

Predator mobbing behaviour in the Greater Spear-Nosed Bat, *Phyllostomus hastatus*

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Abstract. We report that several adult Greater Spear-Nosed Bats (*Phyllostomus hastatus*, Phyllostomidae) extensively harassed a large spectacled owl (*Pulsatrix perspicillata*, Strigidae) for several minutes. We hypothesize that the bats considered the owl to be a potential threat because it was perched in close vicinity of the bats' night roost. To our knowledge, this is the first direct evidence of predator mobbing behaviour in bats.

Keywords: bat predation, owls, *Pulsatrix perspicillata*, Peruvian bats, Strigidae

Introduction

In many species, predators are approached and even harassed upon discovery by their potential prey (Ostreiher 2003). This predator mobbing behaviour is especially common in birds (Krams et al. 2010; Sternalski & Bretagnolle 2010) but occurs in social mammals as well (Graw & Manser 2007). Harassed predators often depart immediately after being discovered; if not, they are usually mobbed until they leave the area (Curio et al. 1978). Since the benefits of harassing predators seem to outweigh the risk for participating individuals (Curio et al. 1978), predator mobbing behaviours should be widespread in all social animals. However, to our knowledge, predator mobbing has not been observed in bats so far, even though its existence has been predicted to explain the adaptive function of distress calls (Russ et al. 1998, 2004). Here, we report that adult bats, *Phyllostomus hastatus*, (Phyllostomidae) severely and repeatedly harassed a large owl. To our knowledge, this is the first direct evidence of predator mobbing behaviour in bats.

The greater spear-nosed bat *Phyllostomus hastatus* is a large (70-100g), omnivorous bat (Gardner 1977; Gorchoy et al. 1995) that is widely distributed throughout the Neotropics (Santos et al. 2003). Adult female *P. hastatus* form stable social groups of on average 17 individuals that are joined by a single adult male (McCracken & Bradbury 1981). Females within a group are unrelated (McCracken & Bradbury 1977, 1981) and may stay together for up to 16 years (Wilkinson & Boughman 1998). Female group members often forage together when food is patchily distributed, thus benefiting from shared information about or communal defence of

feeding sites (Wilkinson & Boughman 1998, 1999; Boughman 2006). The formation of foraging groups and the contact among commuting group members is mediated by loud vocalizations that are audible to the human ear. These 'screech calls' are noisy broadband (4-18 kHz) signals with an average peak frequency of 6.7 kHz. They consist of up to four distinct pulses produced in rapid succession. The average pulse duration is 229 ms (Boughman 1997). Screech calls carry a group-specific signature that is acquired through vocal production learning (Boughman 1997, 1998) and enables females to discriminate between group and non-group members (Boughman & Wilkinson 1998). We report here a group of *P. hastatus* producing screech calls prior to and during the harassment of an owl that had landed in the vicinity of their night roost. Additionally, we describe the mobbing behaviour in detail.

Material and Methods

All behavioural observations were conducted in January 2012 at the Centro de Investigación Jenaro Herrera (4°54'58.92''S, 73°33'47.91''W), a Biological Station located close to the Río Ucayali in the Peruvian Amazon. For six days, we observed a group of approximately 25 adult *P. hastatus* with at least ten pups in a day roost located in the roof of a small house belonging to the Biological Station. An uninhabited building approximately 100m away was used as a night roost by part of the group. Bats were observed with binoculars; a dimmed flashlight provided the necessary illumination in the night roost. Screech calls were recorded to a handheld computer using an Avisoft Ultrasound gate (USG 116Hme; R. Specht, Berlin, Germany) at a sampling rate of 300 kHz and 16 bit depth. The owl was

photographed and identified using a field guide book (Schulenberg et al. 2007).

Results

On January 24th at 11 pm, we observed ten adult *P. hastatus* in the night roost. The bats appeared undisturbed; they were grooming themselves and resting. Several other individuals were flying in the vicinity of the night roost. During that time, no screech calls were produced. At 11:15 pm., flying *P. hastatus* uttered several screech calls after which all roosting bats departed from the night roost and flew towards a tree approximately 5m away (Fig. 1). When we pointed a strong flashlight at the respective tree, we saw a spectacled owl (*Pulsatrix perspicillata*, Strigidae) perching on an outer branch of the tree and being harassed by several *P. hastatus*. The bats continuously circled the owl and repeatedly swooped towards its head and back. During swoops, the bats approached the owl close enough to graze and touch it with their wings. Simultaneously, the mobbing bats produced many screech calls (Fig. 2). The harassment lasted for approximately three minutes during which the owl remained motionless. The number of mobbing *P. hastatus* declined steadily until there were only four individuals left. The remaining *P. hastatus* eventually ceased producing screech calls and

harassing the owl and flew away, which might have been a reaction to us continuously pointing a flashlight at the tree. The owl perched in the tree for another 5 min and then departed out of sight. By that time, no *P. hastatus* were in the night roost.

Discussion

Phyllostomus hastatus severely harassed the spectacled owl for several minutes and we considered this to be unambiguous predator mobbing behaviour. To our knowledge, these observations are the first direct evidence of bats engaging in predator mobbing, a behavioural strategy that is widespread in the animal kingdom (Curio et al. 1978). Young *P. hastatus* may fall victim to different predators ranging from bullfrogs and lizards to screech owls, opossum and even conspecifics (Boughman 2006; Bohn et al. 2009). In contrast to this, adult mortality seems to be low (McCracken & Bradbury 1981) and adult *P. hastatus* have no documented predators yet (Wilkinson & Boughman 1998). It is possible, however, that adult *P. hastatus* are occasionally preyed upon by large owls, especially when leaving or entering a roost as has been shown for other bat species (Sommer et al. 2009).

Spectacled owls are the largest owls in Neotropical humid forests and can reach a body



Figure 1. Owl perching in the vicinity of the bats' night roost. The photo of *Pulsatrix perspicillata* was taken shortly before the owl flew off. The photo of *Phyllostomus hastatus* was taken before the bats were disturbed in their night roost.

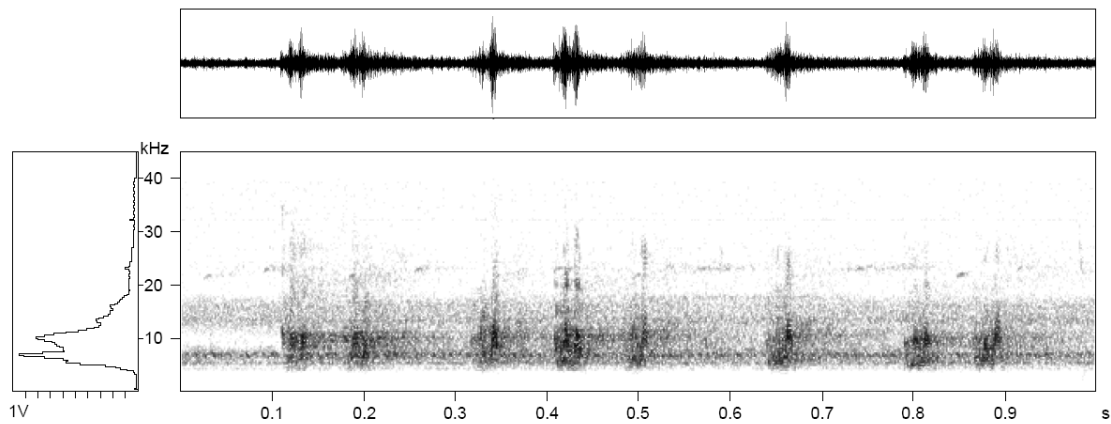


Figure 2. Exemplary screech calls recorded from *Phyllostomus hastatus* while harassing the owl. Oscillogram, power spectrum and spectrogram are shown. The spectrogram was created using a 1024 point FFT and a Hamming window with 50 % overlap, which resulted in a frequency resolution of 293 Hz and a time resolution of 1.71 ms.

length of 43-48 cm (Schulenberg et al. 2007). They attack mammalian prey as big as common agoutis (*Dasyprocta* sp.) and are known to feed on bats at least occasionally (Mikkola 1973; Gomez de Silva et al. 1997). Like other larger owls, they are sit-and-wait predators that have to strike quickly because they are incapable of sustained prey pursuits (Mikkola 1973). Therefore, the arrival of a spectacled owl close to a *P. hastatus* night roost is very likely perceived as a considerable threat by the bats.

Wilkinson and Boughman (1998) considered it unlikely that screech calls function as alarm calls since their production does not increase during periods of higher predation risk (e.g., when aerial raptors are presumably active or when newly volant offspring are present). Nevertheless, it is possible that the screech calls accompanying the mobbing behaviour did function as means to recruit conspecifics. Screech calls might have been used by bats that had already spotted the spectacled owl to attract as many conspecifics as possible that could participate in the mobbing.

We believe that the bats reacted so strongly to the presence of a predator because it was spotted in the vicinity of their night roost. Behavioral observations of bats at night roosts hold great potential to document predator mobbing behaviour in different species and more detail.

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