

## SHORT COMMUNICATION

# Interspecific foraging association between the cryptic forest-falcon, *Micrastur mintoni* and primates in an Amazon rainforest in Brazil

Flávio Kulaif UBAID<sup>1\*</sup> , Renata BECO<sup>1</sup><sup>1</sup> Universidade Estadual do Maranhão – UEMA, Centro de Estudos Superiores de Caxias, Laboratório de Ornitologia, Praça Duque de Caxias S/N, Bairro Alecrim, Caxias, Maranhão, Brazil\* Corresponding author: [flavioubaid@gmail.com](mailto:flavioubaid@gmail.com);  <https://orcid.org/0000-0001-8604-1206>**ABSTRACT**

Following behavior is a well-documented foraging specialization in Neotropical birds, which consists of individuals of solitary or mixed-flocking species following other moving animals to capture fleeing prey. Here, we report two observations of the cryptic forest-falcon, *Micrastur mintoni* following troops of primates during an ornithological inventory in the eastern Brazilian Amazon. During both observations, the falcon emitted a typical vocalization and captured fleeing insects dispersed by the primates moving through the forest while foraging. This is the first report of an apparently commensal association between a *Micrastur* forest falcon and two species of primates.

**KEYWORDS:** following behavior, Neotropical birds, *Plecturocebus moloch*, *Mico argentatus*, *terra firme* forest

## Interação de forrageamento interespecífica entre o falcão-críptico, *Micrastur mintoni* e primatas em uma floresta amazônica no Brasil

**RESUMO**

O comportamento de *following* é uma especialização de forrageamento bem documentada em aves neotropicais, que consiste em indivíduos de espécies solitárias ou em bandos mistos seguindo outros animais em movimento para capturar presas afugentadas. Aqui reportamos duas observações do falcão-críptico, *Micrastur mintoni* seguindo grupos de primatas, durante um inventário ornitológico na Amazônia oriental brasileira. Durante as duas observações, o falcão emitiu uma vocalização típica e capturou insetos afugentados pelos primatas em movimento pela floresta enquanto forrageavam. Esse é o primeiro relato de uma associação aparentemente comensal entre um falcão florestal do gênero *Micrastur* e duas espécies de primatas.

**PALAVRAS-CHAVE:** aves seguidoras, *Mico argentatus*, aves neotropicais, *Plecturocebus moloch*, floresta de terra firme

The ‘following’ behavior is a well-documented foraging specialization in Neotropical birds, consisting of solitary or mixed-flocking species following other moving animals to capture fleeing prey (Willis and Oniki 1978). The most known commensal association is that between birds that follow swarms of army ants, a foraging behavior that can be obligatory in certain bird species (Willis and Oniki 1978; Willson 2004). Similarly, birds have been observed following a wide variety of animals including terrestrial mammals (Silveira et al. 1997; Komar and Hanks 2002), other birds (Baker 1980; Robbins 1981), and marine and freshwater animals (Au and Pitman 1986; Ubaid 2011). Moreover, there are many reports of birds following arboreal animals, such as primates (e.g., Siegel et al. 1989; Ferrari 1990; Warkentin 1993; reviewed by Heymann and Hsia 2015). When troops of primates move through the

forest canopy, birds follow them on the ground, understory or canopy to eat the insects and other small arthropods flushed by their movement (Siegel et al. 1989; Warkentin 1993). However, some bird species can follow monkeys only to decrease their predation risk (Barnett and Shaw 2014). Since it appears that birds are the only beneficiaries of such associations, they are best defined as a form of commensalism (Heymann and Hsia 2015). However, it may possibly involve heterospecific alarm-calling eavesdropping, which can yield tangible fitness benefits by providing valuable information about food resources and predator presence, as seen in ant-following birds (Batcheller 2017; Pollock et al. 2017) under which circumstances it could be considered competition.

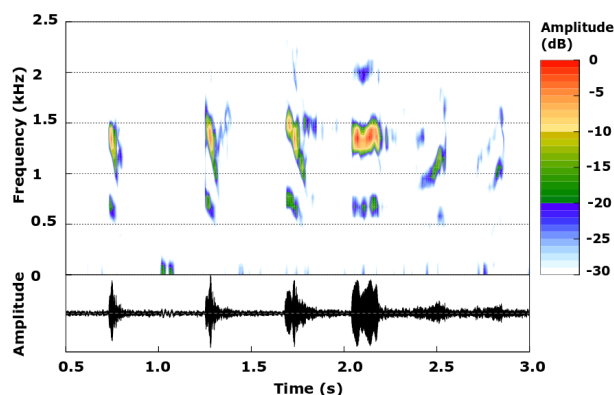
The great majority of such following behaviors in raptors have been reported for Accipitriformes (e.g., Boinski and Scott

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1988; Ferrari 1990; Warkentin 1993), with only one report for a Falconiform, a bat falcon (*Falco rufigularis* Daudin, 1800) hunting in association with squirrel monkeys (*Saimiri oerstedii* Reinhardt, 1872) (Boinski and Scott 1988).

Forest falcons (*Micrastur* Gray, 1841) comprise seven species distributed from southern Mexico to central Argentina (Winkler *et al.* 2020), of which six occur in Brazil. The cryptic forest-falcon (*Micrastur mintoni* Whittaker, 2003) is a recently described species, with specimens labeled for more than a century as lined forest-falcon, *M. gilvicollis* (Vieillot, 1817) (Whittaker 2002), a morphologically similar species which replaces it in west of the Madeira River and north of the Amazonas River (Cohn-Haft *et al.* 2007). The cryptic forest-falcon occurs in eastern and southern Amazonian Brazil, northeastern Bolivia, and also as a disjunct, threatened population, in the Atlantic Forest of eastern Brazil (Whittaker 2002; Fjeldså *et al.* 2020). It inhabits mostly lowland *terra firme* forests, but it can also be found in floodplain forests with bamboo (Whittaker 2002; Fjeldså *et al.* 2020). This falcon is typically concealed, perched in the subcanopy, observing potential prey to attack it. Its prey include invertebrates, reptiles and small birds (Whittaker 2002; Fjeldså *et al.* 2020). Forest-falcons are also known to occasionally follow army-ant swarms to prey on small fleeing animals (Whittaker 2009). Here, we report two observations of cryptic forest-falcons foraging in association with troops of two primate species in an Amazon forest, in a potential interaction of commensalism. This association has not been reported before.

The observations were made in *terra firme* forest on the left bank of the Peri River (2°21'55"S, 52°11'38"W), a tributary of the Xingu River, in the municipality of Porto de Moz, Pará state, Brazil. During an ornithological inventory on 3 July 2010 at 7:35 A.M., FKU observed an individual of cryptic forest-falcon following a group of silvery marmosets, *Mico argentatus* (Linnaeus, 1771) for approximately 10 min. The group was composed of five marmosets that were slowly moving through the treetops at the height of about 6-7 m, and were inspecting crevices, hollows and branches in search of food. The falcon followed the group very closely (about 2-4 m), sometimes occupying the same branch, capturing insects flushed by the primates' activities. Three marmosets were vigilant and did not allow the falcon to approach them. In contrast, two other marmosets were indifferent to the bird's presence and carried on foraging, potentially not perceiving the falcon as a predator. The marmosets constantly vocalized high-pitched, birdlike contact calls, varying from rather low chirps when the group was close together, to the drawn out and frequently repeated long calls when the group was spread out. During the observations, the falcon constantly emitted a typical vocalization called "quacking song", which contains three note types: "uuk, qui, qua-qua" (Whittaker 2002). The song emitted was composed by three "uuk" notes followed by the "qui" and "qua-qua" notes and lasted about 2 s (Figure 1).



**Figure 1.** Spectrogram of the quacking song emitted by a cryptic forest-falcon, *Micrastur mintoni* following a group of silvery marmosets, *Mico argentatus*. This figure is in color in the electronic version.

The vocalizations were recorded using a Marantz PMD-661 recorder and a Sennheiser ME67 directional microphone at a sampling rate of 48 khz. The recording is available in the Macaulay Library collection (ML245169481), and also contains calls emitted by the marmosets. The spectrogram was generated using the seewave package (Sueur *et al.* 2008) of R software. The quacking song, rarely heard in the field, is emitted by excited birds mostly from one of a pair during a territorial advertising duet, as well as by agitated birds responding to playback (Whittaker 2002). Therefore, this song indicates some excitement in the presence of primates, although its function within this type of association still needs to be better understood.

Two days later, an individual of cryptic forest-falcon was found emitting the same quacking song described above at 7:00 A.M. The falcon was perched at about the height of 15 m in *terra firme* forest. A group of red-bellied titi monkey, *Plecturocebus moloch* (Hoffmannsegg, 1807) were simultaneously vocalizing a combination of loud calls (Robinson 1979) in chorus at about 50 m away from the falcon, but no interaction between them was detected. This observation lasted 6 min, until the falcon left. In the vicinity of the previous report, around 8:45 A.M. on the same day, an individual of cryptic forest-falcon was observed actively following a troop of about seven red-bellied titi monkeys. As with the first observation of the troop of silvery marmosets, the falcon followed the primate group closely during their movements, maintaining a distance of about 5-10 m from the last individual in the group. On this occasion, the monkeys constantly produced quiet, high-pitched, pure tone chirps, as described by Robinson (1979) when observing animals foraging in his presence. During some 20 min, we observed five capture events of small arthropods by the falcon. All captured arthropods had been flushed by the movement of the monkeys.

Following behavior involving birds and primates has already been described in several species of Accipitriformes,

such as the double-toothed kite, *Harpagus bidentatus* (Latham, 1790) (e.g., Boinski and Scott 1988), and the sharp-shinned hawk, *Accipiter striatus* Vieillot, 1808 (Warkentin 1993). Although Ferrari (1990) considered species of the genus *Micrastur* to be the main predators of marmosets, at least part of the observed group of silvery marmosets did not seem to be disturbed with the bird's presence. To our knowledge, this is the first report of following foraging association between primates and a *Micrastur* forest-falcon. Forest-falcons are traditionally known to have facultative following behavior in association with army ants (Willis *et al.* 1983). The slaty-backed forest-falcon, *M. mirandollei* (Schlegel, 1862) may also follow army ants, presumably to feed on the fleeing insects (Bierregaard and Kirwan 2020). The collared forest-falcon, *M. semitorquatus* (Vieillot, 1817) occasionally follows army ant swarms, though it rarely attacks birds following ants (Skutch 1981; Willis *et al.* 1983; Mays 1985). Furthermore, a collared forest-falcon individual was recorded preying on a snake fleeing an army ant raid (Driver *et al.* 2018). The lined forest-falcon inhabits the canopy of tall forests, and it is known to follow army ants only at forest edges (Willis *et al.* 1983). While the barred forest-falcon, *M. ruficollis* (Vieillot, 1817) forages in the understory, and often follows army ants (Willis *et al.* 1983; Robinson 1994), the cryptic forest-falcon attends army ant swarms only occasionally (Whittaker 2009).

Although the small number of neotropical bird species observed following terrestrial mammals (53 species, see Heymann and Hsia 2015; present study), the following behavior is probably present in a higher number of bird species than currently known (Warkentin 1993). The lack of reports of this behavior in forest-falcons - specifically of the cryptic forest-falcon - might be due to the difficulty in observing this species in the field due to its elusive foraging behavior, especially in closed habits. In highly biodiverse tropical ecosystems, favorable conditions are created for an uncountable number of known and potential interspecific interactions (Ghazoul and Sheil 2010; Heymann and Hsia 2015). Observations, as described here, are essential for a better understanding of interspecific relationships, such as commensalism. These reports are useful to elaborate conservation guidelines for the species involved in the interaction, in this case especially for the threatened disjunct population of the cryptic forest-falcon in the Atlantic Forest.

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