

## ***Loxosceles* spiders (Araneae: Sicariidae) preying on invertebrates in Brazilian caves**

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*Loxosceles* Heineken & Lowe, 1832 (Sicariidae) possesses a wide distribution in North, Central and South America (Gonçalves-de-Andrade et al. 2012). There are 13 species of *Loxosceles* in Brazil, seven of them can occur in caves (Gonçalves-de-Andrade et al. 2012): *L. similis* Moenkhaus 1898, *L. gaucho* Gertsch 1967, *L. adelaida* Gertsch 1967, *L. variegata* Simon, 1897, *L. amazonica* Gertsch 1967, *L. anomala* Mello-Leitão 1917 and *L. puortoi* Martins et al. 2002. The recently described species *L. chapadensis* Bertani et al. 2010 and *L. niedeguidonae* Gonçalves-de-Andrade et al. 2012 were found in limestone and sandstone rocky shelters, but not deep inside caves (Bertani et al. 2010; Gonçalves-de-Andrade et al. 2012).

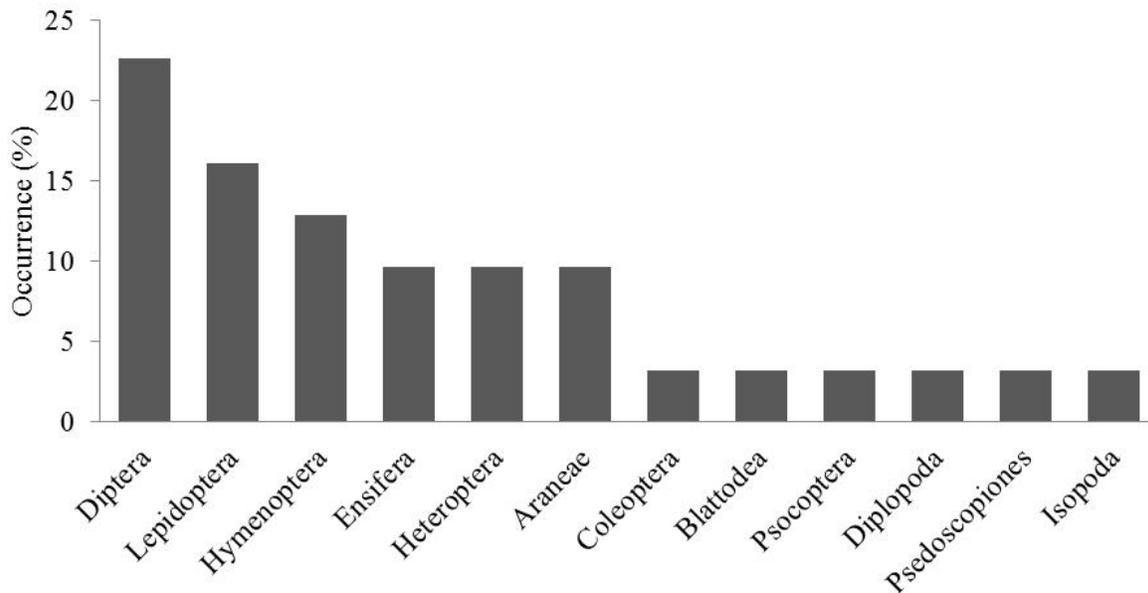
*Loxosceles* spp. spiders are sedentary night predators that live in natural and artificial places sheltered from light on webs stretched on the substrate. They usually capture living invertebrates that are used as food (Fischer et al. 2006). However, *Loxosceles* can use scavenger and cannibal strategies to get food, feeding on dead animals or preying upon living conspecifics (Sandidge 2003; Fischer et al. 2006; Cramer 2008; Vetter 2011).

In Brazilian caves, *Loxosceles* spp. are reported as predatory troglophiles (Ferreira et al. 2005). Abundance within caves can be high, reaching 1.5 individuals per square meter (Ferreira et al. 2005). Little is known on the foraging habits of *Loxosceles* spp. Thus, the objective of the study was to report prey used by *Loxosceles* spp. in cave environments in Brazil.

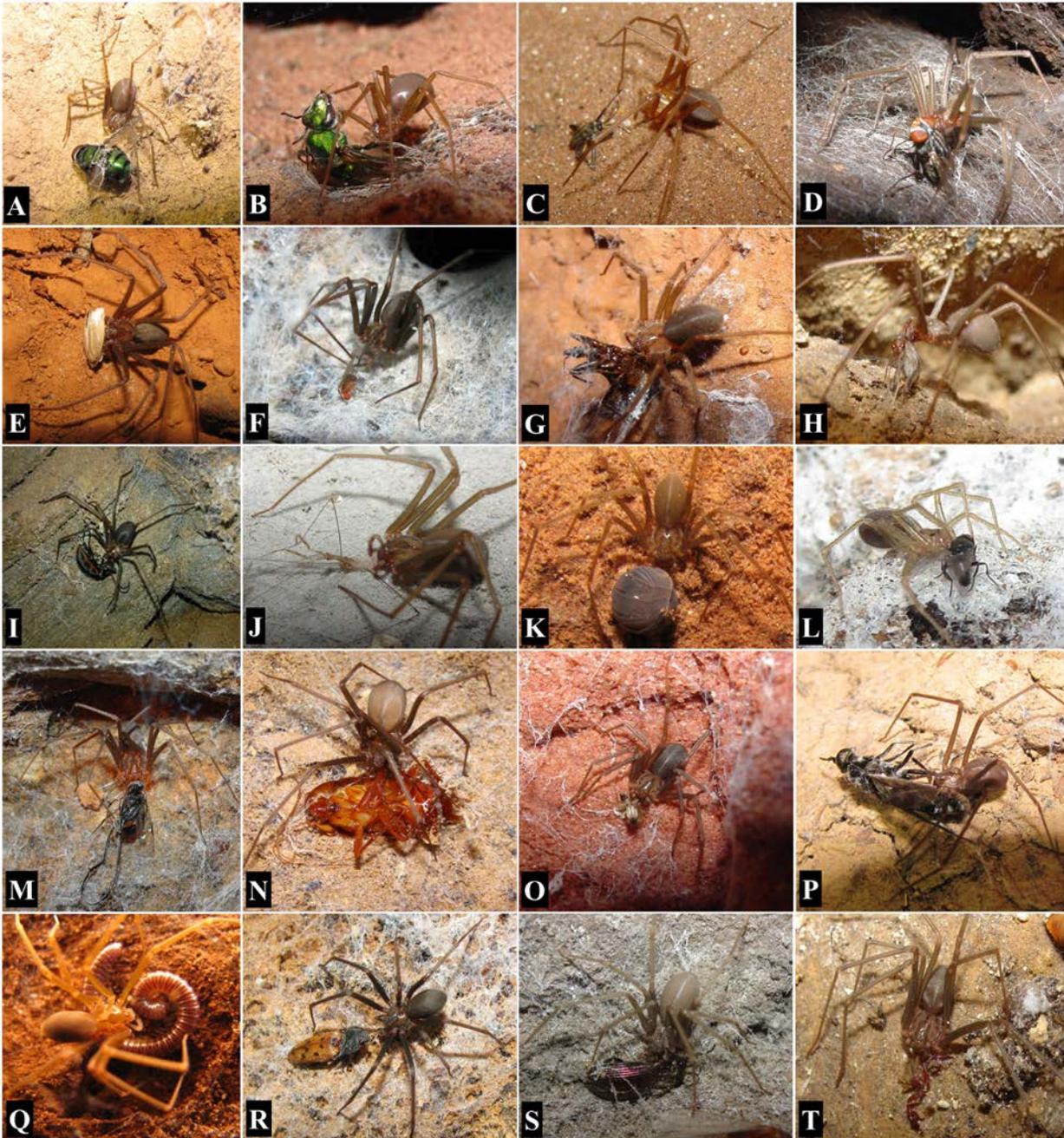
The information presented here originates from observations recorded as digital photographs of prey captured by species of *Loxosceles* that inhabit caves in Brazil. These events were registered during visits to 501 caves in the Caatinga, Cerrado (Brazilian Savannah) and Atlantic Rain Forest biomes from 1999 to 2013. Each cave was visited only once. In many cases spiders were seen capturing prey, but in other cases we only observed the spiders feeding on them.

Thirty predation events, without cannibalism, were observed in the visited caves. All observed prey were arthropods. The majority of prey captures were insects (80%), the remaining being Pseudoscorpiones, Araneae and Diplopoda. Diptera was the most representative order, with 23.3% of occurrence (**Figures 1–2**). Cannibalism was common in spiders of this genus, especially when the caves were extremely dry and oligotrophic (**Figure 3**). Furthermore, cannibalism was also observed when the population densities were large. In some caves, several spiders were observed preying upon smaller individuals (like in Mosquito Cave, located in Curvelo municipality, Minas Gerais, Brazil).

The prey were Hymenoptera (Apidae: *Euglossini* sp., Braconidae, Evaniidae, Formicidae and Vespidae), Ensifera (Phalangopsidae: *Endecous* sp.), Coleoptera (Tenebrionidae, Carabidae and Elateridae), Blattodea, Heteroptera (Emesiinae, Veliidae and Reduviidae – *Cavernicola pilosa*), Psocoptera, Lepidoptera (Tineidae, adult and larvae), Diptera (Empididae, Calliphoridae, Drosophilidae, Milichiidae, Mycetophilidae and Sarcophagidae), Diplopoda (Pseudonannolenidae: *Pseudonannolene* sp.), Isopoda (Armadillididae), Araneae (Pholcidae: *Mesabolivar* sp., Sicariidae: *Loxosceles* sp.) and Pseudoscorpiones (Chernetidae) (**Figures 1–2**). Body sizes of some prey were larger than *Loxosceles* spp. (**Figure 2**).



**Figure 1.** Taxa identified as prey of *Loxosceles* spp. on 30 predation events in cave environments from Brazil.

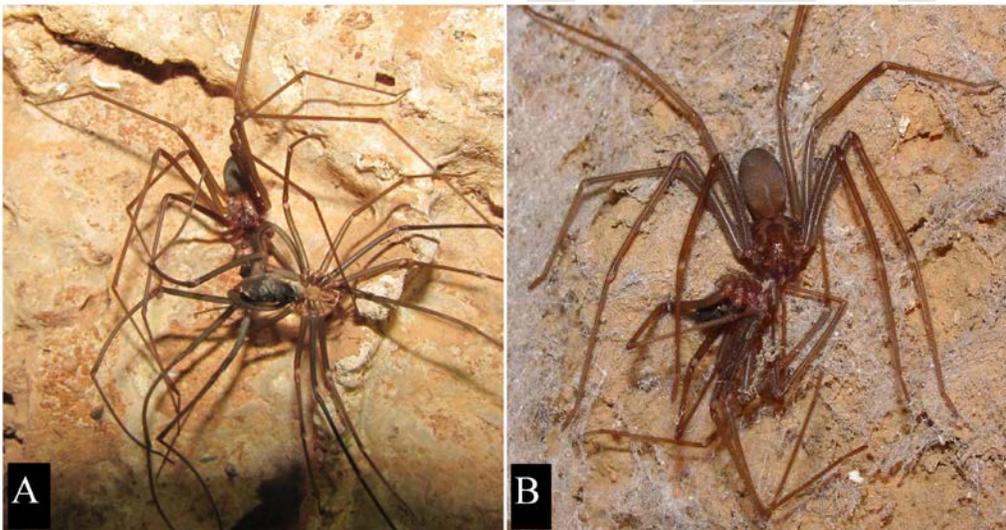


**Figure 2.** Examples of prey captured by *Loxosceles* spp., in Brazilian caves: Sarcophagidae (A), Andrenidae (B), Veliidae (C), Calliphoridae (D), Tineidae (E), Drosophilidae (F), Reduviidae (G), Phalangopsidae (H), Tenebrionidae (I), Emesiinae (J), Isopoda (K), Milichiidae (L), Evaniidae (M), Blattodea (N), Phoridae (O), Empididae (P), Pseudonannolenidae (Q), Elateridae (R), Carabidae (S), and Chernetidae (T).

Previous studies have identified many invertebrates as potential prey for species of *Loxosceles* (Fischer et al. 2006; Hite et al. 1996; Levi and Speilman 1961; Fischer 1996), and some of these invertebrates occur in guano deposits in Brazilian caves (Ferreira and Martins 1999; Ferreira et al. 2000).

In Brazilian caves, web spiders, including *Loxosceles* spp., are frequently observed with webs placed on or near food resources or within invertebrate reproduction sites (e.g. carcasses, feces, organic plant matter, pools of water and margins of subterranean streams), and the spiders obtain their prey opportunistically (Ferreira and Martins 1998; Ferreira and Martins 1999; Ferreira et al. 2000; Gnaspini and Trajano 2000; Ferreira et al. 2007).

The generalist habits and cannibalism, observed in some caves, is probably due to the food resource shortage conditions inside the caves that can result in low prey availability. Cannibalism was very common in some aggregate *Loxosceles* populations, especially those residents in very dry caves and with high food resource shortage conditions. In such cases, the reduced prey availability could have led to such behavior (**Figure 3**). One study about the diet of the *Loxosceles intermedia* showed that cannibalism could be rare in areas with many potential prey (Fischer et al. 2006).



**Figure 3.** Cannibalism events in *Loxosceles*, observed approximately 20 times, especially in those extremely dry and oligotrophic caves.

The availability of organic matter in a specific area of a cave promoted development of abundant fauna as potential prey for *L. similis* (Ferreira and Martins 1998; Ferreira et al. 2007). The only study performed with spiders associated with guano piles in Brazil showed that *L. similis* had a strong dependence on the prey distribution and abundance in Morrinho cave (Bahia, Brazil) (Ferreira and Martins 1998). In that case, the spiders were mainly feeding on silverfish (*Ctenolepisma* sp.) associated with bat guano piles. Accordingly, the increase of potential prey can promote an increase in the abundance of these predators (Ferreira et al. 2005; Ferreira et al. 2007).

However, food resource shortage conditions can result in low prey availability for *L. similis* reducing its abundance and also probably forcing them to move long distances in search of sites with a higher offer of prey (Ferreira et al. 2005) or practice cannibalism. Similarly, the distance from the cave entrance to areas deeper within the cave can reduce *Loxosceles* spp. abundance in two ways (Ferreira and Martins 1998). First, if spiders colonize caves via entrances, the distance from the entrance is a barrier to colonize deeper areas. Second, the distance can reduce prey distribution in the deepest zone (Ferreira and Martins 1998; Ferreira et al. 2005; Ferreira et al. 2007).

Studies regarding aspects of the biology of a ubiquitous genus as *Loxosceles* certainly contribute for a better understanding of the role of these spiders as important predators which can contribute to the structuring of some cave communities here in Brazil. This is especially true when considering dry oligotrophic systems, in which the predation by *Loxosceles* can eventually constitute an important selective pressure for the subterranean communities.

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