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Philodryas olfersii (Serpentes, Dipsadidae) feeding on bats in southern Brazil

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Received: April 27 2015 Received after revision: September 25 2015 Accepted: October 6 2015
Available online at <http://www.ufrgs.br/scerbio/ojs/index.php/rbb/article/view/3376>

ABSTRACT: (*Philodryas olfersii* (Serpentes, Dipsadidae) feeding on bats in southern Brazil). Snakes are often cited as regular or occasional predators of bats. However, information on predator-prey interactions involving bats and snakes is relatively scarce in Brazil considering the high diversity of both taxa. The present note reports two new records of a snake feeding on bats in two different municipalities located in Rio Grande do Sul, the southernmost state of Brazil. The predation attempts were opportunistically observed, and were made by *Philodryas olfersii*, a semi-arboreal dipsadid snake. In the first event, the snake was observed eating a *Nyctinomops laticaudatus* specimen at the entrance of a rocky wall, where there is a colony of this bat species. In the second case, the snake entered a bat roost in a building and bit a *Histiotus velatus* individual, which escaped and died 30 minutes later. This is the first record of *P. olfersii* feeding on bats, and the first and second record, respectively, of *H. velatus* and *N. laticaudatus* being predated by a snake. The strategy of entering roost sites during the day to attack bats is documented for the first time in *P. olfersii*, but this predatory behavior is apparently common among large colubrids, which are closely related to dipsadids. Since *P. olfersii* is diurnal, scansorial, and can be faithful to the hunting site, it is a potential regular predator of gregarious bats inside day roosts.

Keywords: Chiroptera, *Histiotus velatus*, *Nyctinomops laticaudatus*, predation, snakes.

RESUMO: (*Philodryas olfersii* (Serpentes, Dipsadidae) se alimentando de morcegos no sul do Brasil). Serpentes são frequentemente citadas como predadores regulares ou ocasionais de morcegos. Porém, informações sobre interações predador-presa envolvendo morcegos e serpentes são relativamente escassas no Brasil, considerando a alta diversidade de ambos os táxons no país. A presente nota descreve dois novos registros de uma serpente se alimentando de morcegos, em dois diferentes municípios localizados no Rio Grande do Sul, o estado mais meridional do Brasil. As tentativas de predação foram oportunisticamente observadas e foram realizadas por *Philodryas olfersii*, uma serpente semi-arbóricola da família Dipsadidae. No primeiro evento, a serpente foi observada ingerindo um espécime de *Nyctinomops laticaudatus* na entrada de uma parede rochosa, onde há uma colônia desta espécie de morcego. No segundo caso, a serpente entrou em um abrigo diurno, um vão entre uma parede e uma viga de madeira de uma casa, e mordeu um indivíduo de *Histiotus velatus*, que escapou e morreu 30 minutos depois. Este é o primeiro registro de *P. olfersii* se alimentando de morcegos, e o primeiro e segundo registros, respectivamente, de *H. velatus* e *N. laticaudatus* sendo predados por uma serpente. A estratégia de entrar em refúgios durante o dia para atacar morcegos é documentada pela primeira vez para *P. olfersii*, mas esse comportamento predatório é aparentemente comum entre serpentes de grande porte de Colubridae, uma família filogeneticamente próxima de Dipsadidae. Uma vez que *P. olfersii* é diurna, escansorial, e pode ser fiel à área de caça, esta espécie é um potencial predador regular de morcegos gregários dentro de abrigos diurnos.

Palavras-chave: Chiroptera, *Histiotus velatus*, *Nyctinomops laticaudatus*, predação, serpentes.

INTRODUCTION

Bats are diverse, widespread, mobile, and usually small and abundant; they fly at night and frequently aggregate in colonies during the day (Nowak 1994). Because of this, bats can fall prey to a wide variety of animals, including mammals, birds, reptiles, amphibians, fish, and large arthropods (Altringham 1996). Raptors, especially owls and falcons, are the most frequently cited natural predators of bats (e.g. Adams 1989, Best *et al.* 1997, Wright 2009). However, in review papers on more conspicuous and well-known bat species, such as *Lasiurus cinereus*, *Desmodus rotundus*, and *Tadarida brasiliensis*, snakes are

also often mentioned as regular or occasional predators (Shump & Shump 1982, Greenhall *et al.* 1983, Wilkins 1989). Snakes can attack fallen bats on (or near to) the ground, remove them from their roosting sites, or climb to elevated positions to capture flying bats (Herreid 1962).

At least 20 species of snakes have been recorded as predators of bats in the neotropics (reviewed by Esbérard & Vrcibradic 2007). Most predation cases corresponded to snakes species from the family Boidae, which are frequently large, arboreal, and specialized in mammalian prey (Pizzatto *et al.* 2009, Lillywhite 2014). Predation events upon bats by snakes of the family Colubridae were less common but also reported, especially for

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large-bodied snake species. In Brazil, information on predator-prey interactions involving bats and snakes is relatively scarce considering the high diversity of both taxa (Costa & Bérnils 2014, Nogueira *et al.* 2014). There are currently 16 reported predation events, ten by boids (Hopkins & Hopkins 1982, Martins & Oliveira 1998, Esbérard & Vrcibradic 2007, Pizzatto *et al.* 2009, Donato *et al.* 2012), three by colubrids (Rufino & Bernardi 1999, Esbérard & Vrcibradic 2007, Barbo *et al.* 2011), two by dipsadids (Mesquita *et al.* 2010, França & Lima 2012), and one by a viperid species (Valdujo *et al.* 2002).

The reported cases of snakes preying on bats in Brazil were observed in tropical areas in northern (Hopkins & Hopkins 1982, Martins & Oliveira 1998, Rufino & Bernardi 1999), north-eastern (Mesquita *et al.* 2010, Donato *et al.* 2012, França & Lima 2012), south-eastern (Esbérard & Vrcibradic 2007), and central regions of the country (Valdujo *et al.* 2002, Esbérard & Vrcibradic 2007), except one study that reported the predation of a phyllostomid bat by *Spilotes pullatus* in São Paulo municipality (Barbo *et al.* 2011), located in south-eastern Brazil just below the tropic of Capricorn. There is no information on snake predation on bats in southern Brazil, the only predominantly subtropical region in the country. In order to provide new data on natural history of both snakes and bats, here we report two new predation events, which correspond to the second and third records of snakes feeding on bats in a subtropical region of Brazil. The predation attempts were made by *Philodryas olfersii* (Lichtenstein, 1823), a semi-arboreal dipsadid snake, upon two gregarious species of bats, *Nyctinomops laticaudatus* (É. Geoffroy, 1805) and *Histiotus velatus* (I. Geoffroy, 1824).

MATERIAL AND METHODS

The predation events were opportunistically observed in two different areas in Rio Grande do Sul (RS), the southernmost state of Brazil. The first predation case occurred at a rocky site in the municipality of Tabai, and the second event was observed in a rural area in Porto Alegre city. Both municipalities are located in a zone of contact between two vegetation types: deciduous seasonal forest (*Floresta Estacional Decidual*) and steppe (the grasslands of South American pampas) (IBGE 2004). The climate is classified as temperate without dry season and hot summer (Cfa) according to the Köppen system (Peel *et al.* 2007). There are four well-defined seasons characterized mainly by differences in temperature, which averages 24 °C in January (summer) and 13 °C in June (winter) (Rambo 2000). The bat specimens were identified from the following literature: Lara (1955), Barquez *et al.* (1999), Gregorin and Taddei (2002), and Miranda *et al.* (2011).

RESULTS

The first predation event was observed on December 5, 1999 in a rocky site (29°40'46.56"S, 51°42'49.45"W) situated in the municipality of Tabai (RS) at an altitude of 91 m asl. The site consists of a sandstone cliff sparsely covered with herbaceous and shrubby vegetation (Fig. 1A), where a colony of *Nyctinomops laticaudatus* (Chiroptera, Molossidae) roosts in a crevice between rocks about 30 m above the ground. Around 09.30, during climbing activities at this area, a $\approx$ 100-cm specimen of *Philodryas olfersii* (Serpentes, Dipsadidae) was observed on a rocky surface in front of the bat roost. The snake was beginning to swallow an individual of *N. laticaudatus*;



Figure 1. A. Rocky wall (29°40'46.56"S, 51°42'49.45"W) where a colony of the bat *Nyctinomops laticaudatus* roosts in a crevice about 30 m above the ground, in Tabai, southern Brazil (photo by Jerônimo Chisté). B. Snake *Philodryas olfersii* feeding on a *N. laticaudatus* individual in front of the bat roost, on December 5, 1999 (photo by Leandro Chisté Pinto).

approximately the anterior two-thirds of the bat's body were inside the snake's mouth (Fig. 1B). As the observer approached the snake to examine it closely and take pictures, the snake regurgitated the prey and fled, leaving the dead bat on the ground. The bat was then collected, and deposited in the Mammal Collection of the Universidade Federal do Rio Grande do Sul (Number DZMAM 433).

The second case occurred on May 17, 2008, in the headquarters of the Espaço de Conservação Econsciência (30°10'50.17"S, 51°6'4.99"W), a 142 ha private property located in the Morro São Pedro, Porto Alegre (RS), at an altitude of 56 m asl. The Econsciência area is home to several riverheads and continuous fragments of native vegetation, which form a mosaic of forests and grasslands (Econsciência 2015). The headquarters building is made of wood and adobe (Fig. 2A), where colonies of *Histiotus velatus* (Chiroptera, Vespertilionidae) occupy gaps between double walls and wooden beams. Around 10.30, a ≈ 70 cm specimen of *Philodryas olfersii* was observed inside the house, moving on a beam along a wall and entering one of these gaps (Fig. 2B). When two-thirds of the snake's body were inside the gap, bat distress calls were heard, and then an individual of *H. velatus* flew

out of the roost site. The bat remained on the ground for about five minutes (Fig. 2C), and after that it flew out of the house, landing on a bush where it stayed about 30 minutes until its death (Fig. 2D). The specimen was collected and examined; it had an injury in the abdomen where it had been bitten by the snake. This bat was also deposited in the Mammal Collection of the Universidade Federal do Rio Grande do Sul (Number DZMAM 1140).

DISCUSSION

As far as we know, this is the first record of *Philodryas olfersii* feeding on bats. *Philodryas olfersii* is a diurnal and semi-arboreal snake (Martins *et al.* 2008) widely distributed in tropical and subtropical areas throughout South America (Giraud 2001). Studies on its diet report consumption of frogs, lizards, snakes, birds, rodents and unidentified mammals (Hartmann & Marques 2005, França *et al.* 2008, Leite *et al.* 2009, Winck *et al.* 2012, Mesquita *et al.* 2013). This snake species is frequently observed preying on passerines (Lema 2002), including on trees and near houses in rural and urban areas (Sazima & Marques 2007, Almeida & Santos 2011, Morton



Figure 2. A. Headquarters building of the Espaço de Conservação Econsciência (30°10'50.17"S, 51°6'4.99"W), where colonies of the bat *Histiotus velatus* roost in gaps between wooden walls and beams, in Porto Alegre, southern Brazil (photo by Adriano Becker). B. Snake *Philodryas olfersii* entering one of the bat roosts on May 17, 2008. C. Individual of *H. velatus* that flew out of the roost site and landed on the floor after being bitten by the snake. D. The same bat after flying out of the house and landing on a bush, where it stayed about 30 minutes until its death (photos B, C, and D by Renata Orestes Pfau).

et al. 2012, M. D. Freire, personal observation). Since bats often roost in trees and buildings, opportunistic predation of bats by *P. olfersii* may be relatively common. Other species from the genus *Philodryas* have been occasionally recorded as bat predators, such as *P. aestiva* (Gonzalez 1989), *P. viridissima* (Otto & Miller 2004), and *P. nattereri* (Mesquita *et al.* 2011).

Nyctinomops laticaudatus occurs from Mexico to Brazil and northern Argentina (Simmons 2005), and is preyed upon mainly by owls and hawks (Avila-Flores *et al.* 2002, Motta-Junior *et al.* 2004, Aguiar *et al.* 2012). This is the second record of *N. laticaudatus* being predated by a snake. In Central America, local farmers reported regular attacks of boids (*Epicrates angulifer*) on *N. laticaudatus* colonies, in crevices between dead leaves of palms (Silva-Taboada & Koopman 1964). In the present study, the initial attack was not observed, but probably the snake entered the crevice between rocks to capture one bat from the colony, and then began to swallow it on the ground. Another possibility is that *Philodryas olfersii* fed on a dead bat, since bat carcasses are occasionally found around or inside this roost site. The necrophagy hypothesis cannot be ruled out, but we believe it is unlikely because of the absence of signs of decomposition in the bat specimen and the lack of records of scavenger behavior in *P. olfersii* and semi-arboreal species in general, although it occasionally occurs in aquatic and terrestrial snakes (Sazima & Strussman 1990).

Histiotus velatus is endemic to South America (Simmons 2005), and relatively common in both natural and anthropogenic environments in southern Brazil (Pacheco *et al.* 2010, M. A. S. Barros, personal observation). However, information on its natural history is scarce (but see Peracchi 1968, Welter 2009). The only recorded predation of this bat was by an owl (*Asio stygius*) in south-eastern Brazil (Motta-Junior & Taddei 1992); therefore, the present study is the first record of a predation attempt on *H. velatus* by a snake. The snake entered the bat roost during the day to locate and try to capture bats. The predatory behavior of other *Philodryas* species when feeding on bats has not been observed (Gonzalez 1989, Otto & Miller 2004, Mesquita *et al.* 2011), but this same strategy is apparently common among large species of Colubridae (Esbérard & Vrcibradic 2007), a family phylogenetically close to Dipsadidae (Grazziotin *et al.* 2012), in contrast to trying to intercept flying bats leaving their roost sites at dusk, as frequently observed in Boidae species (Esbérard & Vrcibradic 2007). Although the snake failed to catch the *H. velatus* individual, the bat eventually died most likely because of the venom action. *Philodryas olfersii* uses poisoning and constriction to subjugate its prey (Hartmann & Marques 2005) and, similarly to viperids, it has a fast-acting venom able to cause edema, hemorrhage, necrosis, and death (Rocha & Furtado 2007).

Although social life often decreases predation risk by improving antipredator vigilance, diluting capture chance, or increasing defense efficiency, it also makes

groups more conspicuous to predators (Krebs & Davies 1996). Bats are particularly vulnerable to predation as they emerge in groups from the roosts (Altringham 1996), and probably also inside roost sites, since predation risk likely influences the roost selection and behavior of roosting bats (Lima & O'Keefe 2013). Molossidae and Vespertilionidae are large families of bats, within which several species frequently live in large groups in caves, tunnels, rock crevices, buildings, and tree hollows (Nowak 1994). Thus, colonies of molossid and vespertilionid bats represent locally abundant food sources for medium to large snakes, and are often located inside closed roosts provided with few openings, which may increase capture success (Esbérard & Vrcibradic 2007). Since both *Nyctinomops laticaudatus* and *Histiotus velatus* are gregarious bats that roost mainly in rock crevices and buildings, respectively (Nowak 1994), colonies of these species can be repeatedly visited by arboreal (or semi-arboreal) snakes. The same may be true of colonies of bats that roost in hollow trees. As *Philodryas olfersii* is diurnal, scansorial, and can be faithful to the hunting site (Sazima & Marques 2007), it is a potential regular predator of bats inside day roosts.

ACKNOWLEDGMENTS

We are grateful to Felipe Viana (Instituto Econsciência) for helping with data collection and for logistic support in the Espaço de Conservação Econsciência (Porto Alegre, Rio Grande do Sul, Brazil). We also thank Adriano Becker for permission to use his photo of the Econsciência headquarters.

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