

Predation by the centipede *Scolopendra viridicornis* (Scolopendromorpha, Scolopendridae) on roof-roosting bats in the Atlantic Forest of southeastern Brazil

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Abstract. Few invertebrates are currently known to feed upon bats, particularly on adult individuals, fully capable of flying. Herein we present new records of bat predation by centipedes, an interaction only previously known from observations on a Venezuelan cave. Two predation events were recorded, both relating *Scolopendra viridicornis* (Chilopoda, Scolopendromorpha, Scolopendridae) to bats roosted in the roof of houses in the Reserva Natural Vale, an Atlantic Forest remain located in northern Espírito Santo state, southeastern Brazil. Information available from the second event includes the identification of the predated bat (adult female *Eptesicus furinalis* - Vespertilionidae) and the body parts (viscera and muscles of the skull, neck, shoulder, upper arm, and chest) ingested by the *Scolopendra*.

Key words: Chiroptera, *Eptesicus furinalis*, Espírito Santo, feeding behavior, Vespertilionidae.

Introduction

Several vertebrates have been reported to prey upon bats (Stanley & Collett 2009; Breviglieri & Pedro 2010), with at least two groups, birds of prey (hawks, falcons, and owls) (Sommer et al. 2009) and snakes (Esbérard & Vrcibradic 2007; Lewis et al. 2009), acting as regular predators (Altringham 2011). Invertebrates are also known to feed upon bats, but this is a much less documented interaction.

The oldest reference relating bats to invertebrate predators comes from Cantor (1842), who found bats entangled in spider webs. Compelling evidence of bat predation by spiders, however, only became available more recently (Wilson 1971; Timm & Losilla (2007). Scorpions are sometimes cited as bat enemies (Orr 1954; Gillette & Kimbrough 1970), but until the beginning of the 21 century only two other invertebrate groups, ants and cockroaches, were also reported to feed upon bats (Gillette & Kimbrough 1970). While spiders can trap adult bats in their webs (Timm & Losilla 2007), predation by ants and cockroaches seems to occur

essentially over young individuals with limited or no flying ability (Allen 1939; Rice 1957; Wilson 1971; Nogueira & Pol 1998).

The last invertebrate group to be recorded as a bat predator was Chilopoda. Consistent evidences were obtained in a Venezuelan cave, where two mormoopids, *Mormoops megalophylla* and *Pteronotus davyi*, and one phyllostomid, *Leptonycteris curasoae*, were predated by *Scolopendra gigantea* (Molinari et al. 2005). Observations at this cave show that giant centipedes are able to climb cave ceilings to catch and eat flying or perching adult bats substantially heavier than themselves (Molinari et al. 2005).

Herein we present new evidence of bat predation by centipedes, based on two incidental findings at the Reserva Natural Vale (Vale Natural Reserve; RNV), a large Atlantic Forest remain in southeastern Brazil.

Methods

The RNV is a private natural protected area with almost 23,000 ha located in the municipality of Linhares, in the north of the state of Espírito Santo, Southeastern Brazil. This reserve is part of

a larger forest fragment whose the other half is comprised by the Reserva Biológica de Sooretama (Sooretama Biological Reserve), a protected area from Brazilian government. A federal road – BR 101 – separates the two reserves. Together, these reserves harbor more than 47,000 ha of forests and represent the largest Atlantic Forest remnant located in latitudes lower than 22° (SOSMA & INPE 2011). These reserves are covered by “Mata de Tabuleiro” (tablelands), a particular type of Atlantic Forest vegetation located on flat terrain that evolved in association with Tertiary (Pliocene) sediments of the Barreiras series (Joly et al. 1990; Rizzini 1997 & Peixoto et al. 2002, 2008). Phytogeographically, the Tabuleiro forest found at the RNV has been classified as a Semi-deciduous Seasonal Forest (Peixoto & Gentry 1990; Massad et al. 2011) or Perennial Seasonal Forest (Jesus & Rolim 2005). The climate in the municipality of Linhares is tropical warm and wet (Aw in the Köppen’s classification) (Nóbrega et al. 2008). At the RNV, a drier season has been recorded from April to September, with an annual mean precipitation of 1,202 mm and an annual mean temperature of 23.3°C (mean minimum 14.8°C and mean maximum 34.2°C) (Jesus & Rolim 2005).

Results and discussion

The two records of predation at the RNV were obtained close to the administration building of the Reserve (40°4’14” W, 19°9’5”S). On April 2008, at morning, a centipede was found perching from a rafter on the roof of a house, and holding an apparently dead bat with its most anterior legs. The centipede is a 140 mm in length young specimen of *Scolopendra viridicornis* (Chilopoda, Scolopendridae) and is preserved as voucher in the collection of the Laboratório Especial II - Coleções Zoológicas, Instituto Butantan (accession number IBSP 3635). The second predation event was recorded on June 09, 2008, at 06:50 hs, and a *Scolopendra* was found feeding upon a bat, but at this time both specimens were on the floor (Figure 1), in the external area of a second house. They were in an area still covered by the roof of the house, but it was not possible to determine if the centipede attacked the bat on the ground or if the bat was roosting in the roof and felt after being attacked by the centipede. The bat was already significantly damaged when the observer arrived at the predation site (Figure 1), but there was fresh blood and no sign of rigor mortis. The centipede continued its feeding activities, regardless the close presence of the observer. The predation was characterized by the removal of the tegument from cephalic and thoracic regions of the bat, which was followed by the ingestion of the muscles of the skull (mainly the temporal and masseter), neck, right half of the



Figure 1. *Scolopendra viridicornis* feeding upon an adult female *Eptesicus furinalis* at the floor of an administration building at Vale Natural Reserve, state of Espírito Santo, southeastern Brazil.

chest, and right shoulder and upper arm (Figure 2). After feeding upon the chest muscles, the centipede introduced its head into the thoracic box and partially eaten the viscera. The predator also removed the skin tegument of the left side of the abdominal region and continued the viscera’s ingestion. The removal of fragments of abdominal viscera for ingestion was performed through quick and repetitive movements, applied at short time intervals. The bat predated in this latter event is an adult female *Eptesicus furinalis* (Vespertilionidae), with forearm, greatest length of skull (excluding incisors), and maxillary tooththrow measuring, respectively, 38.74, 15.38, and 5.83 mm. Its carcass, including the skull, is deposited as voucher at the Adriano Lúcio Peracchi Collection, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro (accession number ALP 10105).

Unlike other invertebrates that eventually rely on “traps” to capture bats (e.g., spiders; Timm &



Figure 2. Carcass of a female *Eptesicus furinalis* (ALP 10105) after its predation by *Scolopendra viridicornis* at Vale Natural Reserve, state of Espírito Santo, southeastern Brazil.

Losilla 2006) or feed on young bats that fall from roosts (e.g., ants and cockroaches; Allen 1939; Rice 1957; Wilson 1971), centipedes can reach adult perching bats and even capture them while they are flying inside roosts (Molinari et al. 2005). Data presented here show that roof-roosting bats, like cave-roosting species (Molinari et al. 2005), are also subject to centipede predation. In the Neotropics, roof-roosting bats are found among phyllostomids, but more frequently among vespertilionids and molossids (Lima 2008). At the RNV, at least one vespertilionid (*Myotis nigricans*), in addition to *E. furinalis*, and two molossids (*Molossus molossus* and *Molossus rufus*) are commonly found in roofs (pers. obs.). With the exception of *M. rufus* (body mass ca. 30 g), all these species weight nearly equal to or less than 16.5 g, which is the average body mass for *Mormoops megalophylla*, the bat predated in Venezuela by a *S. gigantea* similar in length to the *S. viridicornis* collected at RNV (145 vs 140 mm, respectively) (Molinari et al. 2005). *Scolopendra viridicornis*, however, may reach 200 mm in length (Bücherl 1979; Malta et al. 2008), suggesting that even larger bats may be suitable prey.

As described by Molinari et al. (2005) for bats predated in Venezuela, the specimen of *E. furinalis* preyed upon at RNV presented fresh blood in wounds, suggesting that it was alive when captured by *S. viridicornis*. Centipedes, indeed, capture their prey alive and use a pair of modified legs located just behind head, the forcipules, to inoculate venom (Bücherl 1979; Malta et al. 2008). This venom is particularly toxic in *S. viridicornis*, as revealed by comparative analysis with other major agents of centipede bites in Brazil (Malta et al. 2008). Our record of bat predation by *S. viridicornis* is also similar to that of *S. gigantea* in respect to the body parts ingested by these centipedes (e.g., skull muscles, chest, and viscera) and to their ability of catching roosting bats and holding preys with anterior legs while hanging from the ceiling with the posterior ones (Molinari et al. 2005). These abilities are not seen in most vertebrate predators of bats (Molinari et al. 2005), and are certainly lacking in the few other invertebrate predators cited here.

Scolopendra viridicornis is the most common centipede found in Brazil (Bücherl 1979; Barroso et al. 2001). It is well adapted to live around and inside human buildings (Knysak et al. 1998), a condition shared with bats that can now be viewed as its potential prey. If we consider, in addition, that vertebrates may represent a particularly rewarding nutritious prey in comparison to invertebrates (Molinari et al. 2005), interactions like those reported here can be expected to be more frequently observed, supporting the view of

invertebrates as regular bat predators (Timm & Losilla 2007).

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