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Authors: Miranda, Flávia, Veloso, Roberto, Superina, Mariella, and Zara, Fernando José

Source: Edentata, 2009(10) : 1-5

Published By: IUCN/SSC Anteater, Sloth and Armadillo Specialist Group

URL: https://doi.org/10.1896/020.010.0109

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Food Habits of Wild Silky Anteaters (*Cyclopes didactylus*) of São Luis do Maranhão, Brazil

Flávia Miranda
Roberto Veloso
Mariella Superina
Fernando José Zara

Introduction

None of the four extant anteater species is currently considered to be threatened with extinction (IUCN, 2007; Aguiar and Fonseca, 2008). However, the destruction and fragmentation of their habitat is advancing swiftly throughout their common distribution, and may already have caused local extinctions (Fonseca and Aguiar, 2004; Fallabrino and Castiñeira, 2006). Similarly, fragmentation may expose wild populations to new parasites and infectious diseases, while also increasing the risk of transmission between human and animal populations (Aguirre *et al.*, 2002).

Local extinctions can have damaging effects on ecosystems by causing interruptions in key ecological processes, eventually compromising their integrity. Similarly, they can lead to the loss of populations that are especially important for the genetic diversity of a species, such as isolated populations that have evolved—or are evolving—into different subspecies (Frankham *et al.*, 2002).

The silky anteater (*Cyclopes didactylus*) is the smallest extant anteater, with a body length of approximately 35 cm and a tail length of 20 cm, and a body weight of approximately 500 grams. Its exclusively arboreal and nocturnal habits (Montgomery, 1985a) may explain why it is one of the least-studied of the xenarthrans. *C. didactylus* has recently been removed from the Myrmecophagidae and is now classified in the monotypic Cyclopedidae (Gardner, 2005). Its range includes the tropical forests of Central and South America, but the species is divided into northern and southern populations by the Andes, which present a significant barrier to its distribution. The silky anteater's low metabolic rate, low body temperature (around 33°C) and its reduced ability to thermoregulate all limit its distribution to forests below 1500 m (McNab, 1985). In the northern part of their distribution, individuals have golden fur, but farther to the south this coloration becomes greyer, with a dark dorsal line (Dickman, 1984). An isolated population has been reported from coastal northeastern Brazil (Fonseca and Aguiar, 2004), separated from the Amazonian populations by the xeric Caatinga landscape. Although populations are affected by rapid deforestation and habitat loss throughout its range (Novaes, 2007), the silky anteater is classified as Least Concern by the IUCN (Fonseca and Aguiar, 2004; IUCN, 2007).

Information on their ecology is scarce. Although silky anteaters are predominantly arboreal, they do not have an opposable hallux. Each forelimb bears two digits with strong curved claws that allow them to firmly cling to branches; their strong prehensile tail is used for support, especially when they are using their claws for defense or to rip open ant nests. Information on the food habits of silky anteaters is limited to Best and Harada (1985) and Montgomery (1985b), who argue that their main food item seems to be ants, although Best and Harada (1985) also observed a low number of beetles in fecal samples. These studies involved individuals from the two main segments of the species' distribution (represented by Manaus and Barro Colorado Island, respectively); the isolated population of silky anteaters in Brazil, however, has not yet been thoroughly studied. As part of an ongoing project on the ecology and health of this small coastal population, we had the opportunity to examine the gastrointestinal contents of two recently deceased individuals. The results presented here contribute to the knowledge of this elusive species, and will help in understanding their habitat needs and in developing conservation strategies.

Materials and Methods

Study area

Maranhão is the second-largest state in Brazil, with approximately 330,000 km^2 of land area and 640 km of coastline. The island of São Luis, on the state's northern coast, is a narrow peninsula of 905 km^2 between the Rios Mearim and Itapicuru; it is cut off from the mainland by a narrow channel, the Estreito da Carapanã ("Mosquito Strait"). There are three towns and several villages on the island, in addition to Maranhão's capital city of São Luis. It has a moist tropical climate; most of its yearly precipitation of 2083 mm falls between January and June. The dry season lasts from July to December, but is most intense in September, October and November; the ambient temperature during this time varies between 24–30°C. The vegetation is diverse and consists of uncultivated environments of secondary growth composed mostly of grasses and shrubs of *Baccharis* spp. (*capoeira*), interspersed with babassu palms (*Attalaea speciosa*) and jucúm palms (*Bactris setosa*). Açaí palms (*Euterpe edulis*) and buriti palms (*Mauritia flexuosa*) can be found in humid areas. Marshlands

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and a diverse flora of native fruit trees also exist on the island (Novaes, 2007), and narrow rivers lined with mangroves are present throughout.

Sample collection and analysis

Two dead specimens of *Cyclopes didactylus* were received by the Centro de Triagem de Animais Selvagens in Maranhão (CETASMA/IBAMA), an agency of the Brazilian government dedicated to rehabilitating animals rescued from the wildlife trade. According to the locals who had delivered them to the Rescue Center, the animals were found in forest fragments on the island of São Luis do Maranhão (02°31' S, 44°16' W; Fig. 1).

Intestinal contents and feces were collected during necropsies and preserved in 70% ethyl alcohol. They were shipped to the Morphology and Biochemistry Laboratory of the Universidade Estadual Paulista (UNESP) São Vicente, in the state of São Paulo, for analysis. The composition of intestinal contents and feces was analyzed under a dissecting microscope based on characteristics of size and shape, following Palacio and Fernández (2003). Following examination, the specimens were conserved by IBAMA, the parent agency of CETASMA.

Results

The gastrointestinal tract of the silky anteaters contained fragments of formicid ants belonging to four genera: *Camponotus, Dolichoderus*, *Pseudomyrmex* and *Solenopsis* (Table 1), as well as trace fragments of ant nests.

All the ants identified from the gastrointestinal tract of one silky anteater, and 18.5% of the ants found in the intestines of the other, were of the genus *Camponotus*. This genus comprises over 1000 species, with at least 400 of them living in the Neotropics. Many *Camponotus* species are arboreal and nocturnal (Dejean *et al.*, 2003; Delabie *et al.*, 2003), although they may be found foraging during the day. All known species are omnivorous (Hölldobler and Wilson, 1990; Fernández, 2003a).

One morphospecies of *Dolichoderus* accounted for 26% of the gastrointestinal contents of the first specimen. Sixty-four of the 164 described species are

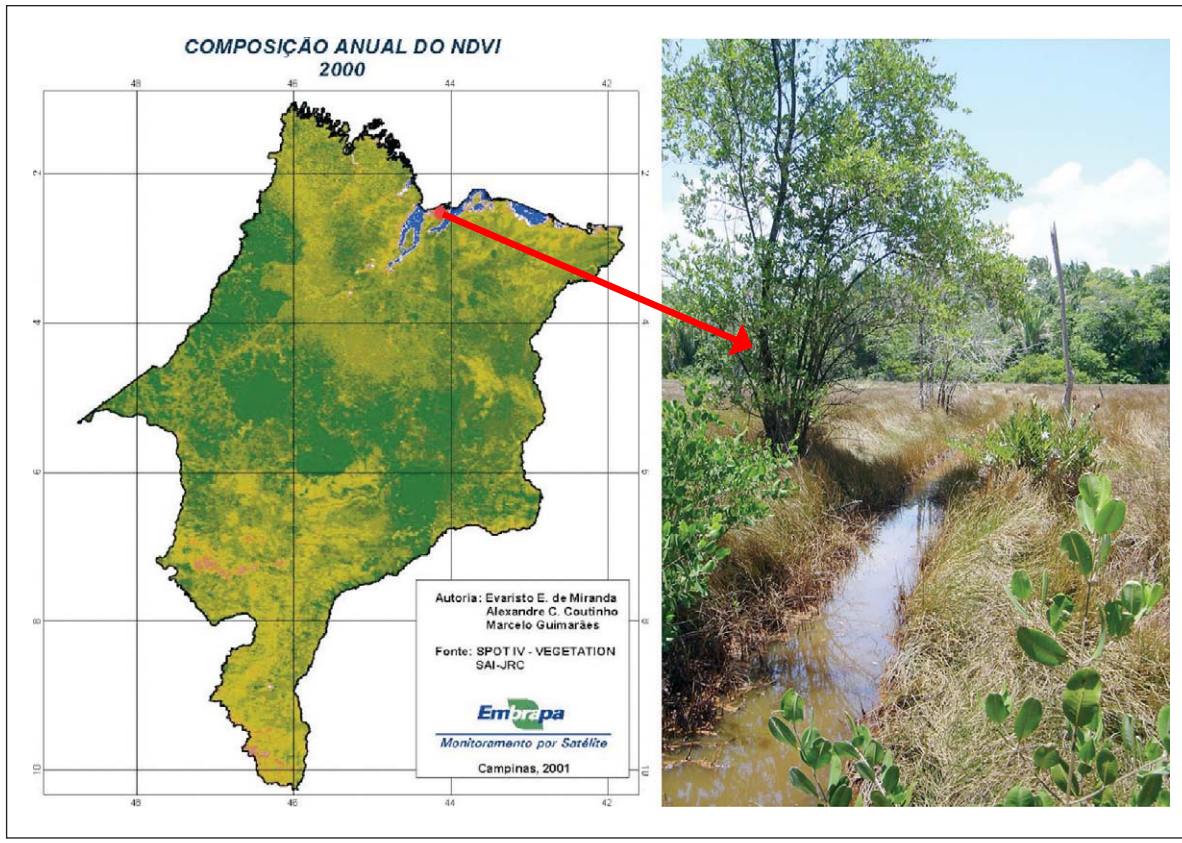

Figure 1a. Approximate locality for the silky anteaters analyzed in this study. **1b**. Typical habitat of silky anteaters in Maranhão. (Map by Embrapa; photo by Flávia Miranda.)

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Neotropical (Cuezzo, 2003). These ants are mainly arboreal and very active in tropical forests, especially in rainforests (Cuezzo, 2003). They can be very abundant in some trees, and may be found with ant-gardens, in which ants actively propagate selected seeds (Dejean *et al.*, 2003; Delabie *et al.*, 2003). They are considered omnivores (Hölldobler and Wilson, 1990; Cuezzo, 2003) and can be active during the day or at night.

The genus *Pseudomyrmex* (subfamily Pseudomyrmicinae) represented only a modest proportion (7.4%) of the gastrointestinal contents of the first specimen. These ants can be found in tropical wet forests, savannas, and occasionally in cold regions (Ward, 2003). They usually live in the arboreal substrate, where they make their nests in dead branches (Ward, 1991, 2003; Delabie *et al.*, 2003). Some are obligate inhabitants of myrmecophilous plants, such as *Triplaris brasiliensis* (Hölldobler and Wilson, 1990; Ward, 2003) and some species tend scale insects (Coccoidea; Ward, 2003).

Ants of the genus *Solenopsis* (subgenus *Diplorhoptrum*) accounted for almost half of the identified food items of the first specimen; these ants are usually found in leaf litter (Fernández, 2003b). Giant anteaters (*Myrmecophaga tridactyla*) of the Pantanal of Nhecolândia have been reported to ingest large quantities of these ants (Medri *et al.*, 2003).

Discussion

The gastrointestinal contents of these two silky anteaters were comprised largely, if not entirely, of arboreal ants. The best-represented genera were *Camponotus* and *Dolichoderus*, which are among the six most abundant ant genera of the Neotropical rainforest canopy (Torbin, 1991), and *Solenopsis*, which are commonly found on trees and with ant-gardens (for a review, see Huxley and Cutler, 1991). *Solenopsis* (subgenus *Diplorhoptrum*, thief ants) is a conspicuous group in leaf litter that needs taxonomic review (Fernández, 2003b) to clarify the biology of its South American species. However, *S. (Diplorhoptrum) picta* and *S. (D.) corticalis* from North and Central America are arboreal and inhabit coastal and mangrove areas (Thompson, 1989), similar to the potential *Cyclopes* habitat on Ilha São Luis. Given the scant knowledge of the silky anteater's behavior, we do not know whether these individuals ingested *Solenopsis* while foraging in the forest canopy, or whether they sometimes descend to the ground and thus may have fed upon them in the leaf litter. We also suspect that *Pseudomyrmex* ants were rarely ingested because they are aggressive, fast-moving and solitary foragers that may be difficult to capture; this would support the findings of Best and Harada (1985).

In contrast to our observations, however, and the findings of Montgomery (1985b), the feces of *C. didactylus* that Best and Harada (1985) collected in the vicinity of Manaus also contained very small amounts (0.1%) of coleopteran fragments. In addition, the silky anteaters studied by both Montgomery (1985b) and Best and Harada (1985) had fed on a greater diversity of ants than our study animals. Although Best and Harada (1985) suggested that a silky anteater opportunistically ingests any ant it can find, our findings suggest that the diet of silky anteaters on the island of São Luis is very specific, potentially consisting only of arboreal ant species.

The ecological advantage for *Cyclopes* to consume only arboreal ants appears to be in terms of biomass. Ants are more abundant than other arthropods in the forest canopy (Adis *et al.*, 1984) and can contribute to more than half of the total arthropod dry weight (Torbin, 1991). Ants obtain most of their energy from nectar and pollen, and the canopy ants could effectively function as primary consumers (Torbin, 1991). A predator feeding exclusively on arboreal ants could thus obtain most of its energy close to the base of the trophic pyramid. Our conclusion is supported by the findings of Montgomery (1985b), who determined that for the *Cyclopes* of Barro Colorado Island, the ant species ingested in the dry season differed only slightly from those consumed during the wet season, suggesting that the silky anteaters fed only on a certain subset of available ants. Moreover, only 12% of

TABLE 1. Number of morphospecies and percentage of ant genera found in the gastrointestinal tracts of two specimens of *Cyclopes didactylus.*

	Specimen 1		Specimen 2	
Genus	No. Morphospecies	%	No. Morphospecies	%
Camponotus	2	18.5	2	100
Dolichoderus (= Monacis)	1	26.0	—	—
Pseudomyrmex	2	7.4	—	—
Solenopsis (Diplorhoptrum)	1	48.1	—	—

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the ant morphospecies found in *Cyclopes* stomach contents had also been ingested by sympatric *Tamandua mexicana*, indicating that the silky anteaters did not feed on all ant species that exist in the area.

The lack of information on the ant fauna of Ilha São Luis does not allow us to evaluate whether silky anteaters feed on all available arboreal ants, or if they selectively ingest certain species. Half of the ant genera in our samples (*Camponotus* and *Pseudomyrmex*) are solitary foragers, which conflicts with Montgomery's (1985b) observations that silky anteaters only forage on nests and covered ant trails, but not on individual ants. It is important to note that no termites have been identified in any dietary study of *Cyclopes* carried out to date (Best and Harada, 1985; Montgomery, 1985b; this study). Silky anteaters thus seem to have a much more specific diet than *Tamandua* or *Myrmecophaga*.

Conclusions

The present study suggests that the diet of *Cyclopes* inhabiting Ilha São Luis is based on a limited diversity of food items, mainly arboreal ants, although it is clear that more samples need to be analyzed to confirm this first approximation. Deforestation is advancing swiftly through the study area (Miranda, personal observation), which could soon put at risk the silky anteater's habitat and food resources. Further studies on the ecology of this nocturnal mammal are urgently needed, and the implementation of conservation units that can support the survival of these species should be encouraged. Environmental education programs should be initiated to involve the local population and teach them the importance of preserving the biodiversity of the Amazon biome.

Acknowledgements

We thank IBAMA – Regional Maranhão for providing the samples and information, Marcio Port for technical information, and the staff of UNESP, Jaboticabal Campus, for their collaboration. The Wildlife Conservation Society (WCS) and the IUCN Edentate Specialist Group provided generous financial support. FJZ also thanks FAPESP (proc. 2005/4707-5).

Flávia Miranda, Projeto Tamanduá and Wildlife Conservation Society, Av. Água Fria, 269 Apt. 133B, 02333-000 São Paulo, São Paulo, Brazil, **Roberto Veloso,** Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – CETAS, São Luis do Maranhão, Maranhão, Brazil, **Mariella Superina,** CCT Mendoza – IMBECU, Ruiz Leal s/n Parque Gral. San Martin, 5500 Mendoza, Argentina, and **Fernando José Zara,** UNESP – Campus do Litoral Paulista, Unidade de São Vicente, Praça Infante Don Henrique s/n, 11330-900 São Vicente, São Paulo, Brazil.

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