de uma ave de rapina. Enquanto o grande impacto de predadores introduzidos em populações de aves é bem estudado, faltam dados sobre esse comportamento em primatas invasores. São necessárias mais pesquisas para compreender melhor as relações ecológicas em ambientes antrópicos e seus impactos na biodiversidade urbana.

Palavras chaves: Callitrichidae, primatas urbanos, primatas invasores

Invasions by non-native species are one of the greatest threats to biodiversity, making it urgent to understand the consequences of introduced animals in new environments, including disease introduction, hybridization, and predation of native species (Gurevitch and Padilla, 2004). The natural distribution of the black-tufted marmoset (*Callithrix penicillata*) is within the Cerrado biome, but it also has been introduced into other areas by the illegal wildlife trade, and can hybridize with other marmoset species, such as the common marmoset (*C. jacchus*) from the Caatinga biome (Braz et al., 2019). The two species are differentiated mostly by their auricular tuft format and colors. While the *C. penicillata* morphotype has blackish pre-auricular tufts, *C. jacchus* has white circum-auricular tufts (Rylands et al., 2009). Their hybrids have diverse traits, like white auricular tufts, similar in color but not in tuft format to those of *C. jacchus* (Cezar et al., 2017). These species and their hybrids have well-established populations in many disturbed areas of the Atlantic Forest including in urban areas (Goulart et al., 2010), where they are successful due to their generalist habits which allow for great adaptive plasticity (Ferrari et al., 2013).

These marmosets' diet includes mostly fruits and insects in the rainy season, but in the dry season, the diet is complemented with tree exudates, small vertebrates, and bird's eggs (Miranda and Faria, 2001). Due to their predatory behavior, marmosets are believed to be a threat to native bird populations (e.g. Lyra-Neves et al., 2007; Galetti et al., 2009; Alexandrino et al., 2012). Most of these studies on bird predation by marmosets were conducted in natural areas, not urban areas, with a relative lack of information about the impacts of invasive primates on urban bird populations.

This report describes a predation attempt on a picazuro pigeon (*Patagioenas picazuro*) nest by two marmosets. The event occurred in the surroundings of the campus of the State University of Campinas (UNICAMP), located in Campinas city, São Paulo state, Brazil (Figure 1). The University's neighborhood is a residential area, with small patches of Atlantic Forest and wooded parks. The city is located in a transition zone of Cerrado and Atlantic Forest, where the black-tufted marmoset (*Callithrix penicillata*) could naturally occur (Rylands et al., 2009). Verçosa and Setz (2020), who studied the local populations' diet, suggest that there are groups containing the local species,

Figure 1. Location of the predation attempt by *Callithrix* spp. on the Picazuro pigeon nest. The circle in the inset map indicates the location of Campinas City in São Paulo state.

Figure 2. Two marmosets from a group on the UNICAMP campus. The individual on the left has a *Callithrix penicillata* morphotype, while the one on the right has a *C. jacchus* morphotype. Photo: Isabela Viotto Conti.

plus non-native common marmosets and their hybrid descendants (Figure 2). Their diet is composed mostly of gum. Due to their charisma, the marmosets are fed by locals with fruit; bananas form a great percentage of their diet, especially in the dry season.

On June 24, 2022, at 11 a.m., a marmoset pair, one adult female (with a *Callithrix penicillata* morphotype) and one adult male (with pre-auricular, but white and gray tufts, probably a hybrid morphotype), came to the corner of a street near to UNICAMP (-22.821240°, -47.073592°), walking along electricity cables. They climbed onto a flamboyant tree (*Delonix regia*), an exotic species, and approached a picazuro pigeon (*P. picazuro*) nest on a branch at 3 m height. These birds are native and common in cities. Both marmosets tried to reach the egg underneath the female pigeon's body, while the bird agitated its wings, trying to get them to go away. These loud movements did not scare the primates, who continued to try to get the egg, removing the twigs in the bottom of the nest. The marmosets only stopped trying to get the egg when a yellow-headed caracara (*Milvago chimachima*) vocalized nearby, and the alarmed marmoset female climbed away to a nearby branch. Although there are no records of this species of caracara preying on marmosets, as a bird of prey it probably was recognized as a potential predator. After a few seconds, the marmosets restarted the quest.

After another two minutes, the female marmoset stopped and moved to another branch in the same tree, while the male persisted in attempting to remove the egg. Another pigeon, possibly the nestmate, flew to the tree while vocalizing, but this did not disturb the primates. After a brief period, the male marmoset destroyed the nest through pulling out twigs, leading to the egg falling and breaking on the ground. The marmoset pair ended their pursuit of the egg and approached the human observers, then climbed into another tree, continuing on along the trees of a nearby backyard. The female pigeon stayed in the ruined nest, but the next day she was gone.

During the 10 minutes of the event, the marmosets apparently were not bothered by the traffic noises, such as cars, motorcycles, and pedestrians, demonstrating their adaptation to the urban environment. However, they immediately showed a reaction to a call of a bird of prey.

While Zaluar and Vale (2021) claim that invasive marmosets do not have an impact on the bird population, Zaluar et al. (2022) argue that they do have a negative impact by causing a decrease in bird acoustic diversity in areas with marmoset occurrence. Although feral cats (*Felis catus*) are reported to be one of the biggest threats to urban bird populations (Marra and Santella, 2016), little is known about invasive marmosets' impact on birds. On the other hand, with the deficit of other frugivorous species in urban areas, marmosets may also have a positive effect on urban ecology through acting as seed dispersers (Silva et al., 2017).

The present report demonstrates the importance of understanding a well-adapted invasive predatory primate's effect on local bird populations. Invasive species are a global problem that causes environmental degradation and can cost hundreds of billions of dollars in the eradication process and in monitoring for new diseases (Warziniack et al., 2021). It is crucial to understand invasive species' effects on biodiversity in any kind of environment, including in urban areas.

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BROWN CAPUCHIN (*SAPAJUS APELLA*) IN FRENCH GUIANA REPEATEDLY INSERTS *IN-SITU* PALM-TRUNK SPINES BETWEEN TEETH

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Guest editor: Tiago Falótico

Abstract

Capuchin monkeys are known for their dexterity, risk-taking, and object manipulation skills, including tool use. Animal populations on islands often produce novel behaviors, especially when the location is absent of key predators. On Île Royale in French Guiana, predators such as large felids are absent, and introduced robust capuchin monkeys (*Sapajus apella*) are abundant and fed both directly and indirectly by tourists. Here we provide a photo sequence of a juvenile robust capuchin monkey using the in-situ spines on a palm tree trunk as toothpicks. The capuchin interacted with stationary, dangerous and delicate objects, the sharp and numerous in-situ palm spines, and positioned the mouth three times consecutively so that a spine entered between two of the teeth. While observations of dental cleaning, probing or flossing in other primate species, including *S. libidinosus*, are considered tool use as they involve the use of movable objects to manipulate the environment, here careful body orientation to utilize a potentially harmful stationary object is not considered tool use, but expands previous findings that capuchins are cognitively skilled, dexterous, highly exploratory and willing to risk pain in foraging and other activities. We hope this observation stimulates further research on capuchin behavior within the Guianas and throughout the Amazon biome, where robust capuchins are abundant but relatively little studied in regards to tool use behavior and object manipulation.

Keywords: Cebidae, cognition, dexterity, Guianas, island behavior, object manipulation

Résumé

Les singes capucins sont réputés pour leur dextérité, leur goût du risque et leur capacité à manipuler des objets, notamment des outils. Les populations animales insulaires développent souvent des comportements inédits, surtout en l'absence de prédateurs importants. L'Île Royale, en Guyane française, connait une absence de prédateurs, tels les grands félins, et les capucins bruns (*Sapajus apella*), introduits sur l'île, y sont nombreux et nourris, directement et indirectement, par les touristes. Nous présentons ici une séquence de photos d'un jeune singe capucin brun utilisant les épines d'un tronc de palmier comme cure-dents. Le capucin a interagi avec des objets immobiles, dangereux et fragiles, les nombreuses épines acérées du palmier, et a positionné sa bouche à trois reprises dans le but de glisser une épine entre deux dents. Alors que les observations de nettoyage dentaire, de sondage dentaire ou d'utilisation de fil dentaire chez d'autres espèces de primates, y compris *S. libidinosus*, sont considérées comme une utilisation d'outils car elles impliquent l'utilisation d'objets mobiles pour manipuler l'environnement, ici l'orientation corporelle soignée pour utiliser un objet stationnaire potentiellement dangereux n'est pas considérée comme une utilisation d'outils, mais élargit les conclusions précédentes selon lesquelles les capucins sont cognitivement doués, habiles, très explorateurs et prêts à risquer la douleur lors de la recherche de nourriture et d'autres activités. Nous espérons que cette observation encouragera de nouvelles recherches sur le comportement des capucins dans les Guyanes et dans tout le biome amazonien, où les capucins robustes sont abondants mais relativement peu étudiés vis-àvis de l'utilisation d'outils et de la manipulation d'objets.

Mots-clés: Cebidae, cognition, comportement insulaire, dextérité, Guyanes, manipulation d'objets

Introduction

Capuchin monkeys are known for their dexterity, risk-taking, and object manipulation skills, including tool use (Fragaszy et al., 2004). Animal populations on islands may become bolder (Gavriilidi et al., 2022) and capuchins on islands may produce novel behaviors, especially when the location is absent of key predators (Phillips, 1998; Goldsborough et al., 2025). Here we describe a novel behavior for brown capuchin monkeys (*Sapajus apella*) on Île Royale, of the Îles du Salut (Salvation Islands), French Guiana. These islands were formerly a French penal colony and are now a tourist destination for learning about the brutal regional colonial history. The capuchins likely were introduced to the islands but are native to mainland French Guiana. On Île Royale, predators such as large felids are absent, and the robust capuchin monkeys are abundant (Guyane la 1ére, 2021; The Lazy Nomad, 2022; ParoDeeJay, 2025). They are hand fed directly by tourists (Les Aventures de Fishou, 2019) and eat human-made foods from garbage cans near the restaurant-guesthouse on the island (The Lazy Nomad, 2022; ParoDeeJay, 2025), or take food directly from the restaurant (Guyane la 1ére, 2021).

We provide a photo sequence of a juvenile robust capuchin monkey (*Sapajus apella*) using the in-situ spines on the trunk of a Macaw or Mouyaca palm tree (*Acrocomia aculeata*) (or possibly an Awara palm tree, *Astrocaryum vulgare*) as toothpicks (Figure 1, panels A-N). The photo series was taken from 9:54.51 a.m. to 9:55.23 a.m. October

2, 2022 at Île Royale (5.286581, -52.588167), French Guiana. While standing on the palm fronds from another palm tree, the capuchin touched several palm-trunk spines with its fingers while visually assessing them. Over the course of the observation, the capuchin positioned its head three times consecutively so that an *in-situ* palm spine entered between its teeth, then held the spine in place with its lips closed before releasing it (see Figure 2 for close up). While capuchins frequently bite and hold attached objects with their teeth to pull them out (Tiago Falótico, pers. obs.), in this case we did not observe the juvenile pulling or twisting the thorn. However juvenile capuchins often exhibit exploratory behaviors that do not have a clear function.

The use of loose sticks as probe tools for teeth cleaning or brushing has been reported for ape species in the wild, including a bonobo (*Pan paniscus*: Ingmanson, 1996) and orangutans (*Pongo abelii*: van Schaik et al., 2008; Meulman and van Schaik, 2013). An urban population of long-tailed macaques (*Macaca fascicularis*: Watanabe et al., 2007) used human hair and coconut shell fiber as dental floss, and other wild long-tailed macaque populations were reported to brush their teeth with twigs (Watanabe et al., 2007) or to pick their teeth with strings from nylon or coconut fiber rope (Mazumder and Kaburu, 2020). Bonnet macaques (*M. radiata*: Pal and Sinha, 2022) used twigs or sticks for dental probing. A wild adult female bearded capuchin (*Sapajus libidinosus*: Haslam and Falótico, 2015) used sticks as toothpick tools to repeatedly target the same gum area; this behavior was considered by the authors to be directed at relieving discomfort or dislodging an irritant.

These observations of dental cleaning, probing or flossing in other primate species are considered a type of tool use because they involve the use of movable objects to manipulate the environment—in this context, self-directed tool use to the body (Pal and Sinha, 2022). Beck's (1980) definition of tool use requires the use of an unattached environmental object to alter another object, another organism or the user itself. Shumaker et al. (2024) modifies this definition to include "manipulable attached environmental" objects as potential tools. However, in the case presented here the capuchin repeatedly interacted with stationary, dangerous and delicate objects, the sharp and numerous in-situ palm spines attached to the trunk of a palm tree, in order to position the mouth so that one of the spines entered between two of the teeth (Figure 2). This selection of a spine for use, and subsequent

Figure 1(A-D). A brown capuchin (*Sapajus apella*) repeatedly positions its head so *in-situ* palm spines enter between its teeth. A) The capuchin touches several spines with fingers while visually assessing them, while standing on the palm fronds from another palm tree. B) Placement of the open mouth to position spine between teeth. C) Closure of mouth around the inserted spine. D) Holding still with spine in closed mouth. Photographs by Carlos Navarro.

Figure 1 (E-H). E) Capuchin touches and visually examines the same spines again. F) Visual examination of shorter spines lower on the trunk. G) Turning of head for further observation of spines. H) Approaching a second spine with mouth open. Photographs by Carlos Navarro.

Figure 1 (I-L). I) Placement of spine between teeth. J) Movement of head to side and closer to insert spine farther into mouth. K) Holding still with spine in mouth. L) Release of spine. Photographs by Carlos Navarro.

Figure 1 (M-N). M) New approach so that a third spine enters mouth. N) Holding still with spine in mouth. Photographs by Carlos Navarro.

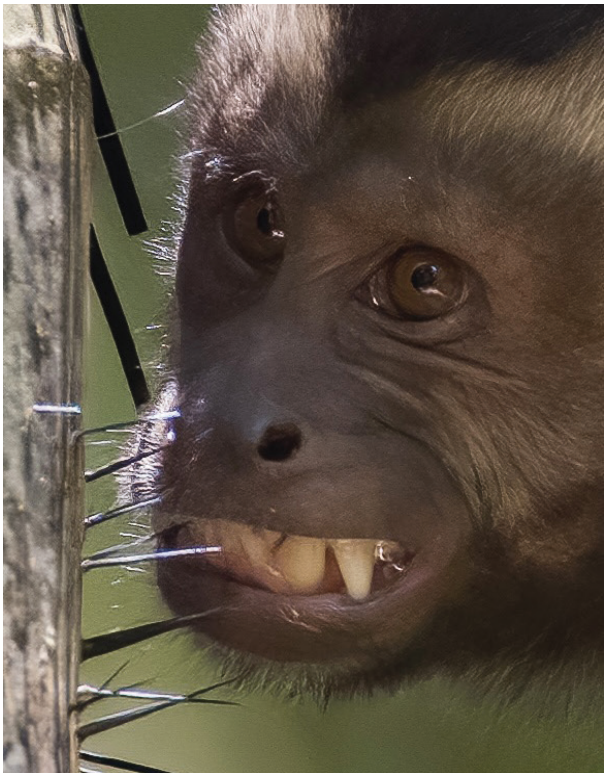

Figure 2. Close-up of palm spine in mouth, between teeth. Photograph by Carlos Navarro.

positioning of the head and mouth in order for a single spine to enter between the teeth, occurred three times consecutively during our observations. All this while the capuchin was balancing on palm fronds. Although this type of interaction with a stationary immobile object is not considered tool use (St. Amant and Horton, 2008; Steinberg et al., 2022), it certainly illuminates capuchin cognitive abilities and dexterity. It also reinforces diverse findings that describe capuchins as highly exploratory and willing to risk pain in foraging and other activities (Fragaszy et al., 2004). We hope this observation stimulates further research on capuchin behavior within the Guianas and throughout the Amazon biome, where robust capuchins are abundant but relatively little studied (Lynch Alfaro et al., 2014), especially in regard to tool use behavior and object manipulation.

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Primates in History, Myth, Art, and Science, by C. Veracini, B. Wood (eds). CRC Press, 328pp. 2024. ISBN: 978-1032710877. Non-human primates play a special role in human societies, especially in regions where modern humans and primates co-exist. Primates feature in myths and legends and in traditional indigenous knowledge. Explorers observed them in the wild and brought them, at great cost, to Europe. The international team of contributors to this book draws these different perspectives together to show how primates helped humans better understand their own place in nature. *Contents:* 1) Lore and mythology of non-human primates since antiquity; 2) The Middle Ages and the age of exploration in Europe and in the Arab world; 3) Modern period (until Darwin); 4) Our place in nature.

Primate Anatomy: Introduction to Extant Primates, by F. Ankel-Simons. Academic Press, Kindle edn. 2024. ISBN: 978-0443217180. This book synthesizes the taxonomy, anatomy, physiology, and genomics of extant primates, including humans. It takes a holistic approach to describing primate skeletal, muscular, and organ structure and function. This book provides the tools to understanding the fundamentals and state of the science of primatology.

Primate Adaptation and Evolution, by J. G. Fleagle, A. L. Baden, C. C. Gilbert. Academic Press, 466pp. 2024. ISBN: 978-0128158098. This updated version covers recent developments in primate palaeontology, the latest taxonomy, and includes new visuals, including helpful illustrations and evolutionary trees. It is the ideal text for undergraduate and post-graduate students studying the evolution and functional ecology of primates and early fossil hominids. *Contents:* 1) Adaptation, evolution and systematics; 2) The primate body; 3) Primate lives; 4) The Prosimians: Lemurs, Lorises, Galagos and Tarsiers; 5) New World anthropoids; 6) Old world monkeys; 7) Apes and humans; 8) Primate communities and biogeography; 9) Primate adaptations; 10) The fossil record; 11) Primate origins; 12) Fossil prosimians; 13) Early anthropoids; 14) Fossil Platyrrhines; 15) Primitive Catarrhines and fossil apes; 16) Fossil Old world monkeys; 17) Fossil hominis, the bipedal primates; 18) Patterns in primate evolution.

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ABSTRACTS

Abstracts of oral presentations related with *Neotropical Primates* from the ASP 46th Meeting, Riviera Maya, Mexico, September 2024.

Abreu, F., et al. 2024. Identifying the optimal interval between instantaneous scan sampling of the behavior of small platyrrhines (*Saimiri* and *Callithrix*)

Alikhan M., et al. 2024. Using modified 2D photographic images to examine the role of contrasting facial pelage in intraspecific communication in owl monkeys *(Aotus nancymaae*)

Alvarez-Velazquez, M. F., et al. 2024. Lead exposure and its relationship with fecal cortisol levels in black howler monkeys (*Alouatta pigra*)

Alvarez-Velazquez, M. F., et al. 2024. A simple assay for measuring tannin-protein precipitation capacity offers insights into the diet and food choice of black howler monkeys (*Alouatta pigra*)

Arroyo, J. P., et al. 2024. Resting metabolic rates and body composition of geriatric common marmosets (*Callithrix jacchus*), before and after fecal microbiota transplantation from young donors

Ash, H., et al. 2024. Cognitive development in the common marmoset (*Callithrix jacchus*)

Azofeifa-Rojas, I., et al. 2024. Improving habitat connectivity for arboreal mammals with canopy bridges in Santa Cruz-Carrillo, Guanacaste, Costa Rica with a focus on howler monkeys (*Alouatta palliata palliata*)

Babb, M., et al. 2024. Prosocial decisions increase with relationship quality, but are not mediated by oxytocin in capuchin monkeys

Baker, M., et al. 2024. How removing trash from the diets of free-ranging White-Faced Capuchin Monkeys (*Cebus capucinus*) impacts their feeding and activity patterns.

Balolia, K., et al. 2024. Taxonomic differences in sagittal cresting among gracile and robust capuchin monkeys

Behr, R., et al. 2024. Marmoset (*Callithrix jacchus*) pluripotent stem cells: generation, characterization, and potential applications

Bicca-Marques, JC., et al. 2024. Canopy discontinuity and food supplementation influence the locomotor behavior and use of space of urban howler monkeys

Campos, F., et al. 2024. Wild capuchins as a model system for investigating the social and ecological determinants of aging

Corewyn, L., et al. 2024. Continued decrease in mantled howler monkey (*Alouatta palliata palliata*) population at La Pacifica, Costa Rica

Crzerwinski, M., et al. 2024. Mother-offspring conflict in mantled howler monkeys

Da Faira Oliveira, G., et al. 2024. Play behavior and sex--specific OXTR methylation profile in a juvenile common marmoset

De la Torre, S., et al. 2024. Evidence of population declines of pygmy marmosets *Cebuella* spp. in protected areas in Ecuador

Evans, S., et al. 2024. Responses of adult captive owl monkeys to novel sensory stimuli

Fonseca-Leal, T., et al. 2024. Changing the purpose of embroidery: experiences of gathering women embroidering for the conservation of the mantled howler monkey (*Alouatta palliata*) in the Balzapote, Veracruz community

Fonta, C., et al. 2024. Hemodynamic changes in the brain of aged marmosets (*Callithrix jacchus*)

Franquesa-Soler, M., et al. 2024. Can stakeholders reach consensus on how to improve the coexistence between howler monkeys and the residents of Palenque, Mexico? Application of Q methodology

Gerwing, M., et al. 2024. Capuchin monkey (*Sapajus libidinosus*) rehabilitation and reintroduction in Northeastern Brazil

Giavedoni, L., et al. 2024. Biomarker identification in New World Monkeys for improved clinical and research outcomes

Gisbrecht, A., et al. 2024. Female mantled howler monkeys (*Alouatta palliata mexicana*) alter their diet in terms of tannins consumption according to their reproductive stage

Gorostiaga, N., et al. 2024. Demographic characteristics of *Alouatta caraya* in sites affected by yellow fever in the southern cone Mesopotamian

Grove, C., et al. 2024. Species matters: training times differ significantly between captive-housed Bolivian (*Saimiri boliviensis*) and Guyanese (*S. sciureus sciureus*) Squirrel Monkeys

Guardia, V., et al. 2024. Measuring abnormal behavior in white-faced capuchins (*Cebus capucinus*) under professional care: insight from observational study at Akumal Monkey Sanctuary & Rescued Animals

Guisneuf, N., et al. 2024. How does habitat fragmentation affect home range, vocal behaviour, and group cohesion in wild white-faced capuchins (*Cebus imitator*)?

Hankerson, S., et al. 2024. Influences on the daily path length of wild golden lion tamarins

Howell, S., et al. 2024. Longitudinal species monitoring in a Costa Rican protected tropical rainforest

Kaser, F., et al. 2024. A quantitative comparison of same-sex and different-sex sexual behavior in wild capuchins (*Cebus imitator*)

Kemp, Y., et al. 2024. The effectiveness of arboreal wildlife bridge designs in the South Pacific of Costa Rica

López-Pérez, A. M., et al. 2024. An outbreak of dermatophytosis in a group of howler monkeys (*Alouatta palliata*) in Mexico

Mah, M., et al. 2024. Impacts of age on activity budget, microhabitat use, and positional behaviour in free-ranging adult white-faced capuchins (*Cebus imitator*) at Santa Rosa, Costa Rica

Manca, C., et al. 2024. Interactions Between Kappa Opioids and Oxytocin in Pair-Bonded Titi Monkeys (*Plecturocebus cupreus*)

Mayerhoff, S., et al. 2024. State-dependent risky choices in primates: Variation in energy budget does not affect captive tufted capuchin monkeys' (*Sapajus* spp.) risky choices

Nicolás, Y., et al. 2024. Ontogeny of the spider monkey *(Ateles geoffroyi*) vocal repertoire

Ordoñez, J., et al. 2024. Variables that determine the basic acoustic structure of the spider monkeys' (*Ateles geoffroyi*) calls

Perez-Cruz, C. et al. 2024. The impact of aging in the atrophy of astrocytes in the common marmosets (*Callithrix jacchus*)

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Philips, K., et al. 2024. PET Imaging of Neuroinflammation in Common Marmosets (*Callithrix jacchus*) is Associated with Cognitive Performance

Proctor, D., et al. 2024. Fission-fusion housing decreases aggression and increases affiliation in zoo-living spider monkeys (*Ateles geoffroyi*)

Ramos-Luna, J., et al. 2024. Participatory wildlife films for primate conservation education in Los Tuxtlas Biosphere Reserve, Veracruz, Mexico

Ramos-Luna, J., et al. 2024. Traveling festivals to mobilize primate conservation education in Southern Mexico

Rodriguez, M., et al. 2024. "Little seeds" an environmental education program for the conservation of Spider Monkeys and their habitat in Jucuarán, El Salvador

Rodriguez M., et al. 2024. Promoting the conservation of the Central American Spider Monkey (*Ateles geoffroyi*) in the modified landscape of El Salvador

Rodriguez-Callejas, J. D., et al. 2024. Analysis of autophagic alterations and senescence in dystrophic microglia of male common marmoset (*Callithrix jacchus*)

Rojas, C., et al. 2024. Behavioral flexibility of mantled howlers (*Alouatta palliata aequatorialis*): Does altitude affect their activity budgets?

Rothwell, E., et al. 2024. Social aging in the context of brain aging and cognitive decline in common marmosets (*Callithrix jacchus*).

Saldana, J., et al. 2024. Sooner better? Capuchin monkeys (*Sapajus [Cebus] apella*) continue to show a start bias

Simmons, S., et al. 2024. Personality and relationship quality influence preference to cooperate in an Iterated Prisoners Dilemma in capuchin monkeys (*Cebus [Sapajus] apella*)

Snodderly, M., et al. 2024. Activity patterns of two sympatric wild primates*, Pithecia aequatorialis* and *Plecturocebus discolor* in the rainforest of Amazonian Ecuador

Snodderly, M., et al. 2024. Predicting fruit foraging performance of color vision genotypes of wild *Ateles belzebuth, Lagothrix lagotricha*, and *Pithecia aequatorialis* in the rainforest of Amazonian Ecuador

Solano, D., et al. 2024. "La Voz de los Monos": an urban campaign against the electrocution of primates in rural, peri-urban and urban areas of Costa Rica

Spaan, D., et al. 2024. Modelling hotspots of potential human-spider monkey interaction in the Yucatan Peninsula using citizen science data

Spaan, D., et al. 2024. Spider monkeys may learn to use artificial canopy bridges to cross areas with traffic flow

Speiran, S., et al. 2024. Monkey business: 'sustainable' primate tourism in Costa Rican sanctuaries?

Stramelini, J., et al. 2024. Genome dynamics in Neotropical primates: compositional pattern of chromatin in *Ateles* and *Aotus*

Tejeda-Gomez, V., et al. 2024. Who's going to cross the road: testing canopy bridge designs over a logging road in Madre de Dios, Peru

Whitney, T., et al. 2024. Non-invasive biomarkers as a conservation tool to assess the impact of habitat degradation on the health of Mexican mantled howler monkeys

Yates, B., et al. 2024. Exploring play behavior in zoo-living spider monkeys (*Ateles geoffroyi*)

Zubillaga-Martin, D., et al. 2024. Genetic diversity and population structure of wild mantled howler monkey populations in México

Zubillaga-Martin, D., et al. 2024. Monkey's bacteria: knowing the gut microbiome of wild Mexican primates

Meetings

PSGB WINTER MEETING 2024

The Primate Society of Great Britain winter meeting will be held on 18th and 19th January 2024, hosted by London Zoo, a ZSL conservation zoo. For more information visit https://www.psgb.org/events/psgb-winter-meeting

17TH GERMAN PRIMATOLOGICAL SOCIETY CONFERENCE

The 17th Conference of the Gesellschaft für Primatologie will be held at the University of Konstanz from 13-16 March, 2024. For more information go to https://www.uni-konstanz.de/gfp-2024/

V CONGRESO LATINOAMERICANO DE PRIMATOLOGÍA

El V Congreso Latinoamericano de Primatología se llevará a cabo en la ciudad de Pereira, Colombia, del 25 al 29 de noviembre de 2024. Será organizado conjuntamente por la Sociedad Latinoamericana de Primatología (SLAPrim), la Asociación Primatológica Colombiana (APC) y la Facultad de Ciencias Ambientales de la Universidad Tecnológica de Pereira. Para propuestas de Simposios, Mesas redondas o Talleres, la fecha límite es 10 de enero 2024. Para más información http://www.asoprimatologicacolombiana.org/congreso-slaprim-2024.html

46TH MEETING AMERICAN SOCIETY OF PRIMATOLOGISTS

The 46th annual meeting of the ASP will be held at the Iberostar Paraíso Beach in Riviera Maya, Mexico, September 8th – 11th 2024, and hosted by Akumal Monkey Sanctuary & Rescued Animals. Abstract submission will open February 1, 2024. For more information, check https://www.asp.org/asp-meetings/asp-mexico-meeting-2024/

Notes to Contributors

Scope

The journal aims to provide a basis for conservation information relating to platyrrhine monkeys. We welcome texts on any aspect of primate conservation, including articles, thesis abstracts, news items, recent events, recent publications, primatological society information and suchlike.

Contributions

Manuscripts may be in English, Spanish or Portuguese, should be prepared with MS Word, and must use page and line numbering. The full name and address for each author should be included. Please avoid abbreviations and acronyms without the name in full. Authors whose first language is not the language of the manuscript submission should have their manuscripts carefully reviewed by a native speaker. To submit a manuscript on-line, please register at https://primate.socgen.ucla.edu/index.php/multivitaminic/user/register or you can send your contribution to: Jessica Ward Lynch, University of California, Los Angeles, email: jwlynx@g.ucla.edu. Manuscripts that do not conform to the formal requirements (formatting, style of references, etc.) will be returned to authors without review. They can be resubmitted, provided all formal requirements are met.

Articles. Each issue of *Neotropical Primates* will include up to three full articles, limited to the following topics: Taxonomy, Systematics, Genetics (when relevant for systematics and conservation), Biogeography, Ecology and Conservation. Text for full articles should be typewritten, double-spaced with no less than 12 cpi font (preferably Times New Roman) and 3-cm margins throughout, and should not exceed 25 pages in length (including references). Please include an abstract in the same language as the rest of the text (English, Spanish or Portuguese) and (optional) one in Portuguese or Spanish (if the text is written in English) or English (if the text is written in Spanish or Portuguese). An abstract in the local Indigenous language relevant to the study may also be included. Tables and illustrations should be limited to six, except in cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review. For articles that include protein or nucleic acid sequences, authors must deposit data in a publicly available database such as GenBank/EMBL/DNA Data Bank of Japan, Brookhaven, or Swiss-Prot, and provide an accession number for inclusion in the published paper.

Short articles. These manuscripts are usually reviewed by the editors only. A broader range of topics is encouraged, including such as behavioral research, in the interests of informing on general research activities that contribute to our understanding of platyrrhines. We encourage reports on projects and conservation and research programs (who, what, where, when, why, etc.) and most particularly information on geographical distributions, locality records, and protected areas and the primates that occur in them. Text should be typewritten, double-spaced with no less than 12 cpi (preferably Times New Roman) font and 3-cm margins throughout, and should not exceed 12 pages in length (including references).

Figures and maps. Articles may include small color photographs, high-quality figures, and high-quality maps. (Resolution: 300 dpi. Column widths: one-column = 8-cm wide; two-columns = 17- cm wide). Please keep these to a minimum. We stress the importance of providing maps that are publishable. When reporting geographic coordinates please utilize one of the following formats consistently throughout the manuscript: DMS (degrees, minutes, seconds) standard 4°36'19.1"N, 74°3'20.7"W or DD (Decimal Degrees) 4.605306, -74.055750.

Tables. Tables should be double-spaced, using font size 10, and prepared with MS Word. Each table should have a brief title.

News items. Please send information on projects, field sites, courses, theses or dissertations recently defended, recent publications, awards, events, activities of Primate Societies, etc. to Brenda Solórzano brenda_solorzano@yahoo.com.mx.

References. Examples of house style may be found throughout this journal. In-text citations should be first ordered chronologically and then in alphabetical order. For example, "…(Fritz, 1970; Albert, 1980, 2004; Oates, 1981; Roberts, 2000; Smith, 2000; Albert et al., 2001)…"

In the list of references, the title of the article, name of the journal, and editorial should be written in the same language as they were published. All conjunctions and prepositions (i.e., "and", "In") should be written in the same language as rest of the manuscript (i.e., "y" or "e", "En" or "Em"). This also applies for other text in references (such as "PhD thesis", "accessed" – see below). Please refer to these examples when listing references:

Journal article
Stallings, J. D. and Mittermeier, R. A. 1983. The black-tailed marmoset (*Callithrix argentata melanura*) recorded from Paraguay. *Am. J. Primatol*. 4: 159–163.

Chapter in book
Brockelman, W. Y. and Ali, R. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.

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Napier, P. H. 1976. *Catalogue of Primates in the British Museum (Natural History)*. Part 1: Families Callitrichidae and Cebidae. British Museum (Natural History), London.

Thesis/Dissertation
Wallace, R. B. 1998. The behavioural ecology of black spider monkeys in north-eastern Bolivia. Doctoral thesis, University of Liverpool, Liverpool, UK.

Report
Muckenhirn, N. A., Mortensen, B. K., Vessey, S., Fraser, C. E. O. and Singh, B. 1975. Report on a primate survey in Guyana. Unpublished report, Pan American Health Organization, Washington, DC.

Website
UNESCO. 2005. UNESCO Man and the Biosphere Programme. United Nations Educational, Scientific, and Cultural Organisation (UNESCO), Paris. Website: http://www.unesco.org/mab/index.htm. Accessed 25 April 2005. ("Acessada em 25 de abril de 2005" and "Consultado el 25 de abril de 2005" for articles in Portuguese and Spanish respectively).

For references in Portuguese and Spanish:

"and" changes to "e" and "y" for articles in Portuguese and Spanish respectively. "In" changes to "Em" and "En" for articles in Portuguese and Spanish respectively.

"Doctoral thesis" changes to "Tese de Doutoramento" and "Tesis de Doctorado" for articles in Portuguese and Spanish respectively.

"MSc Thesis" changes to "Dissertação de Mestrado" and "Tesis de Maestría" for articles in Portuguese and Spanish respectively.

"Unpublished report" changes to "Relatório Técnico" and "Reporte no publicado" for articles in Portuguese and Spanish respectively.

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Short Articles