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PREDATION BY A SLATE-COLORED HAWK, *LEUCOPTERNIS SCHISTACEA*, ON JUVENILE GRAELL'S BLACK MANTLED TAMARINS, *LEONTOCEBUS NIGRICOLLIS GRAELLSI*

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Introduction

Predation is considered an important factor in callitrichid ecology and evolution (Caine 1993; Pulliam 1984). However, predation events on wild groups are difficult to observe (Ferrari 2009). Here we report two predation events by the slate-colored hawk *Leucopternis schistacea* on one group of Graell's black mantled tamarins *Leontocebus nigricollis graellsi* in Amazonian Ecuador.

Study site

The predation events took place in Sacha Lodge Reserve, a private area of well-preserved forest in the northern bank of the Napo River in Amazonian Ecuador (0°28'16.55" S, 76°27'32.38" W). A group of seven Graell's black mantled tamarins, *Leontocebus nigricollis graellsi* (2 adults, 24-26 cm; 3 subadults, 22-23 cm; and 2 juveniles that were probably twins (14-15 cm)), was followed from May 30 through August 9, 2018, to collect data of their feeding behavior.

Results and Discussion

On June 23, 2018, at 11:55 (local time), the tamarins were feeding on *Parkia* sp. exudates and resting at about 25 m above ground. One of the individuals suddenly started to emit alarm calls after a slate-colored hawk captured one of the juveniles that was resting in the treetop of a *Cecropia* sp. The rest of group moved quickly to the treetop where the tamarin was caught, emitting alarm calls and apparently trying to mob the hawk, but it flew to a nearby tree, holding the juvenile in its claws (Fig. 1a and b). Once perched, with its right claw the hawk grabbed the upper part of the tamarin, while using its beak to tear off the skin, moving its head from side to side. At that moment, the rest of the tamarins moved back and hid in other trees. Twenty-two minutes after the hunt, the hawk left with the carcass. The tamarins remained vigilant, producing sporadic alarm calls. About 30 minutes after the hawk left, the tamarins started moving very slowly and silently. They moved to an area 500 m away from the hunting scenario, resting for 45 minutes on a tree about 30 m high. Late in the afternoon, hours after the hunt, the group continued to be alert; they were difficult to follow, moving rapidly and quietly. At dusk the group remained together in a tree. The next day, June 24, the group started moving early, at around 6:03 am, emitting very few vocalizations. The group traveled quickly through the forest all day, with a path length that day of 875 m. Two days after the hunt, the tamarins seemed to return to their normal behavior, emitting more vocalizations and reducing their daily path to 750 m (daily paths were measured with ArcMap software using the GPS coordinates recorded every time the group moved).

Figure 1. Slate-colored hawk *Leucopternis schistacea* feeding on a juvenile Graell's black mantled tamarin *Leontocebus nigricollis graellsi* in Sacha Lodge Reserve, Amazonian Ecuador.

On August 4, 2018 at 9:35 we observed a second predation event by a slate-colored hawk on the same tamarin group. The six tamarins were resting in a kapok tree (*Ceiba pentandra*) at about 20 m above ground. The hawk caught and squeezed the remaining juvenile with its claws while the tamarin emitted distress calls. The hawk flew into the forest while the rest of the tamarins began to move quickly emitting alarm calls.

About 30 minutes after the predation event, the tamarins were silent and vigilant, moving very slowly to an area about 600 m away. By late afternoon, the tamarins remained hidden and quiet in the dense vegetation of the treetops until nightfall. The next day the tamarins were quiet, emitting only very few alarm calls. They rested hidden the whole morning and only moved in the afternoon. Three days later, the group returned to their normal daily travel pattern.

These two successful predation events carried out in less than two months point to the importance of the slate-colored hawk in controlling this tamarin population. This species was reported hunting saddle-back tamarins in Peru (Lledo-Ferrer et al., 2009) but, to our knowledge, ours is the first report of effective attacks of this raptor on Graell's black-mantled tamarins. It is remarkable that in both occasions, the hawk hunted a juvenile, suggesting that it may use specific criteria to select its prey while observing tamarin groups before the attack. The response of this tamarin group to a predation event, moving faster, hiding and emitting fewer vocalizations in the next three to four days after the attack, is similar to that reported by Lledo-Ferrer et al. (2009) for saddle-back tamarins in Peru. This consistent response points to the strong influence that predation pressure may have on tamarins' behavior.

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OBSERVATIONS OF DIURNAL ACTIVITY IN A 'STRICTLY' NOCTURNAL PRIMATE, THE PERUVIAN NIGHT MONKEY *(AOTUS MICONAX)*, YAMBRASBAMBA, PERU

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Introduction

Cathemerality, defined as "sporadically active throughout a 24-hour day" (Fleagle 1988, p.52), or as "when significant amounts of activity, particularly feeding and/or traveling, occur within both the light and dark portions of that cycle" (Tattersall 1987, p. 201), is widespread across many mammal species, in all major biomes (Curtis and Rasmussen 2006). As with nocturnality, cathemerality must confer an evolutionary advantage. This advantage may be in the form of decreased interspecific competition, coping with deficits in ambient light and temperature, and/or predator avoidance or prey capture (Curtis and Rasmussen 2006).

It is probable that modern primates are descended from nocturnal basal taxa (Ross et al. 2007; Santini et al. 2015). In the extant primates, nocturnal behavior is well established in the lorises and galagos, as well as several genera of lemur (Colquhoun 2011), and cathemerality is known in two genera of lemurs, *Eulemur* and *Hapalemur* (Colquhoun 2011). There are also several published records of nocturnal behavior in other diurnal primate species including *Cebus capucinus, Lemur catta, Macaca fuscata yakui, Pan troglodytes,* and *Rhinopithecus brelichi* (Nishikawa and Mochida 2010; Parga 2011; Perry 2012; Donati et al. 2013; Tan et al. 2013; Krief et al. 2014).

Night monkeys (*Aotus* spp.) are the only nocturnal haplorhine, and subsequently the only nocturnal platyrrhines (Fernandez-Duque 2011). Most *Aotus* are considered 'strictly' nocturnal, with only two species (*A. azarae* and *A. nigriceps*), in the southernmost, most seasonal, part of the genus distribution, showing cathemerality (Mann 1956; Wright 1989; Donati and Borgognini-Tarli 2006; Fernandez-Duque and Erkert 2006; Erkert et al. 2012; Khimji and Donati 2014). Nocturnal and diurnal activity in *Aotus* spp. is influenced by moon luminosity and ambient temperature (Fernandez-Duque 2003; Fernandez-Duque and Erkert 2006). The paucity of field studies on most *Aotus* species means that many aspects of their behavioral ecology are still unknown, and diurnal activity may be more common than thought.

The Peruvian night monkey (*Aotus miconax)* is one of the least studied of all Neotropical primates. This species is endemic to northern Peru (Shanee et al. 2015) and restricted to montane and pre-montane forests between ~1,200 and 3,100 m a.s.l. (Shanee et al. 2015). This species is considered Endangered by the IUCN (2019). *Aotus miconax* is considered a 'strictly' nocturnal night monkey (Fernandez-Duque 2011) and previously had only been observed leaving and arriving at its nest sites between sunset and sunrise (Shanee et al. 2013). The diet of *A. miconax* is highly omnivorous, composed of large amounts of ripe fruits, leaves and insects, and smaller amounts of buds and flowers (Shanee et al. 2013). Two studies have suggested the possibility of diurnal activity in *A. miconax* (Shanee et al. 2013; Campbell et al. 2019), but these studies did not document diurnal activities first hand.

Here we present *ad libitum* observations of diurnal behavior in *Aotus miconax* gathered in 2012 and 2018. The first observations, from 2012, were made whilst surveying forest fragments in preparation for presence/absence surveys of *A. miconax*, and the 2018 observations, during behavioral studies of *Lagothrix flavicauda,* in continuous forest. As cathemerality in *A. azarae* and *A. nigriceps* is influenced by light and temperature, we tested whether moon illumination, moon phase, or ambient temperature had an effect on instances of diurnal behavior in *A. miconax*.

Study site and Methods

Observations were made at the El Toro field site, in Amazonas region, Peru (05°39′46″ S, 77°54′32″ W) (Fig. 1), an area of made up of ca. 700 ha of disturbed primary forest and regenerating secondary forest, interspersed with pasture, that is part of continuous forest leading to the Amazonian lowlands. Terrain in the area is very rugged, with high ridges and deep valleys between 1,800 and 2,400 m a.s.l. Annual rainfall is ca. 1,700 mm, with a drier season from August to December. The primary premontane and montane forests of the area have been selectively logged over the past ~ 30 years and have a thick mid- and understory with an average canopy height of 15–25 m. The land is titled to the *Campesino Community* of Yambrasbamba, with a single land title of 80,545 ha. People in the community are predominantly subsistence farmers (tubers, corn and beans), with some small-scale commercial production (cattle, coffee and '*rocoto*').