OROPENDOLA NEST PREDATION AND RODENT CONSUMPTION BY THE BLACK-CAPPED CAPUCHIN (*SAPAJUS APELLA*) IN THE MANU BIOSPHERE RESERVE, PERU

Andrew Lee
Michelle Huang

Capuchins (*Cebus* and *Sapajus* spp.) are generalist primates, occurring in most Neotropical forest types where they forage opportunistically (Sabbatini et al., 2008; Lynch Alfaro et al., 2012; Boubli et al., 2020). They exploit a diverse variety of food sources, such as fruit, seeds, arthropods and a wide array of vertebrate prey (Rose, 1997; Albuquerque et al., 2014; Watts, 2020). Their foraging strategy is highly resourceful and adaptive, and they are often considered important predators of nests (Canale and Bernardo, 2016; Watts, 2020), including those of caiman (Torralvo et al., 2017), coatis (Rose, 1997; Ferrari, 2009) and especially of birds (Watts, 2020). In this work, we report observations of a foraging event by the black-capped capuchin, *Sapajus apella* (Linnaeus, 1758), a widely distributed platyrrhine species, common across much of the Amazon basin (Boubli et al., 2020). This report involves the first record of nest predation of the russet-backed oropendola, *Psarocolius angustifrons* (von Spix, 1824), by a primate, as well as the predation of arboreal rice rats, *Oecomys* sp. (Thomas, 1906).

The predation event occurred within the grounds of the Manu Learning Centre (MLC), Manu Biosphere Reserve, southeast Peru (-12.78917, -71.39111). The MLC is a research facility, owned and operated by the Crees Foundation, within a 643 ha reserve of secondary-growth, lowland tropical forest. The grounds are a mostly cleared area which hold a research station and lodges. On 13 December 2018 at 10:30 a.m., two *Sapajus apella* individuals were spotted descending from the trees of the neighboring forest. The pair ran across the ground, travelling a distance of 25 m, to reach a cluster of vegetation within the MLC grounds. They ascended an aguajal palm (*Mauritia flexuosa*) and leapt onto an adjacent Ecuador laurel (*Cordia alliodora*), which is utilized as a nesting colony for *Psarocolius angustifrons*, hosting a dozen individual nests. With no adult oropendolas present, the capuchins began to systematically raid the nests, shaking them and reaching into each nest entrance (Fig. 1). The pair appeared to alternate between inspecting the nests and engaging in vigilance behavior towards human observers and potentially returning adult oropendolas. At around 10:40 a.m., one capuchin successfully located a *Psarocolius angustifrons* egg from within a nest and descended to the palm tree, against which it proceeded to crack open the egg. It consumed the contents as if the egg were a cup. Meanwhile, the other capuchin continued to inspect the remaining nests, but failed to acquire any eggs. Following the egg predation, the capuchins began

rummaging through the layers of palm sheath. They continued to alternate between inspection and vigilance (Fig. 2). At 10:50 a.m., one capuchin extracted an *Oecomys* sp. individual from within the sheaths and performed a fatal craniocervical bite. It proceeded to feed on the rat by consuming its head first (Fig. 3), then fed selectively on parts of its torso before discarding the carcass into the palm sheath. Soon after, the second capuchin captured another arboreal rice rat, from the same location, killing, ingesting and disposing of it in a similar manner. No food transferring was observed. The foraging event was interrupted as spectators gathered at the base of the palm tree. Both monkeys remained in the tree until the spectators dispersed, before descending to the ground and retreating to the surrounding forest. No remnants of either rodent carcass were able to be retrieved.

Figure 1. *Sapajus apella* inspecting the oropendola nests in the canopy. Photograph by Ruth Little.

Figure 2. Both *Sapajus apella* individuals on the aguajal palm, with one inspecting the palm sheaths and the other appearing vigilant toward human observers. Photograph by Ruth Little.

Figure 3. *Sapajus apella* consuming the head of the *Oecomys* sp. Photograph by Ruth Little.

Despite co-occurring across much of their distributional ranges (BirdLife International, 2018; Boubli et al., 2020), no previous records exist of any predation event involving *Sapajus apella* and *Psarocolius angustifrons*. Oropendolas are social colonists, known to select nesting sites in isolated trees which are difficult for primates to access and therefore deter attacks (Robinson, 1988; Leak and Robinson, 1989). Furthermore, adult oropendolas are known to actively defend their nests against predators by employing alarm call warnings and aggressive, mobbing tactics (Leak and Robinson, 1989), but no adults were present at the time of the nest raid. There are records of capuchins depredating the nests of other *Psarocolius* spp. and the closely related cacique (*Cacicus* spp.), with entire colonies being eradicated as the nesting sites in these events allowed access from the surrounding canopy (Robinson, 1985; Leak and Robinson, 1989).

Capuchins have great capacity for cognitive and extractive, manipulative skills (Sabbatini et al., 2008; Canale et al., 2013). In fact, *Sapajus apella* has the ability to use tools, unique amongst Amazon forest-dwelling platyrrhines (Torralvo et al., 2017). Since their foraging techniques are flexible and explorative, capuchin monkeys can habituate to human-modified landscapes, especially in response to abundant, novel food resources (Sabbatini et al., 2008). They are also known to alter their foraging strategy to locate bird nesting sites (Sabbatini et al., 2008; Canale and Bernard, 2016). To reach the oropendola colony here, the capuchins travelled terrestrially across the cleared grounds, a risky behaviour due to possible exposure to predators such as felids and raptors (Ferrari, 2009), but especially to humans as they are widely hunted for bushmeat and illegal trade (Sabbatini et al., 2008; Boubli et al., 2020). Capuchins can indeed utilize the forest floor, especially during times of food scarcity in the dry season (Siemers, 2000; Sabbatini et al., 2008). However, the event reported here occurred at the onset of the wet season, when food is relatively abundant (Siemers, 2000; Ferrari et al., 2008). As opportunistic foragers, capuchin monkeys may exploit any available food sources, regardless of season or resource abundance (Milano and Monterio-Filho, 2009).

Among platyrrhine species, capuchins are perhaps the most omnivorous (Resende et al., 2003; Watt, 2020), exhibiting plasticity in their diet, foraging behavior and habitat use. In this event, given their explorative approach, it is assumed that the capuchins were actively seeking out the oropendola colony and that the arboreal rodents were opportunistic encounters. These observations serve as useful additions to the dietary and behavioral repertoire of this generalist primate.

Acknowledgments

Andrew Lee and **Michelle Huang**, Crees Foundation, Fundo Mascoitania, Manu, Madre de Dios, Peru, E-mails: <andrewlee1523@gmail.com>; <michelle0huang@gmail.com>.

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PRELIMINARY INVESTIGATION INTO THE DIFFERENCES IN VOCALISATIONS BETWEEN WILD SAKI MONKEYS (*PITHECIA* SPP.)

Jen Muir
Adrian A. Barnett
Magdalena S. Svensson

Introduction

Information on primate vocalisations can be applied in several ways, including: improving captive welfare, as a census tool for cryptic species, or to investigate the impacts of anthropogenic disturbance on species' behaviour (Delgado and van Shaik, 2000; Konrad and Geissman, 2006; Jacobsen et al., 2010). Vocalisations can be used as a taxonomic tool, and structural differences between calls have been used to compare a wide variety of taxa, including species of gibbon (Hylobatidae spp., Ruppell, 2010), marmosets (*Callithrix* spp., Mendes et al., 2009), owls (Strigidae spp., Flint et al., 2015), wolves (*Canis* spp., Kershenbaum et al., 2016), and galagos (Galagidae spp.,

Svensson et al., 2017). Additionally, differences in vocalisations across taxonomic groups can be used to help determine genetic distances between species or investigate why vocal behaviours evolved (Blumstein and Armitage, 1998; Ord and Garcia-Porta, 2012).

One primate group that recently has been revised taxonomically is the genus *Pithecia,* the saki monkeys, in which five species were previously described: *P. monachus, P. aequatorialis, P. irrorata, P. albicans,* and *P. pithecia* (Hershkovitz, 1987). After a review of morphological data, the group was rearranged into 16 species, including three subspecies elevated to full species and five newly described species (Marsh, 2014). It has been suggested that taxonomic research should utilize several disciplines in combination so as to decrease the risk of inaccurate conclusions (Schlick-Steiner et al., 2010). In the case of the sakis, the use of purely morphological features opens the opportunity for the taxonomic conclusions to be tested by evidence based on genetic structure, behaviour, ecology, or life history, among others.

In the current study, vocalisations produced by wild golden-faced sakis, *Pithecia chrysocephala,* white-faced sakis*, P. pithecia*, and Equatorial sakis, *P. aequatorialis,* were compared to study how calls might differ between closely related species (*P. pithecia* and *P. chrysocephala*), and whether any features were conserved across more evolutionarily separated species (*P. chrysocephala* and *P. pithecia* compared to *P. aequatorialis*). Before the reclassification of *Pithecia* by Marsh (2014), *P. chrysocephala* was considered a subspecies of *P. pithecia*, and so these taxa were expected to display similar vocalisations.

Methods

Study Species
Pithecia chrysocephala, P. pithecia, and *P. aequatorialis* all occupy forest habitats, including Amazonian várzea, igapó, and terra firme forests. However, the species occupy different geographical areas (Fig. 1), with *P. chrysocephala* occurring within the Brazilian states of Amazonas, Pará, and Roraima, and *P. pithecia* found in the states of Pará and Amapá, as well as in the countries of Venezuela, Guyana, French Guiana and Suriname (Marsh, 2014). *Pithecia aequatorialis* is present only in central Peru (Marsh and Heymann, 2018).

Data Organisation and Analysis
We collected vocalisation data for *Pithecia chrysocephala* in June-August 2018 in Manaus, Brazil (-3.083, 59.983) (for methodology and vocal repertoire see Muir et al., 2019). We then gathered vocalisation data on two other *Pithecia* species from previous published studies, which we re-analysed and compared across species. For *P. pithecia*, data from Henline's (2007) study conducted in Isla Redonda, Venezuela (7.766, – 62.883) was used, and *P. aequatorialis* data came from Keiren's (2012)