Natural history of *Loxosceles chapadensis* Bertani, Fukushima & Nagahama, 2010 (Araneae, Sicariidae)

História natural de *Loxosceles chapadensis* Bertani, Fukushima & Nagahama, 2010 (Araneae, Sicariidae)

Júlia Andrade-de-Sá[I] | Tania Kobler Brazil[I] | Yukari Figueroa Mise[II] | Rejâne Maria Lira-da-Silva[I]

[I]Federal University of Bahia. University Campus. Institute of Biology Nucleus of Ophiology and Venomous Animals of Bahia. Salvador, Bahia, Brazil

[II]Federal University of Bahia. Institute of Collective Health. Salvador, Bahia, Brazil

Abstract: Brown recluse-spiders of the genus *Loxosceles* comprise 147 species and it is responsible for the most significant araneism in South America. Gaps in knowledge exist for various species, such as *Loxosceles chapadensis*, whose biological information is scarce and limited to its description in 2010 and a few publications that mentioned it in some way. We aim to characterize the natural history of *L. chapadensis* and expand its knowledge and distribution. We captured 457 specimens through active search between 2022-2024 in seven locations (six caves) in Bahia, Brazil. We marked sampling areas according to microclimatic variables. Temperature and humidity were considered environmentally homogeneous, but the spatial distribution of spiders was heterogeneous, determined by luminosity. We conclude that *L. chapadensis* is a spider with cave-dwelling habits, endemic to the Brazilian *Caatinga* environments with high-altitude xeric geomorphological and vegetational characteristics, until then, with records in the States of Bahia and Piauí. Its occurrence at places with a large tourist flow requires care in the management plan of the caves where it occurs.

Keywords: Brown recluse-spider. Caves. Chapada Diamantina. *Caatinga*.

Resumo: Aranhas-marrons do gênero *Loxosceles* compreendem 147 espécies e são responsáveis pelo araneísmo mais significativo na América do Sul. Existem lacunas de conhecimento para várias espécies, como *Loxosceles chapadensis*, cuja informação biológica é escassa, limitada à sua descrição em 2010 e a poucas publicações que a mencionam de alguma forma. Objetivamos contribuir com a caracterização da história natural de *L. chapadensis*, bem como com a expansão sobre seu conhecimento e sua distribuição. Foram coletados 457 espécimes por meio de busca ativa entre 2022-2024 em sete localidades (seis grutas) da Bahia, Brasil. As áreas de amostragem nas grutas foram marcadas de acordo com variáveis microclimáticas. Temperatura e umidade foram consideradas ambientalmente homogêneas, mas a distribuição espacial das aranhas foi heterogênea, determinada pela luminosidade. Concluímos que *L. chapadensis* é uma aranha de hábitos cavernícolas, endêmica dos ambientes de Caatinga brasileira com características geomorfológicas e vegetacionais xéricas de altitude, até então com registros nos estados da Bahia e do Piauí. Sua ocorrência em locais de grande fluxo turístico demanda cuidados no plano de manejo das cavernas onde ocorre.

Palavras-chave: Aranha-marrom. Grutas. Chapada Diamantina. Caatinga.

Andrade-de-Sá, J., Brazil, T. K., Mise, Y. F., & Lira-da-Silva, M. (2025). Natural history of *Loxosceles chapadensis* Bertani, Fukushima & Nagahama, 2010 (Araneae, Sicariidae). *Boletim do Museu Paraense Emílio Goeldi. Ciências Naturais*, *20*(1), e2025-1005. http://doi.org/10.46357/bcnaturais.v20i1.1005

Corresponding author: Júlia Andrade de Sá. Institute of Biology. Federal University of Bahia. Av. Barão de Jeremoabo, 668, Ondina. University Campus. Salvador, BA, Brazil. CEP 40.170-115 (jubs.andrade.2014@gmail.com).

Received on 10/20/2024
Approved on 12/26/2024
Editorial responsibility: Cláudia Xavier

INTRODUCTION

Loxosceles is one of the three genera of medically important spiders in Brazil (Ministério da Saúde, 2001) and it is responsible for the most important form of araneism in South America (Sampaio et al., 2016). Currently, 147 species are recognized with a global and cosmopolitan distribution. Of these, 22 are recorded in different regions of Brazil (World Spider Catalog, 2024), but only 3 are recognized as etiological agents according to the Ministry of Health in Brazil: *L. intermedia* Mello-Leitão, 1934, *L. laeta* (Nicolet, 1849), and *L. gaucho* Gertsch, 1967 (Ministério da Saúde, 2001), which occur in the southern region of the country. The contribution of other *Loxosceles* species occurring in Brazil to human accidents remains unknown, as case reports almost never identify the causative agent. Furthermore, there is limited data on the venoms of these other species, but available evidence suggests that these less-studied venoms exhibit relevant toxicity (Silva-Magalhães et al., 2024). Most confirmed cases with the identified species are in the South and Southeast regions, reflecting the proximity of institutions that house taxonomists and health-qualified teams. The Brazilian Ministry of Health has recorded approximately 38,000 accidents caused by these spiders in the period from 2019 to 2023, the majority in the Southeast and South regions, particularly in the state of Paraná, where the largest case series of loxoscelism in the country is concentrated (Brasil, 2024a). However, these recorded numbers probably do not reflect the real number of accidents caused by *Loxosceles*. As noticed in other countries, cases can be underreported, as there is often no development of symptoms and no reference to spider bites by the victim, or overreported, as many of the differential symptomatic characteristics of loxoscelism are confused with several other diseases (Vetter, 2015).

It has been shown in review studies that spider bites remain a controversial issue globally. The harmful effects of spider bites are often mistakenly attributed to harmless spider groups. This attribution of clinical effects to various spiders is problematic due to vague case definitions and a lack of clinical evidence (Isbister & White, 2004; Vetter, 2015). Isbister et al. (2005) reinforced that to avoid perpetuating misinformation and in the interest of advancing the clinical understanding of spider bites, future publications must focus on witnessed and definitive bites, with expert identification of the spider involved. However, in Brazil there are significant challenges in training the hospital emergency teams, who typically handle accident cases, to identify spiders accurately at any taxonomic level. Consequently, during the period from 2019 to 2023, the majority of cases (63.9%) were simply reported as "spiders" (Brasil, 2024a).

A recent study shows eight species identified in the state of Bahia (Northeast region) *L. amazonica* Gertsch, 1967, *L. boqueirao* Bertani & Gallão, 2024, *L. cardosoi* Bertani, von Schimonsky & Gallão, 2018, *L. carinhanha* Bertani, von Schimonsky & Gallão, 2018, *L. chapadensis* Bertani, Fukushima & Nagahama, 2010, *L. karstica* Bertani, von Schimonsky & Gallão, 2018, *L. similis* Moenkhaus, 1898, and *L. troglobia* Souza & Ferreira, 2018 (Andrade-de-Sá et al., 2024). None of them are recognized as being of medical interest or related to any reported accident in this state, which does not mean they can't be. This probably occurs for at least two reasons: because some are recently described species and have not been evaluated for their risk to human health yet, and because of the lack of taxonomic identification by the health team providing care. Of the 995 spider accidents reported in 2023 in Bahia, only 80 (8%) were diagnosed as loxoscelism, the vast majority through the clinical effects of the patients, while 670 (67.3%) were undiagnosed (Brasil, 2024a).

Despite the volume of research surrounding these cosmopolitan spiders, the main focus has been on aspects of poisoning and accidents, so there are still many gaps in knowledge about the biology and distribution of the species in different regions of the country. The taxonomy of the genus was the subject of numerous debates, most intensely in the 1960s, regarding the number and overlap of *Loxosceles* species found in South America (Marques-da-Silva & Fischer, 2005). The last taxonomic revision was conducted by Willis John Gertsch in 1967, when he divided them into four groups according to the characteristics of the male and female genitalia: *gaucho*, *laeta*, *spadicea*, and *amazonica* (Gertsch, 1967). Taking into account the Gertsch criteria, the gaucho group includes six species in Brazil, currently: *L. gaucho*; *L. adelaida* Gertsch, 1967; *L. similis*; *L. chapadensis*; *L. niedeguidonae* Gonçalves-de-Andrade, Bertani, Nagahama & Barbosa, 2012; *L. troglobia*.

Loxosceles chapadensis is a small spider, measuring approximately 5 to 8 cm. The male can be distinguished from other species by a palpal tibia more than two times longer than the cymbium, and by a thickened embolus. The female can be recognized by its broad transversal plate, straight, apically enlarged seminal receptacles, and dorsal part of the bursa copulatrix strongly sclerotized for half of its length (Bertani et al., 2010).

Little is known beyond its morphological characteristics, which included it in the Gaucho group (Bertani et al., 2010). Its type material (holotype and paratype) was destroyed in the fire that ravaged the National Museum of Rio de Janeiro (Brazil) in 2018 (World Spider Catalog, 2024), and its taxonomic *status* remained unchanged until then.

After its description, only six publications mentioned *L. chapadensis* in some way, revealing a restricted distribution in *Caatinga* regions of the States of Bahia (Gonçalves-de-Andrade et al., 2012; Almeida et al., 2017; Carvalho et al., 2014; Bertani et al., 2018; Andrade-de-Sá et al., 2024) and Piauí (Carvalho et al., 2020). The scarcity of recent publications on *L. chapadensis*, which are limited to specific occurrence records, highlights the need to fill gaps in our understanding of its natural history. This is particularly important given that the species has only been documented in a specific region characterized by unique environmental features and located within a designated environmental protection areas like Chapada Diamantina National Park (Bahia) and Serra das Confusões National Park (Piauí). Herein we aim to identify and analyze the environmental variables influencing its distribution, examine its coexistence with other species, and characterize its biological and behavioral aspects within its natural habitat.

MATERIAL AND METHODS

This is a participant observational study focusing exclusively on *Loxosceles chapadensis* spiders found in caves (except for Serra das Paridas). Observations were conducted *in situ*, and the study involved specimen collection and field observations (Permanent License for Collection of Zoological Material SISBIO/ICMBio [Sistema de Autorização e Informação em Biodiversidade/Instituto Chico Mendes de Conservação da Biodiversidade] No. 73871, and Licenses No. 10751-6; 10751-7).

To confirm the occurrence of *L. chapadensis* in the various municipalities of the state of Bahia, we consulted the data from the following scientific collections: Arachnological Collection (Order Araneae) of the Natural History Museum of Bahia, Federal University of Bahia [UFBA-ARA, T. K. Brazil]; Arachnida Collection of the Federal University of Minas Gerais [UFMG-ARA, A. J. Santos]; Zoological Collections Laboratory, Butantan Institute [IBSP, A. D. Brescovit]; Myriapoda and Arachnida Collection of the National Museum of Rio de Janeiro, Federal University of Rio de Janeiro [MNRJ, A. B. Kury]. All records from MHNBA and UFMG were consulted on the SpeciesLink platform (SpeciesLink, n. d.). All the MHNBA specimens were analyzed by the authors. Data from the IBSP and MNRJ collections were kindly provided by their respective curators.

The primary data were obtained in the localities of the Chapada Diamantina ecoregion, in the municipalities of Iraquara, Lençóis, and Seabra, Bahia, Brazil. The captured specimens are deposited in the arachnology collection of the Natural History Museum of the University of Bahia (curator T. K. Brazil, acronym UFBA-ARA). Live specimens are still being kept in the arachnidarium of the Nucleus of Ophidiology and Venomous Animals (NOAP).

RESEARCH AREA

The study was conducted at seven locations, six of which were caves in the municipalities of Lençóis, Iraquara, and Seabra, in the state of Bahia, Brazil. All sites are situated within Chapada Diamantina *Caatinga* ecoregion.

The Chapada Diamantina, part of the Serra do Espinhaço Plateau, covers an area of 41,751km^2 and comprises 33 municipalities. Endemism is a defining characteristic of this region, due to its semi-arid climate, high potential evapotranspiration throughout the year, and low, erratic rainfall. Average precipitation is significantly lower than in other regions of Brazil, with prolongated drought periods. Rainfall tends to occur almost entirely in the summer months between November and April, ranging from 300 to 2,000 mm per year (Barreto, 2010). In the Iraquara region, where a transition to higher altitudes occurs, average annual rainfall exceeds 750 mm (Laureano, 1998). The entire area lies within the *Caatinga* biome (Velloso et al., 2002), but exhibits a mix of rocky countryside vegetation, Brazilian *Cerrado*, and varying degrees of humid forest remnants. It is the highest ecoregion within the *Caatinga* biome, with altitudes ranging from 200 to 1,800 meters, forming a natural watershed where rivers flow into the São Francisco basin. The soils are generally poor, with shallow, rocky soils prevalent in the massifs and high mountains, while deeper soils are found in the plains (Velloso et al., 2002).

The Chapada Diamantina National Park (PARNA_CD) is part of this ecoregion as a Conservation Unit with 'full protection' *status*, spanning 1,520 km^2 across six municipalities: Andaraí, Ibicoara, Itaetê, Lençóis, Mucugê, and Palmeiras (ISA, 2024) and it is considered the main ecotourism hub in the State of Bahia (Santos, 2006). It became economically important in the early 1990s, due to diamond mining, and more recently, ecotourism. Both activities have significantly impacted the environment, especially considering that this region is the source of nearly all the rivers in the Paraguaçu, Jacuípe, and Rio de Contas basins (Bahia, 2004).

It is important to note that all caves in Brazil are property of the Union (Brazilian government) (Brasil, 1988). In Bahia, they are designated as areas of permanent protection (Bahia, 1989). As inalienable assets, their sustainable use by private individuals, such as for tourism, is permitted; however, this use is regulated by public law rather than private law norms (Ribas & Carvalho, 2009).

The studied caves have distinct formations and characteristics, despite being in the same ecoregion:

- Lapão Cave (Figure 1A): Recognized by the Brazilian Speleological Society (SBE) under number BA-41, it is located at the northernmost point of the Chapada Diamantina National Park (12° 32' 25" S, 41° 24' 09" W), about 2 km from the center of the city of Lençóis. It is part of the São José River basin, a tributary of the Paraguaçu River, at an approximate altitude of 600 meters, and consists mainly of sandstones interspersed with conglomerates. It has two known entrances: the North entrance, which measures 50 x 10 m (width and height), and the East entrance, which measures 80 x 40 m (width and height). The cave extends for about 800 meters (tourist section), is predominantly straight, with some meandering sections and contains all zones: photic, dysphotic, and aphotic. The cave features several large chambers with ceilings close to 20 meters high and sections with low-ceilinged galleries (1.5 meters). Its uneven floors consist of blocks or sandy sediment. The Lapão Cave receives constant visitors, mainly due to its proximity to the city of Lençóis, a tourist city with significant national and international traffic (Linhares, 2007). It is not exploited by private initiative;
- Torrinha Cave (Figure 1B): Recognized by the SBE under number BA-37, it is located in the municipality of Iraquara (12° 19' 4" S, 41° 36' 13" W). The Torrinha Cave is rich in speleothems, concentrating some of the rarest formations in the world, which is its distinguishing feature (Brunelli, 2001). The cave entrance is an elliptical horizontal opening

approximately 15 meters high and 20 meters wide. Its total linear development reaches 14 km. The photic zoning is characterized by all zones: photic, dysphotic, and aphotic (Loureiro, 2017). The vault spans sometimes reach a hundred meters. In the 1990s, 8,300 meters were mapped by the French speleological group "Meandres," positioning Torrinha Cave as one of the largest caves in Brazil (Brunelli, 2001). It has exploited by private initiative and receives around 7,000 to 9,000 visitors annually (Loureiro, 2017);

- Lapa Doce I Cave (Figure 1C): Recognized by the SBE under numbers BA-72 (Doce I) and BA-200 (Doce II), this cave is part of a complex, located in the municipality of Iraquara (12° 19' 59" S, 41° 36' 14" W). The cave has several entrances, with the tourist entrance being an elliptical horizontal opening 60 meters high and 50 meters wide. The tourist section is only 950 meters long (Loureiro, 2017) and contains all zones: photic, dysphotic, and aphotic. This is considered one of the most extensive known cave systems. It has larger galleries, many of which have widths and heights of more than 50 and 15 meters, respectively (Cruz Jr., 1998). The emergent galleries mostly contain a rich collection of speleothems, predominantly calcite deposits, which occur as stalactites, stalagmites, columns, flowstones, and travertines (Laureano & Cruz Jr., 2002). The farm where the Lapa Doce cave is located has been owned by the same family for more than 150 years (Loureiro, 2017). It is exploited by private initiative;
- Fumaça Cave (Figure 1D): Recognized by the SBE under number BA-125, it is located in the municipality of Iraquara (12° 19' 57" S, 41° 35' 48" W). The Fumaça Cave is notable for its richness in speleothems. Information in the National Cave Registry (CNC) only contains information relating to its linear development: 246 meters (Loureiro, 2017). All zones can be distinguished in this cave: photic, dysphotic, and aphotic. Despite no further published information being found, large spaces and galleries less than two meters in height, which required the team to crouch, were observed. It is exploited by private initiatives, with installations such as wooden stairs to facilitate tourist access. Heavy truck traffic passing over it has caused internal damage to the cave (Sbragia & Cardoso, 2008);
- Lapa do Sol Cave (Figure 1E): Recognized by the SBE under number BA-74, it is located in the municipality of Iraquara (12° 19' 51" S, 41° 36' 23" W). Lapa do Sol Cave only presents horizontal projection data, with no further topographical information in the National Cave Registry (CNC). This cave also features panels of rock paintings, constituting yet poorly investigated evidence of the prehistoric civilizations that inhabited the region (Laureano & Cruz Jr., 2002). During the expedition, it was observed that the cave entrance was below ground level, requiring descent with the aid of equipment. Besides, it contains all zones: photic, dysphotic, and aphotic. The cave is part of the same property as Lapa Doce I but currently does not have organized visits;
- Lapa da Santa Cave (Figure 1F): This cave is not registered in the SBE. It is located near the Bolo-de-Noiva cave (formerly Buraco do Cão), in the municipality of Seabra (12° 23' S, 41° 35' W). Although no further published information was found, it is visible that this cave is heavily degraded. It contains only the photic and dysphotic zones. The cave's name comes from a rock formation resembling a Saint, which attracted many visitors over the years, leaving permanent marks of human alteration on the site. Currently, there are no signs of commercial exploration;
- Serra das Paridas (Figure 2): Serra das Paridas is the only locality that is not a cave, despite having cliffs and rock projections that resemble cave entrances. Therefore, there is no aphotic zone. It is located between the

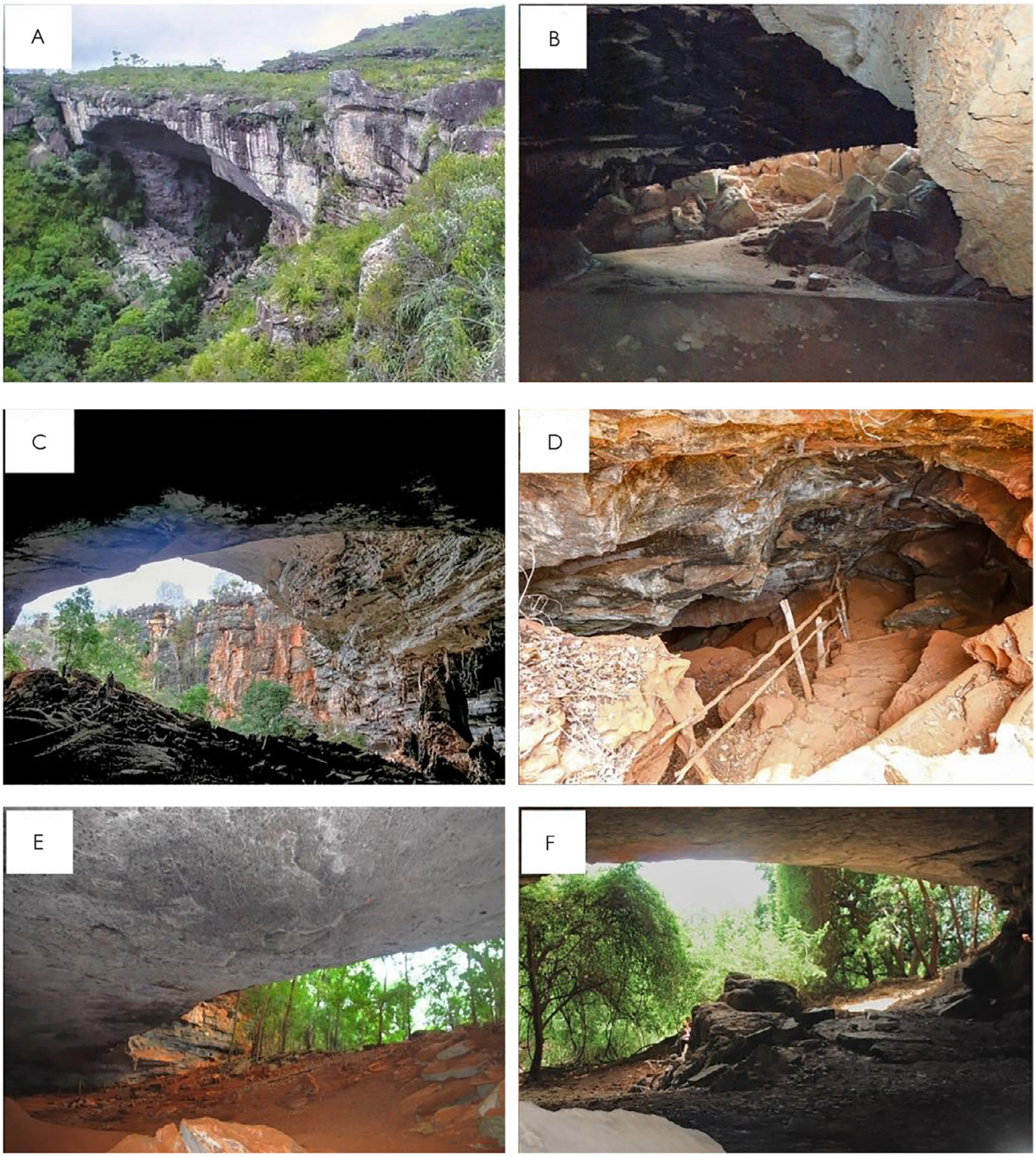

Figure 1. Caves sampled in this study: A) Lapão Cave, Lençóis; B) Torrinha Cave, Iraquara; C) Lapa Doce Cave, Iraquara; D) Fumaça Cave, Iraquara; E) Lapa do Sol Cave, Iraquara; F) Lapa da Santa Cave, Seabra. Photos: Gruta Lapão – Lençóis (n. d.) (A); Gruta da Fumaça (n. d.) (C); images by the authors (2024) (B, D, E, F).

Figure 2. Serra das Paridas, Lençóis, Bahia. Photo: image by the authors (2024).

municipalities of Lençóis and Wagner (12° 20' 48" S, 41° 14' 44" W). The area consists of 18 archaeological sites forming an important complex where the daily life of prehistoric Brazilian man is recorded in rock paintings (Silva Jr., 2008). It comprises shelters and cliffs in sandstone outcrops. The rocky blocks emerge in a landscape characterized by a flat strip with mangabeira (*Hancornia speciosa* Gomes) fields and a wide hilly zone with denser and more varied vegetation. The shelters are mostly located at the base of the outcrops. The complex has four concentrations of outcrops: Serra das Paridas I, II, III, and IV, with the first and last having the highest number of graphic representations (Etchevarne, 2023).

SPIDER SAMPLING

Five expeditions were carried out from November 2022 to March 2024, with an average stay of 4 days in different climatic periods (autumn, summer, and spring) throughout the year. The team, composed of five to nine people, spent approximately two hours each day collecting, with at least one session in the morning and/or another in the afternoon or night. The total sampling effort (SE) for all the expeditions was around 230 hours. The spiders captured were categorized according to these segments: photic zone (above 002 lux) and aphotic zone (less than or equal to 002 lux) (Figure 3). The light intensity values were obtained using a luxmeter, temperature and humidity with a thermohygrometer. The variables were measured at the beginning and end of each sampling effort. A total of 457 spiders were collected from the seven caves, with Gruta do Lapão (212 specimens collected) and Gruta da Torrinha (176 specimens collected) standing out. This was associated with the sampling effort in these locations, which were visited during more than one expedition and over a longer period than the other sites.

DATA ANALYSIS

The variables analyzed aimed to evaluate the spiders' conditions of permanence in their natural environment:

- Qualitative variables were estimated in absolute and relative frequency measures: coexistence with other arthropods, spatial distribution inside of caves, behavior (spatial distribution, aggregation, cannibalism), and types of prey on feeding;
- Quantitative variables were summarized using measures of central tendency (arithmetic mean) and dispersion (standard deviation): temperature (°C), humidity (%), and luminosity (lux). Quantitative and qualitative data were arranged in tables, with quantitative variables depicted in scatter plots and boxplots. We used SPSS (Statistical Package for the Social Sciences) version 26 to process, tabulate, and analyze all data.

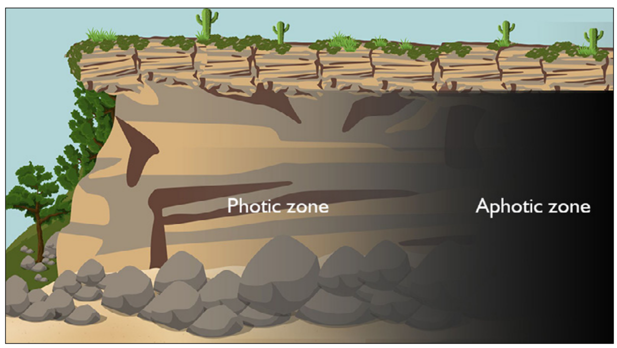

Figure 3. Schematic drawing in a vertical section of the caves' inside where the spiders were captured. Photic zone: cave entrance in contact with the outside, with direct and indirect light influence. Aphotic zone: cave zone without light influence. Illustration by the authors (2024).

MAP

The map was produced using the Geographic Information System (GIS) software QGIS versions 3.36.3-Maidenhead and 3.38.0-Grenoble (QGIS Development Team, 2024). The ESRI Satellite topographic map (ArcGIS/World_Imagery) was obtained from the QuickMapServices plugin of the QGIS GIS software versions 3.36.3-Maidenhead and 3.38.0-Grenoble (QGIS Development Team, 2024). The São Francisco River shapefile was obtained from the 50K Hydrographic Ottocoded Base – drainage section of the database from the National Water and Basic Sanitation Agency (ANA, 2017). The shapefiles for the *Caatinga*, *Cerrado*, and Atlantic Forest biomes were obtained from the Brazilian Institute of Geography and Statistics and delimited only for the state of Bahia (IBGE, 2019). The South America shapefiles and the shapefile for Bahia were obtained from the Brazilian Institute of Geography and Statistics (IBGE, 2021, 2022, 2023). The Chapada Diamantina National Park (PARNA-CD) boundaries were obtained from the National Register of Conservation Units (CNUC) (Brasil, 2024b).

The geographic coordinates were obtained from the scientific literature and the previously cited scientific collections. Occurrences without any information on geographic coordinates were georeferenced using the SpeciesLink geoLoc geoprocessing tool of the Environmental Information Reference Center (CRIA, n. d.), and the Brazilian National Registry of Caves (SBE, n. d.).

RESULTS AND DISCUSSION

OCCURRENCE IN THE CHAPADA DIAMANTINA

We confirmed the presence of *Loxosceles chapadensis* in 10 locations (Table 1) spanning 6 municipalities in Bahia, all in the Chapada Diamantina ecoregion (Figure 4). So far, the species has only been registered in Iraquara, Lençóis, Palmeiras (Bertani et al., 2010), Ituaçu, and Maracás

Table 1. Distribution of *Loxosceles chapadensis* by municipalities, related to environmental data (biome, phytophysiognomy/environment, altitude, temperature, rainfall).

Municipalities	Location	Biome	Environment/ Phytophysiognomy	Altitude (m)	Average annual temperature (°C)	Average annual rainfall (mm)
Iraquara	Pratinha Farm	*Caatinga*	Indeterminated	655	22.2	687
Iraquara	Lapa Doce I	*Caatinga*	Cave	655	22.2	687
Iraquara	Torrinha Cave 🕷	*Caatinga*	Cave	655	22.2	687
Iraquara	Fumaça Cave 🕷	*Caatinga*	Cave	655	22.2	687
Iraquara	Lapa do Sol 🕷	*Caatinga*	Cave	655	22.2	687
Ituaçu	Mangabeira Cave	*Caatinga*	Cave	522	21.5	967
Lençóis	Lapão Cave	*Caatinga*	Cave	394	21.8	637
Lençóis	Serra das Paridas 🕷	*Caatinga*	Rocky fields	394	21.8	637
Lençóis	Indeterminated	*Caatinga*	Indeterminated	394	21.8	637
Maracás	Indeterminated	*Caatinga*; Atlantic Forest	Indeterminated	964	21.0	750
Palmeiras	Indeterminated	*Caatinga*	Cave	870	21.0	637
Palmeiras	Riachinho Cave	*Caatinga*	Cave	870	21.0	637
Seabra 🕷	Lapa da Santa 🕷	*Caatinga*	Cave	812	20,5	609

🕷 = new record

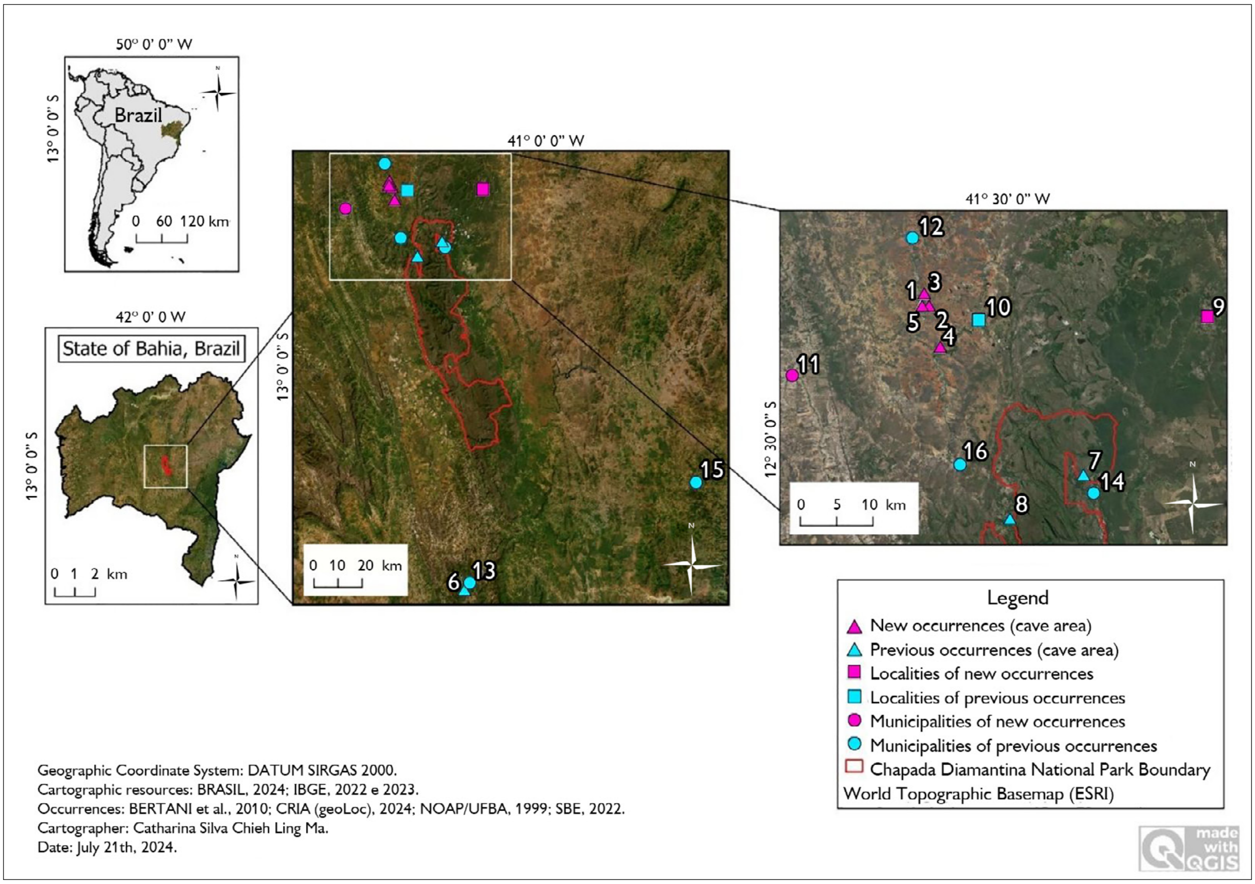

Figure 4. Occurrence map of *L. chapadensis* in the municipalities and localities of Chapada Diamantina ecoregion. Legends: 1 = Lapa do Sol cave, Iraquara; 2 = Fumaça cave, Iraquara; 3 = Torrinha cave, Iraquara; 4 = Lapa da Santa Cave, Seabra; 5 = Lapa Doce cave, Iraquara; 6 = Mangabeira cave, Itaetê; 7 = Lapão cave, Lençóis; 8 = Riachinho Cave, Palmeiras; 9 = Serra das Paridas, Lençóis; 10 = Pratinha Farm, Iraquara; 11 = Seabra; 12 = Iraquara; 13 = Ituaçu; 14 = Lençóis; 15 = Maracás; 16 = Palmeiras. Map: Catharina Ma (2024).

(Andrade-de-Sá et al., 2024). Herein we have expanded its distribution to include Seabra municipality.

All these records shown in Table 1 and in the map (Figure 4) indicate that *L. chapadensis* is found in a climatic scenario typical of the ecoregion, with an altitude reaching 964 meters, an average temperature of 22 °C, and 967 millimeters/year of rainfall (Andrade-de-Sá et al., 2024). The ecoregion of Chapada Diamantina has more than 30,000 km^2 and many other caves, so we consider the possibility that *L. chapadensis* could be dispersed and distributed in different locations within this region. Passive transport contributes to the dispersal of spiders of this genus (Gertsch, 1967), mainly through the movement of goods transported between cities. Additionally, the record of its occurrence in the Serra das Confusões National Park (Piauí) in 2020, expands its distribution within the Northeast region (Carvalho et al., 2020), but maintains its occurrence in similar Brazilian *Caatinga* environments with high-altitude xeric geomorphological and vegetational characteristics.

Although this study focuses on caves, we also found *L. chapadensis* in Serra das Paridas (Lençóis) which is not a cave but has rock projections similar to cave entrances. It is already known that these spiders can occur in other environments as already found in rock crevices, under rocks in Palmeiras and Lençois in the natural environment, and under construction materials (stones, bricks, and tiles) near human dwellings in Iraquara (Bertani et al., 2010). Records outside the cave refuge and close to human habitations may indicate that the species can acclimatize to the urban environment. This is the case of *L. gaucho*, frequently found in the north of Paraná state, adapted to the specific climatic characteristics. It is often found in cracks between the ground, under roof tiles, and leftover construction debris, where temperatures are likely milder and humidity is higher, as intra-domiciliary occurrences are rarely recorded (Marques-da-Silva & Fischer, 2005).

OCCURRENCE IN CAVES

Of the 10 confirmed locations of *L. chapadensis* occurrence, nine are caves. Of these, four are new records: Torrinha, Fumaça, Lapa do Sol, and Lapa da Santa Caves (Table 1).

Studies on *Loxosceles* species in Brazilian caves have focused only on their presence in different caves (Dessen et al., 1980; Trajano & Gnaspini-Neto, 1990; Trajano & Moreira, 1991; Gnaspini & Trajano, 1994; Gnaspini et al., 1994; Gonçalves-de-Andrade et al., 2001). Of the 22 species of *Loxosceles* already described in Brazil, ten were recorded in caves: *L. adelaida* Gertsch, 1967, *L. boqueirao*, *L. bodoquena* Bertani & Gallão, 2024, *L. similis*, *L. willianilsoni* Fukushima, de Andrade & Bertani, 2017, *L. karstica*, *L. carinhanha*, *L. cardosoi*, *L. planetaria* Bertani & Gallão, 2024 and *L. troglobia* (Bertani et al., 2024), six of them from the Gaucho group. We can now include *L. chapadensis* in this group and consider it as one of the 11 species with cave-dwelling habits.

Most *Loxosceles* spiders found in caves are troglophiles (facultative cave dwellers) as they can complete their life cycle inside and outside caves, with source populations in epigeal and hypogeal habitats, with gene flow between habitats (Trajano & Carvalho, 2017; Bertani et al., 2024). Until now, *L. troglobia* and *L. boqueirao* are the only troglobite species (restricted and exclusive cave dwellers) recorded in Brazil (Bertani et al., 2024). Since *L. chapadensis* has been found both inside and outside the caves, it is suggested that there are troglophilic populations. However, this only means that some populations of species live above ground and do not show clear evidence of living in an isolated underground environment. To confirm this suggestion, it is important to carry out long-term studies using chronobiological methods to detect any recurring patterns of movement between surface and underground habitats (Trajano & Carvalho, 2017).

SPATIAL DISTRIBUTION INSIDE THE CAVES

Caves are unique environments: extremely stable, with high humidity, constant temperatures, and absence of light, which favor the colonization and persistence of these spiders if there is sufficient food (Ferreira et al., 2005). Although all the caves in this study were in the same range of humidity (median between 75 and 85%) (Figure 5A) and temperature (median between 22 and 25 °C) (Figure 5B), we draw attention to the fact that their little variation between the photic and aphotic zones for each cave, could also interfere with the distribution of the spiders. *L. chapadensis* was observed in high humidity values of 58.5 and 89%, and temperature values of 20.7 and 29.2 °C.

It was observed that *L. chapadensis* is distributed heterogeneously according to the level of luminosity throughout the interior of the caves. So, we can understand that light intensity was a crucial factor in the spiders' distribution. Almost 90% of the spiders were collected in photic zones, with direct or indirect light influence (Figure 6). Despite being photophobic (Bücherl, 1961), these spiders occurred predominantly in the photic zone. This could suggest that the spiders are feeding in areas where there are more arthropods, naturally oriented towards light. However, defensively, the spiders do not remain exposed to light, preferring locations with low light intensity. Therefore, it is common to find *L. chapadensis* in crevices, sheltered areas, and places with lower light intensity. The presence of *L. chapadensis* in diverse environments, including caves already heavily influenced by human activity, indicates its adaptation to environmental variations.

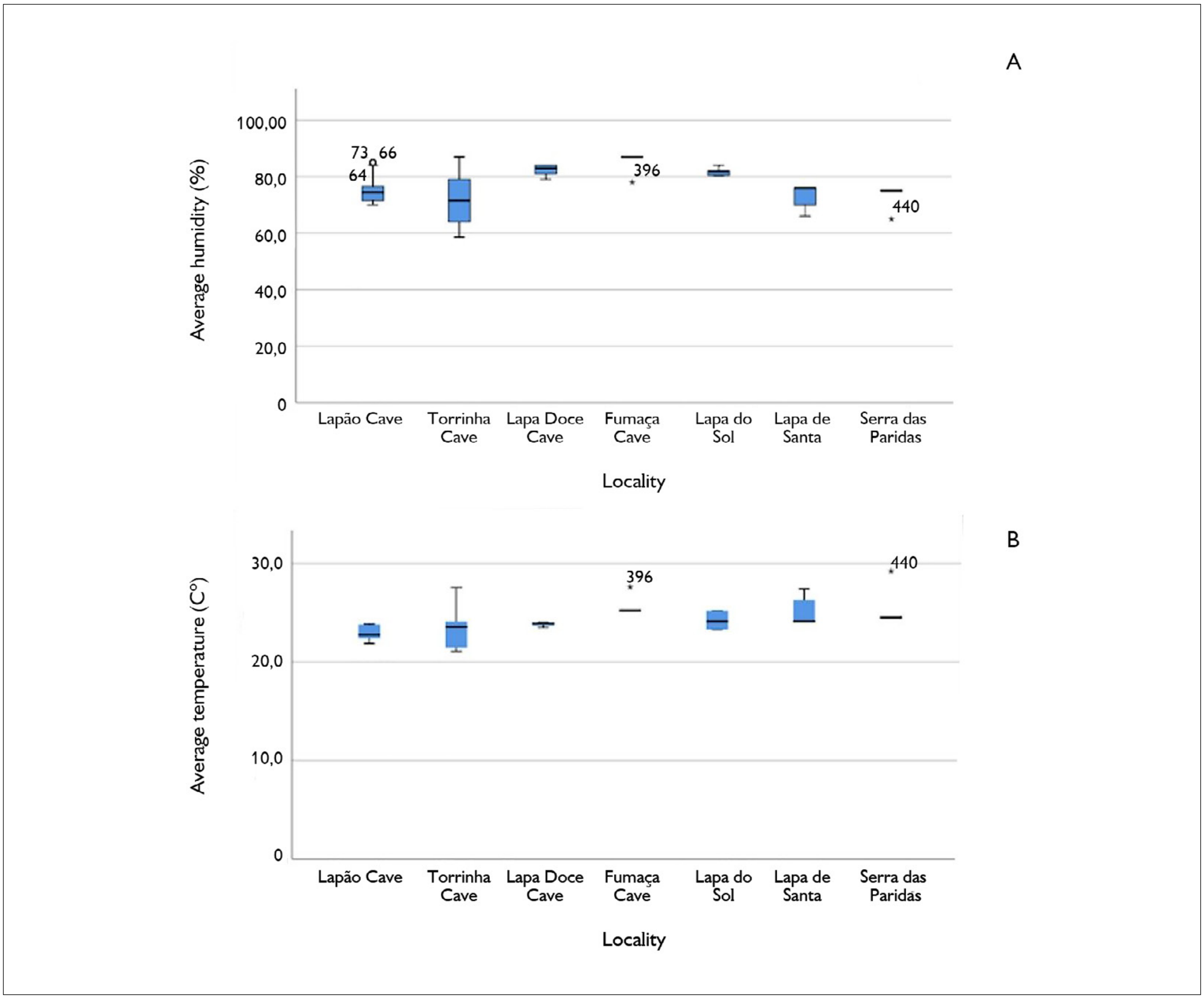

Figure 5. A) Graph of humidity values (%) in different collection localities; B) graph of temperature values (°C) in different collection localities.

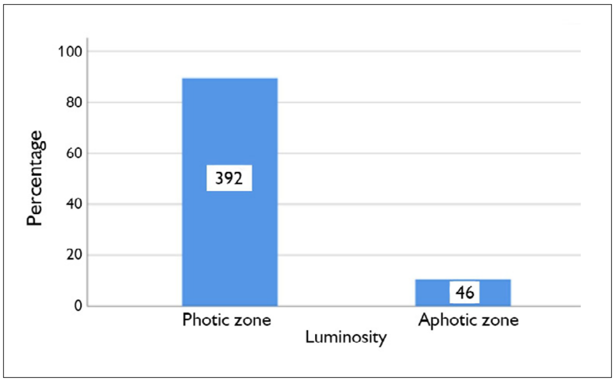

Figure 6. Percentage of spiders collected by luminous zone (photic and aphotic).

Abundance variation regarding *L. similis* within caves was discussed in Ferreira et al. (2005). In their work, the decrease in abundance in inner zones can be explained in two ways: first, if spiders colonize caves through entrances, the distance may act as a barrier to colonizing deeper areas; second, the reduction in prey in the deeper zone. The authors indicate that the presence or absence of food resources can influence spider concentration in certain areas. So, the reduced availability of potential prey inside the cave may lead to a decrease in *Loxosceles* abundance in these zones (Ferreira et al., 2005).

Despite the difficulty in finding *L. chapadensis* in aphotic zones, which was consistent across all sampled locations, molts of these spiders were often found in these environments. In the same study by Ferreira et al. (2005), it is mentioned that the lack or irregular distribution of prey in a cave may lead spiders to travel longer distances in search of food, with movements of up to 40 meters recorded in *L. similis*. Thus, the hypothesis raised is that spiders may frequent aphotic environments especially when more vulnerable during molting, but they would preferentially inhabit photic zones for foraging, reproduction, and other activities.

According to Vetter (2015), *Loxosceles* spiders prefer vertical to horizontal distribution, which probably does not apply to cave-dwelling spiders of this genus, as we observed for *L. chapadensis*. Despite we found the spiders up to about six meters in height (Figure 7) (which varies depending on the reference point, given the irregular structure of the environments) they generally are located close to the ground. That is similar to the described behavior of *Loxosceles boqueirao*: generally solitary in their webs on cave walls very close to the ground, with one specimen found approximately 2 meters above ground (Bertani et al., 2024).

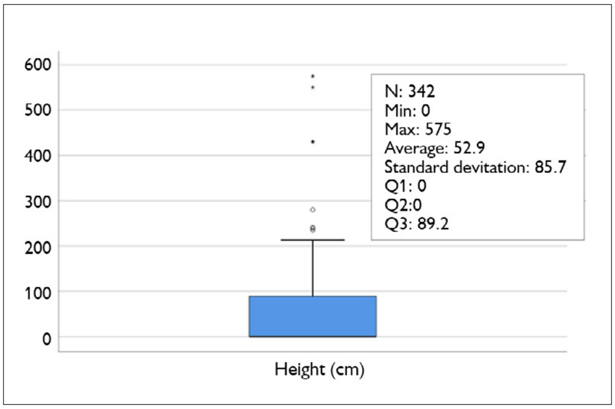

Figure 7. Boxplot of substrate height to collected *Loxosceles.*

COEXISTENCE WITH OTHER TAXA

Twenty-six taxa were recorded coexisting with *L. chapadensis* in this study (Table 2; Figure 8). The majority had already been reported as cave fauna, including non-identified *Loxosceles* species (Trajano, 1986). A diversity of 25 taxa was found in the photic zones, while only 12 were observed in the aphotic zones (Table 2). The discrepancy in the number of observed taxa reinforces the argument that abundance is associated with prey presence.

No predation of *L. chapadensis* was observed by any of the taxa mentioned. However, amphibians and reptiles have been reported as important predators of spiders, regardless of the taxonomic level (Foelix, 1996). And, for some species of *Loxosceles* predators such as bats (Chiroptera) (Fischer et al., 2006) and Pholcidae spiders - *Pholcus phalangioides* (Fuesslin, 1775) (Sandidge, 2004; Fischer & Krechemer, 2007) this has already been observed. Both bats, frogs, and Pholcidae spiders were found in the cave fauna of the explored environments, thus considered potential predators of *L. chapadensis*

Table 2. Taxa recorded coexisting with *L. chapadensis* by zone. Legends: amb = Amblypygi; anu = Anura; aran = Araneae; araneid = Araneidae; blatt = Blattaria; chirop = Chiroptera; coleop = Coleoptera; cten = Ctenidae; dermap = Dermaptera; dip = Diptera; diplop = Diplopoda; hemip = Hemiptera; hymenop = Hymenoptera; kerodon = *Kerodon rupestris*; lepdop = Lepdoptera; lycosid = Lycosidae; opili = Opiliones; ortop = Ortoptera; pholc = Pholcidae; pseudo = Pseudoscorpiones; sau = Sauris; scutig = Scutigera; *tityus*_m = *Tityus martinpaechi*; therap = Theraphosidae; ulob = Uloboridae; zygent = Zygentoma; X = presence; 0 = absence.

Zone	amb	anu	aran	araneid	blatt	chirop	coleop	cten	dermap	dip	diplop	hemip	hymenop
Fotic	X	X	X	X	X	X	X	X	X	X	X	X	X
Aphotic	X	0	X	X	X	X	0	0	0	0	X	0	0
	kerodon	lepdop	lycosid	opili	ortop	pholc	pseudo	sau	scutig	*tityus*_m	therap	ulob	zygent
Fotic	X	X	X	X	X	X	0	X	X	X	X	X	X
Aphotic	0	0	X	X	X	0	X	0	0	0	X	0	X

(Figure 9). The identification of Pholcidae individuals remains at the family level, but it is a common taxa observed among caves.

AGGREGATION AND BEHAVIOR

Regarding horizontal distribution, the distance between the closest *Loxosceles* was measured (Figure 10). According to Bücherl (1961), these animals tend to keep themselves separate from each other, strictly respecting the habitat of their neighbors and not invading each other's domicile while living. However, it was not uncommon to find adult *L. chapadensis* separated by only a few centimeters without displaying hostile behavior (Figure 11).

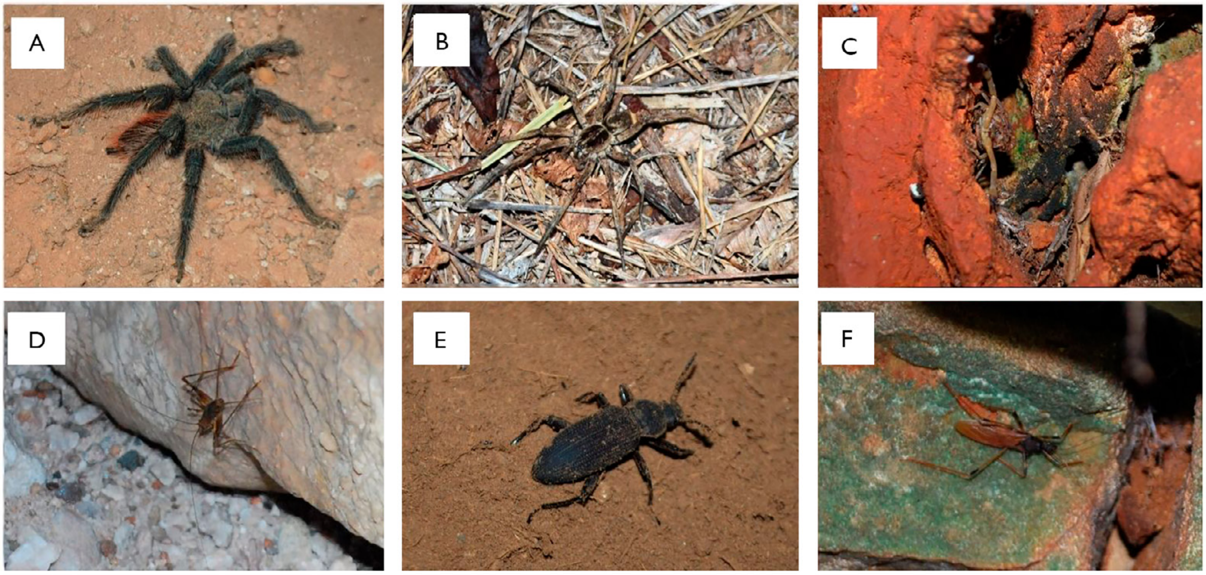

Figure 8. Cave fauna of the Lapão (Lençóis), Torrinha, Lapa Doce, and Fumaça caves, (Iraquara): A) Theraphosidae (tarantula); B) Lycosidae (wolf spider); C) *Tityus martinpaechi* (scorpion); D) Gryllidae (cricket); E) Coleoptera (beetles); F) Hemiptera (true bugs). Photos: images by the authors (2023/2024).

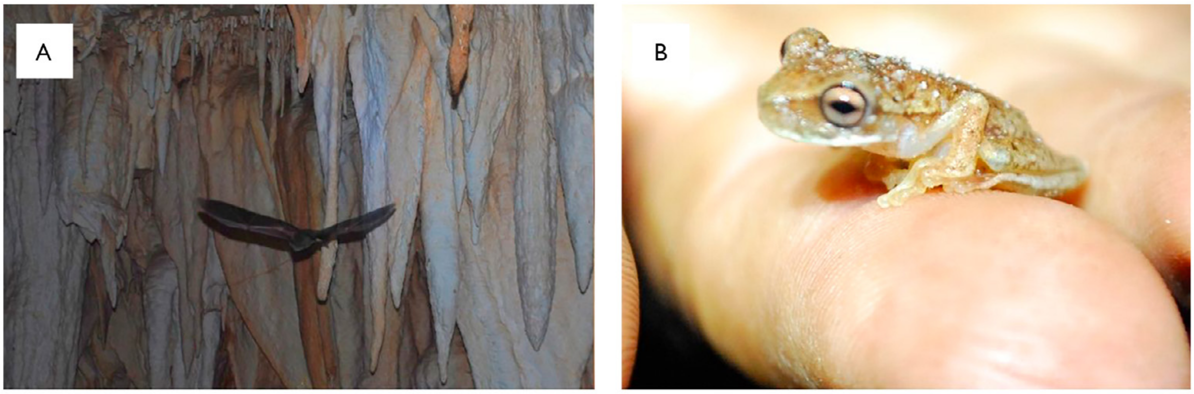

Figure 9. Possible predators of *L. chapadensis*, found in the studied caves: A) Chiroptera in Fumaça Cave, Iraquara; B) Amphibia in Lapão Cave, Lençois. Photos: images by the authors (2024).

A discrepant ratio between females and males was observed (Table 3), which can be explained by the evasive behavior of males in the field. This male behavior was already observed by Rinaldi et al. (1997), showing they are more evasive than females when promptly hiding to any slight disturbance occurs. Additionally, females (total length 8.76 mm) are larger than males (total length 5.60 mm), making them possibly easier to spot and capture. These values refer to the holotype and paratype measure (Bertani et al., 2010).

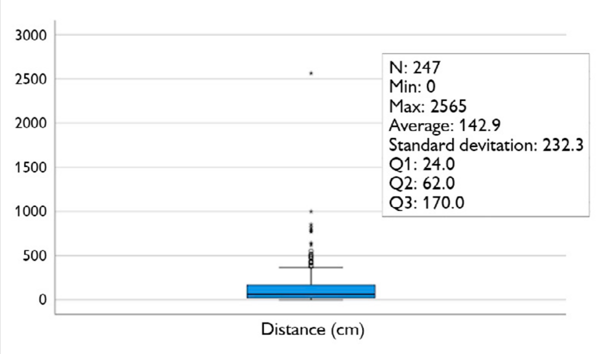

Figure 10. Distance (cm) between the nearest *Loxosceles*.

Specimens of *L. chapadensis* are often found resting on the substrate in their web sheets, as is well-known for the genus (Bücherl, 1961). Among the categorized behaviors, 'Inactive' stood out among those observed during the expeditions (Figure 12). This behavior includes the classic position where the animal rests its ventral side on the substrate and retracts its legs in a slanted way (Figure 13C), characterized by other authors, such as Vetter (2015). They were found on a variety of substrates, including sand, rock, and soil (Figure 13).

A behavior not systematically recorded but frequently observed among *L. chapadensis* was site fidelity, as expected. According to Vetter (2015), the recluse-spiders show site fidelity: it is not uncommon to find multiple shed

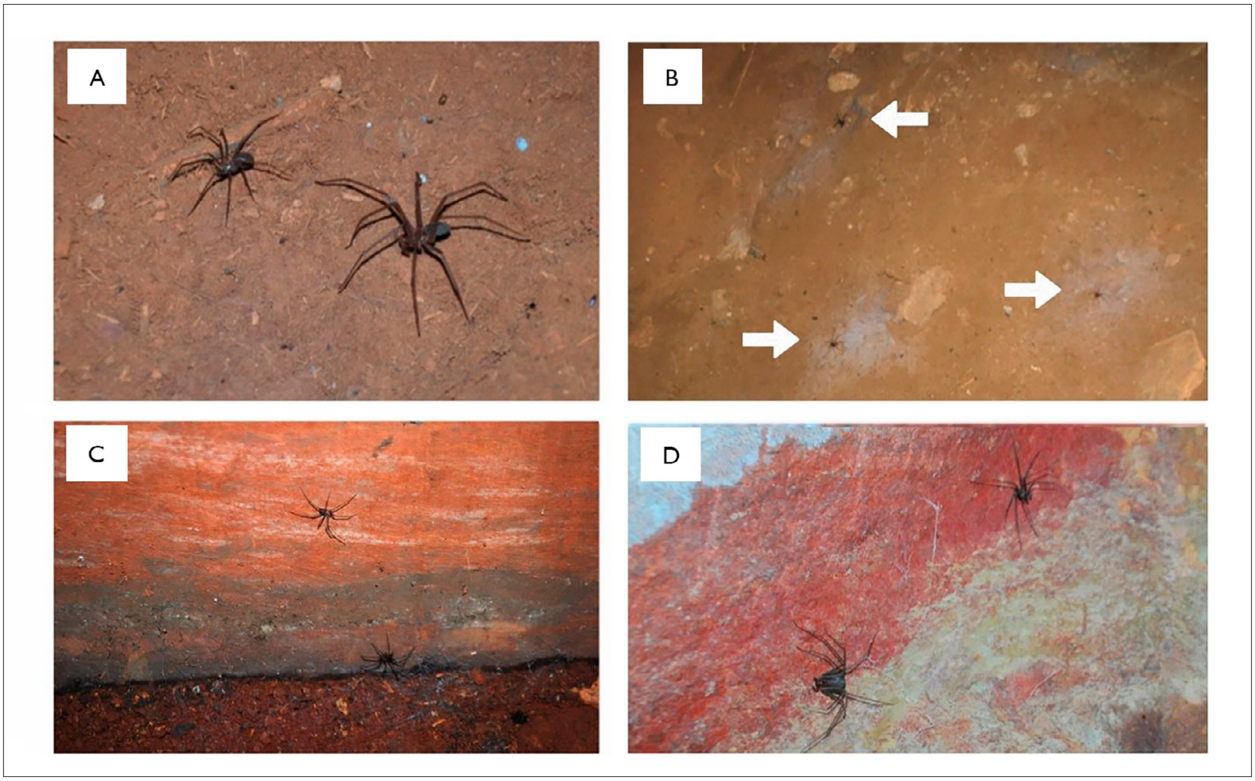

Figure 11. *L. chapadensis* coexisting just a few centimeters apart: A, B) *L. chapadensis* in Torrinha Cave, Iraquara; C) Fumaça Cave, Iraquara; D) Lapão Cave, Lençóis. Photos: images by the authors (2023/2024).

Table 3. Percentage of animals collected by sex. Legend: * = omission cases relate to occasions where the information was either not provided or not identified for some reason that made it impossible to determine. This could happen due to limitations in the observation process.

		Frequency	Percentage	Valid percentage
Valid	Female	258	56.5	65.0
	Male	63	13.8	15.9
	Indeterminate	76	16.6	19.1
	Total	397	86.9	100.0
Omission*	Ignored/White	60	13.1	
Total		457	100.0	

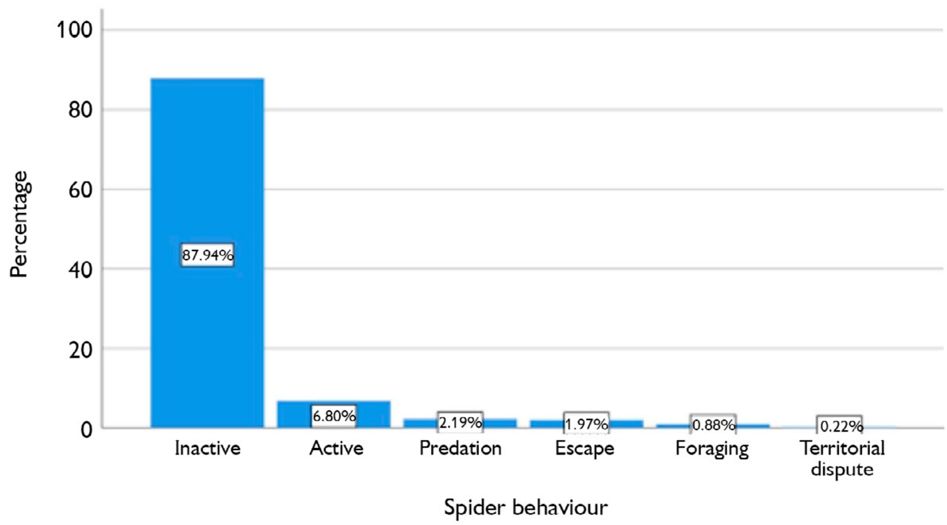

Figure 12. Percentage of *Loxosceles chapadensis* observed behavior.

skins of increasing size in one spot, indicating the repeated return of the spider to the same retreat as it was growing. Some of them hide during the day in a retreat such as a slot in a sliding window or a hole at the base of a staircase and then emerge at night and wait in their same retreat for a prey item to land nearby (Vetter, 2015).

Regarding feeding, *Loxosceles* species are reported as troglophile predators (Ferreira et al., 2005), but little is known about their foraging habits (Souza-Silva & Ferreira, 2014). They generally capture live invertebrates as food (Fischer et al., 2006), but *Loxosceles* can also use necrophagous strategies and cannibalism (Sandidge, 2003; Fischer et al., 2006; Cramer, 2008; Vetter, 2011). In Brazilian caves, *Loxosceles* are often observed with their webs placed over or near food resources or within invertebrate breeding sites, thereby obtaining their prey opportunistically (Ferreira & Martins, 1998, 1999; Ferreira et al., 2000, 2007; Gnaspini & Trajano, 2000). According to Souza-Silva and Ferreira (2014), out of thirty predation events of *Loxosceles* species observed in caves, all the prey were arthropods: most of the prey captures were insects (80%), with the remainder being Pseudoscorpiones, Araneae, and Diplopoda. Diptera was the most representative order, with 23.3% occurrence. The body sizes of some prey were larger than those of *Loxosceles* species. In this work, all the *L. chapadensis* recorded prey were also arthropods, with Coleoptera being the most representative taxa (Figure 14).

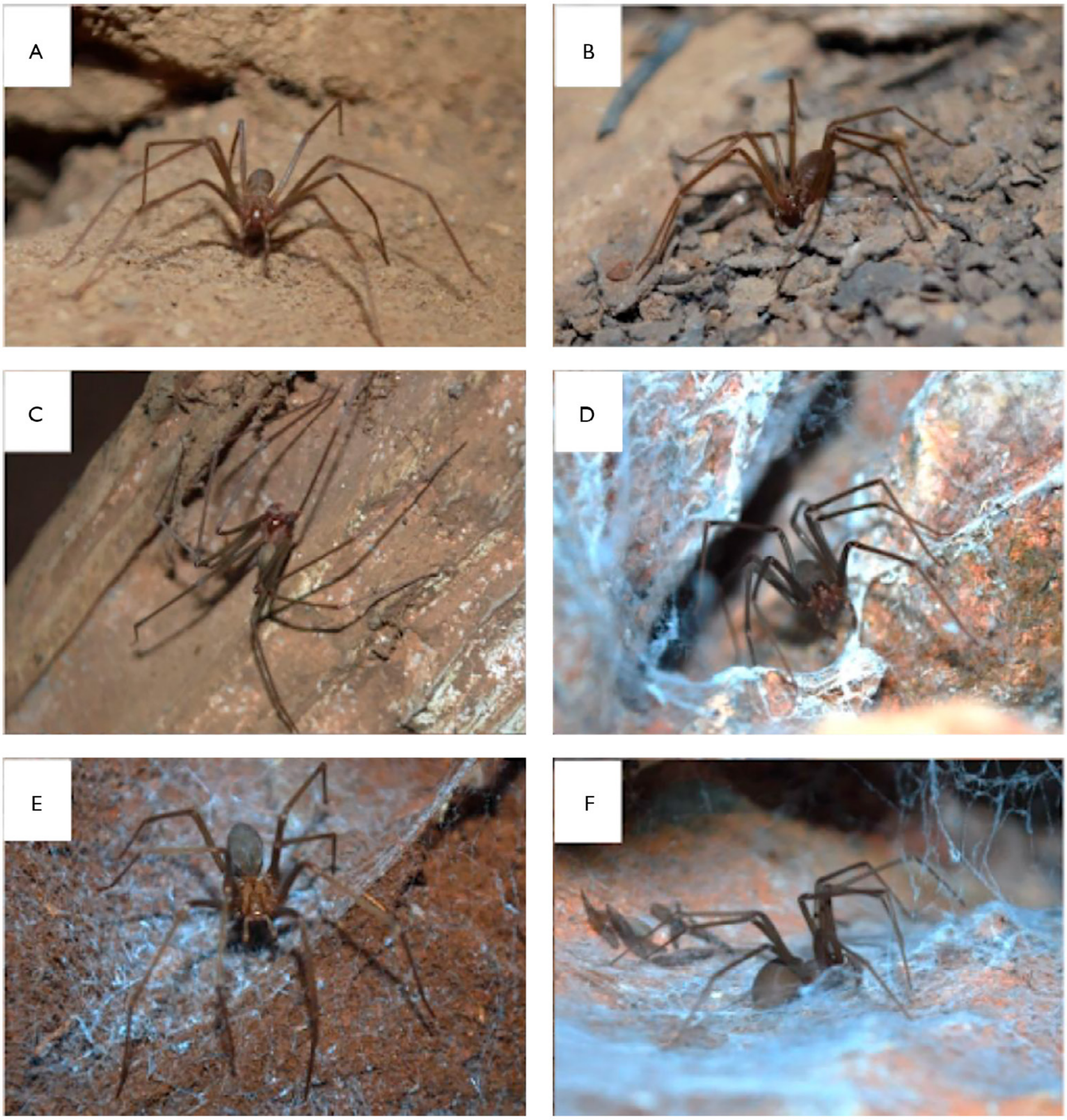

Figure 13. Behavior of *L. chapadensis* inside of caves: A) *L. chapadensis* inactive on sand; B) inactive on rock; C) resting on rock; D-F) inactive on rock, in a sheet web. Photos: images by the authors (2023/2024).

In most cases, it was not possible to observe *L. chapadensis* approaching prey to feed, but it was possible to photograph them in the act of feeding (Figure 15).

Cannibalism has been evidenced on at least two occasions (Figure 14). This event is considered common in spiders of this genus, especially when the caves are extremely dry and oligotrophic; additionally, cannibalism was also observed when population densities were high (Souza-Silva & Ferreira, 2014). In some caves, several spiders were observed preying on smaller individuals (Souza-Silva & Ferreira, 2014). According to Fischer et al. (2006), the generalist habits and cannibalism observed in some caves are likely due to the scarcity of food resources within the caves, and it may be rare in areas with much potential prey. In the case of *L. chapadensis*, it was not possible to associate cannibalism with a reduction in prey or other factors. However, given the diversity of taxa found in this work, it is believed that cannibalism was more related to population density than to resource scarcity.

CONCLUSION

We conclude that *Loxosceles chapadensis* is a spider that has populations with cave-dwelling habits, endemic to the Brazilian *Caatinga* environments with high-altitude xeric geomorphological and vegetational characteristics, until then, with records in the states of Bahia and Piauí.

Their strong presence in caves indicates an adaptation to this environment. Also, it is possible that this spider occurs in other caves in the same region, or even could acclimatize to the human environment. Due to the presence of individuals in both hypogean and epigean habitats, we can suggest that troglophile populations of *L. chapadensis* do exist.

The distribution of *L. chapadensis* inside the caves is directly related to the luminosity, associated with the presence of invertebrate fauna as part of the spiders' foraging availability. In the photic zone, *L. chapadensis* are distributed horizontally among varied substrates, not far from each other (aggregation). Vertically, they can reach approximately 6 meters on the cave walls.

The presence of *L. chapadensis* in areas with high tourist traffic demands careful consideration in the management plans for the caves where it has been found. Despite its restricted occurrence in a region with unique environmental characteristics, current data are still insufficient to determine the species' threat *status*.

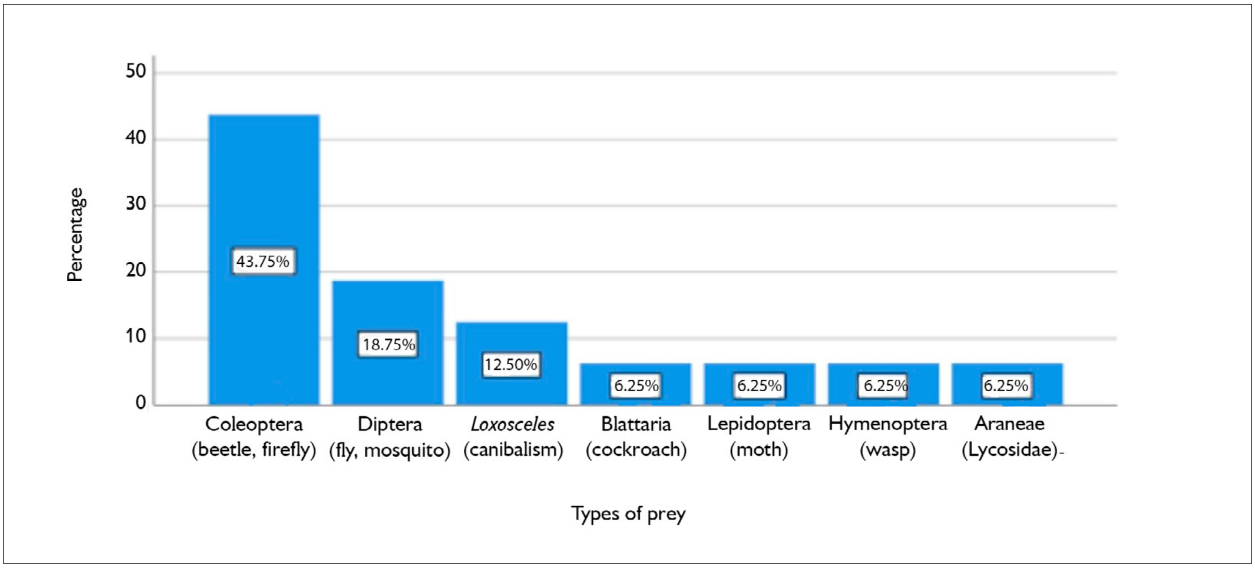

Figure 14. Percentage of *Loxosceles chapadensis* types of prey.

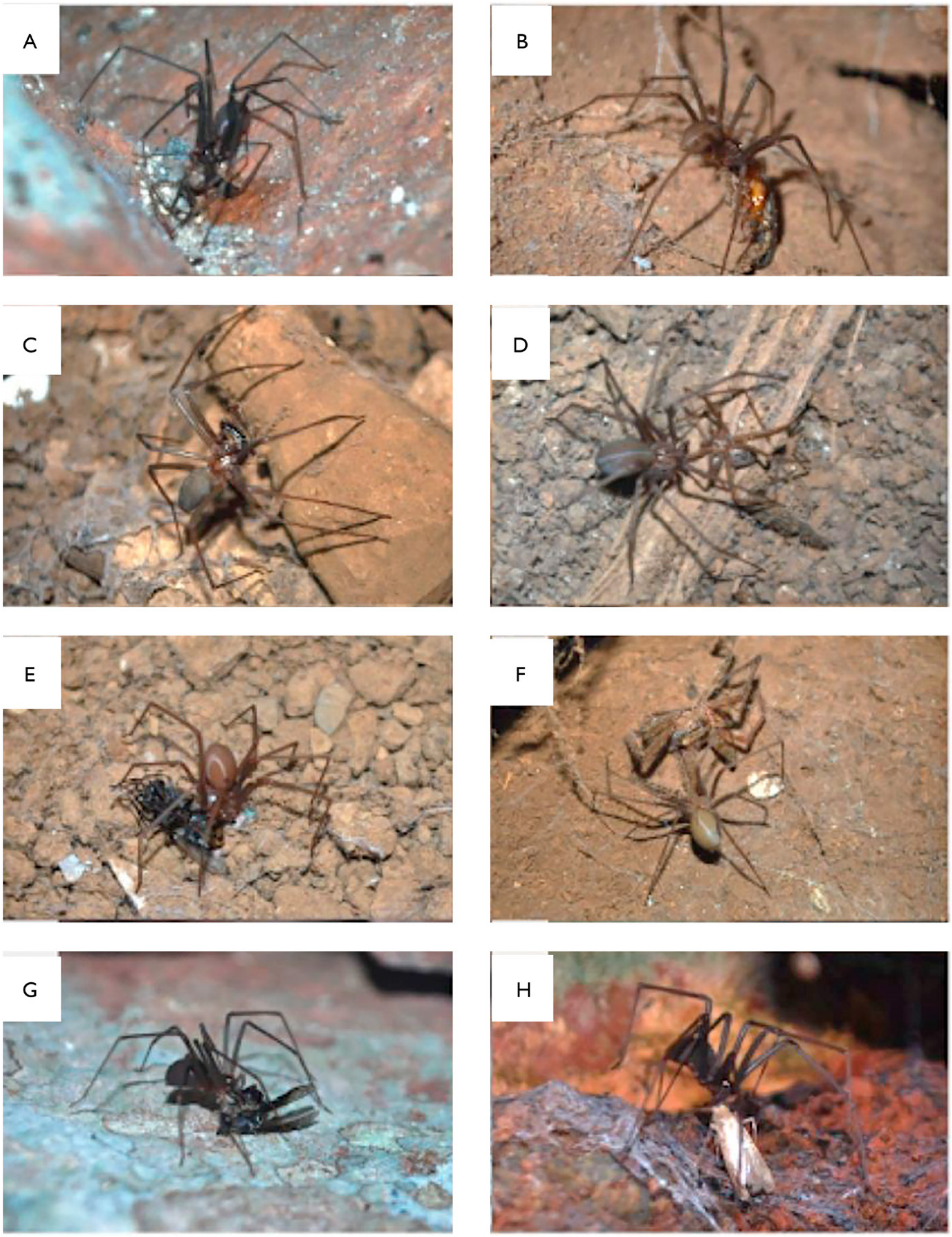

Figure 15. Observations on *L. chapadensis* feeding: A, B) on Blattaria; C, H) on Lepidoptera; D) cannibalism; E) on Diptera; F) on Lycosidae; G) feeding on Hymenoptera. Photos: images by the authors (2023/2024).

ACKNOWLEDGMENTS

This work was financially supported by Fundação de Amparo à Pesquisa do Estado da Bahia (FAPESB) scholarship to JAS (proc. 084.0508.2021.0003001-19). Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq grant PQ 316413/2021-6) to RMS. Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq grant Project "The Museum Animals go to the communities – Mobile Science" proc. 407131/2022-1 and Project "National Institute of Science and Technology in Venom and Antivenoms: INCT INOVATOX" grant Project proc. 406816/2022-0). We thank Catharina Ma for the distribution map, Lúcio Costa and Glauber Rocha for guiding and greatly assisting us during the expeditions. Additionally, to the owners and staff of Gruta da Torrinha, Lapa do Sol, and Lapa Doce for hosting the team and allowing access to the caves. We also appreciate the guides and staff of Gruta da Fumaça, Serra das Paridas, and Lapa da Santa caves.

REFERENCES

Almeida, M. Q., Salvatierra, L., Carvalho, T. G., Prestes, F. J., Brescovit, A. D., & Gasnier, T. R. (2017). Long time not seen: Expanding the records of *Loxosceles amazonica* (Araneae: Sicariidae) in the Amazonas state, Brazil. *Acta Amazonica*, *47*(2), 163-166. https://doi.org/10.1590/1809-4392201602592

Agência Nacional de Águas e Saneamento Básico (ANA). (2017). *Base Hidrográfica Ottocodificada 2017 50K - trecho de drenagem*. https://dadosabertos.ana.gov.br/datasets/dc696eb4e24b485a8fd9aea6c0f99eb4_0/explore

Andrade-de-Sá, J., Brazil, T. K., Lira-da-Silva, R. M., & Brescovit, A. D.(2024). The Sicariidae spiders in the State of Bahia, Brazil (Araneae, Arachnida). *PeerJ*, *12*, e17942. https://doi.org/10.7717/peerj.17942

Bahia. (1989). *Constituição Estadual*. https://www2.senado.leg.br/bdsf/handle/id/70433

Bahia. (2004). *Plano de Desenvolvimento Integrado do Turismo Sustentável*. Polo Chapada Diamantina. http://www.setur.ba.gov.br/arquivos/File/PDITSChapadaDiamatina.pdf

Barreto, E. A. S. (2010). *Reconstituição da pluviosidade da Chapada Diamantina (BA) durante o Quaternário tardio através de registros isotópicos (O e C) em estalagmites* [Masters' thesis, University of São Paulo]. ReP. https://repositorio.usp.br/item/001827890

Bertani, R., Fukushima, C. S., & Nagahama, R. H. (2010). *Loxosceles chapadensis* (Araneae: Sicariidae): a new recluse spider species of the gaucho group from Brazil. *The Journal of Arachnology*, *38*(2), 364–367. https://doi.org/10.1636/A09-92.1

Bertani, R., von Schimonsky, D. M., Gallão, J. E., & Bichuette, M. E. (2018). Four new troglophilic species of *Loxosceles* Heinecken & Lowe, 1832: contributions to the knowledge of recluse spiders from Brazilian caves (Araneae, Sicariidae). *Zookeys*, *806*, 47–72. https://doi.org/10.3897/zookeys.806.27404

Bertani, R., Bichuette, M. E., Cordeiro, L. M., & Gallão, J. E. (2024). Three new species of *Loxosceles* Heinecken & Lowe, 1832 (Araneae, Sicariidae) from Brazilian caves. *European Journal of Taxonomy*, *921*(1), 98-115. https://doi.org/10.5852/ejt.2024.921.2419

Brasil. (1988). *Constituição da República Federativa do Brasil de 1988*. https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

Brasil. (2024a). *Acidente por animais peçonhentos - notificações registradas no Sistema de Informação de Agravos de Notificação*. Ministério da Saúde. http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinannet/cnv/animaisbr.def

Brasil. (2024b). Cadastro Nacional de Unidades de Conservação (CNUC). *Relatório Parametrizado - Unidade de Conservação: Chapada Diamantina National Park (PARNA-CD)*. https://sistemas.mma.gov.br/cnuc/index.php?ido=relatorioparametrizado.exibeRelatorio&relatorioPadrao=true&idUc=137

Brunelli, A. P. (2001). Proposta e estudos para implantação do Plano de Manejo Turístico da Caverna Torrinha. In *Proceedings of the 4th Speleological Congress of Latin America and Caribbean* (pp. 657-662). http://www.bibliotecadigital.gpme.org.br/bd/proposta-e-estudos-para-implantacao-do-plano-de-manejo-turistico-da-caverna-torrinha-iraquara-ba/

Bücherl, W. (1960). Aranhas do gênero *Loxosceles* e o Loxoscelismo na América. *Memória Instituto Butantan*, *13*(4), 167-186.

Carvalho, L. S., Oliveira, B. B., Dias, D. F., Silva, I. S. S., Soares, J. F., . . . Paranhos, J. D. N. (2020). Biodiversidade e conservação dos aracnídeos do Parque Nacional da Serra das Confusões, sul do Piauí. In M. M. M. Ivanov (Org.), *Unidades de conservação do estado do Piauí* (pp. 119-150). EDUFPI.

Carvalho, L. S., Brescovit, A. D., Santos, A. J., Oliveira, U., & Guadanucci, J. P. L. (2014). Aranhas da Caatinga. In F. Bravo & A. Carlor (Orgs.), *Artrópodes do semiárido: biodiversidade e conservação* (pp. 15-38). Printmídia.

Centro de Referência e Informação Ambiental (CRIA). (n. d.). *Specieslink*. https://splink.cria.org.br/tools?criaLANG=pt

Cramer, K. L. (2008). Are brown recluse spiders, *Loxosceles reclusa* (Araneae, Sicariidae) scavengers? The influence of predator satiation, prey size and prey quality. *The Journal of Arachnology*, *36*(1), 140-144. https://doi.org/10.1636/St06-27.1

Cruz Jr., F. W. (1998). *Aspectos geomorfológicos e geoespeleologia do carste da região de Iraquara, centro norte da Chapada Diamantina, Estado da Bahia* [Masters' thesis, Universidade de São Paulo]. https://repositorio.usp.br/item/001012887

Dessen, E. M. B., Eston, V. R., Silva, M. S., Temperini-Beck, M. T., & Trajano, E. (1980). Levantamento preliminar da fauna de cavernas de algumas regiões do Brasil. *Ciência e Cultura*, *32*(6), 714-725.

Etchevarne C. (2023). *Complexo Arqueológico Serra das Paridas*. https://www.serradasparidas.com.br/about-1

Ferreira, R. L., & Martins, R. P. (1998). Diversity and distribution of spiders associated with bat guano pile in Morrinho cave (Bahia State, Brazil). *Diversity and Distributions*, *4*(5-6), 235-241. https://www.jstor.org/stable/2999829

Ferreira, R. L., & Martins, R. P. (1999). Trophic structure and natural history of bat guano invertebrate communities, with special reference to Brazilian caves. *Tropical Zoology*, *12*(2), 231-252. https://doi.org/10.1080/03946975.1999.10539391

Ferreira, R. L., Martins, R. P., & Yanega, D. (2000). Ecology of bat guano arthropod communities in a Brazilian dry cave. *Ecotropica*, *6*(2), 105-116.

Ferreira, R. L., Prous, X., Machado, S. F., & Martins, R. P. (2005). Population dynamics of *Loxosceles similis* (Moenkhaus, 1898) in a Brazilian dry cave: a new method for evaluation of population size. *Revista. Brasileira de Zoociências*, *7*(1), 129-141.

Ferreira, R. L., Prous, X., & Martins, R. P. (2007). Structure of bat guano communities in a dry Brazilian cave. *Tropical Zoology*, *20*(1), 55-74.

Fischer, M. L., Vasconcellos-Neto, J., & Santos-Neto, L. G. (2006). The prey and predators of *Loxosceles intermedia* Mello-Leitão 1934 (Araneae, Sicariidae). *The Journal of Arachnology*, *34*(2), 485-488. https://doi.org/10.1636/M03-51.1

Fischer, M. L., & Krechemer, F. S. (2007). Interações predatórias entre *Pholcus phalangioides* (Fuesslin) (Araneae, Pholcidae) e *Loxosceles intermedia* Mello-Leitão (Araneae, Sicariidae). *Revista Brasileira de Zoologia*, *24*(2), 474-481. https://doi.org/10.1590/s0101-81752007000200028

Foelix, R. F. (1996). *Biology of spiders* (2. ed.). Oxford University Press.

Gertsch, W. J. (1967). The spider genus *Loxosceles* in South America (Araneae, Scytodidae). *Bulletin of the American Museum of Natural History*, *136*, 121-182.

Gnaspini, P., & Trajano, E. (1994). Brazilian cave invertebrates with a checklist of troglomorphic taxa. *Revista Brasileira de Entomologia*, *38*(3-4), 549-584.

Gnaspini, P., Trajano, E., & Sánchez, L. E. (1994). Província espeleológica da Serra da Bodoquena, MS: exploração, topografia e biologia. *Espeleo-Tema*, *17*, 19-44.

Gnaspini, P., & Trajano, E. (2000). Guano communities in tropical caves. In H. Wilkins, D. C. Culver & W. F. Humphreys (Eds.), *Ecosystems of the World: subterranean ecosystems* (pp. 251-268). Elsevier Press.

Andrade, R.G. M., Galati, E. A. B., & Tambourgi, D. V. (2001). Presença de *Loxosceles similis* Moenkhaus, 1898 (Araneae, Sicariidae) na Serra da Bodoquena, Estado de Mato Grosso do Sul, Brasil. *Revista da Sociedade Brasileira de Medicina Tropical*, *34*(3), 275-277. https://doi.org/10.1590/S0037-86822001000300008

Gonçalves-de-Andrade, R. M., Bertani, R., Nagahama R. H., & Barbosa M. F. B. (2012). *Loxosceles niedeguidonae* (Araneae, Sicariidae) a new species of brown spider from Brazilian semi-arid region. *ZooKeys*, *175*, 27–36. https://doi.org/10.3897/zookeys.175.2259

Gruta da Fumaça. (n. d.). *Guia de Destinos*. https://imgmd.net/images/c_limit%2Cw_800/v1/guia/1627405/gruta-da-fumaca.jpg

Gruta Lapão – Lençóis. (n. d.). *Tripadvisor*. https://www.tripadvisor.com.br/Attraction_Review-g635725-d15769868-Reviews-Gruta_Lap ao-Lencois_State_of_Bahia.html

Instituto Brasileiro de Geografia e Estatística (IBGE). (2019). *Caatinga, Cerrado, and Atlantic Forest biomes*. https://portaldemapas.ibge.gov.br/portal.php#mapa222600

Instituto Brasileiro de Geografia e Estatística (IBGE). (2021). *South America [223417. BC250 - Versão 2021]*. https://portaldemapas.ibge.gov.br/portal.php#mapa223417

Instituto Brasileiro de Geografia e Estatística (IBGE) (2022). *State of Bahia [223803. Bahia - Unidade da Federação 2022]*. https://portaldemapas.ibge.gov.br/portal.php#mapa223803

Instituto Brasileiro de Geografia e Estatística (IBGE). (2023). *South America [224030. BC250 - Versão 2023]*. https://portaldemapas.ibge.gov.br/portal.php#mapa224030

Instituto Socioambiental (ISA). (2024). *Unidades de Conservação no Brasil*. Parque Nacional da Chapada Diamantina. https://uc.socioambiental.org/pt-br/arp/978

Isbister, G. K., & White, J. (2004). Clinical consequences of spider bites: recent advances in our understanding. *Toxicon*, *43*(5), 477-492. https://doi.org/10.1016/j.toxicon.2004.02.002

Isbister, G. K., White, J., Currie, B. J., Bush, S. P., Vetter, R. S., & Warrell, D. A. (2005). Spider bites: addressing mythology and poor evidence. *The American Journal of Tropical Medicine and Hygiene*, *72*(4), 361–367. https://doi.org/10.4269/ajtmh.2005.72.361

Laureano, F. V. (1998). *O registro sedimentar clástico associado aos sistemas de cavernas Lapa Doce e Torrinha, Município de Iraquara, Chapada Diamantina (BA)* [Masters' thesis, University of São Paulo]. https://repositorio.icmbio.gov.br/handle/cecav/496

Laureano, F. V., & Cruz Jr., F. W. (2002). *Grutas de Iraquara (Iraquara, Seabra e Palmeiras), BA: Um dos principais sítios espeleológicos do Brasil.* https://www.sigep.eco.br/sitio018/sitio018.pdf

Linhares, J. C. F. (2007). *Diagnóstico de cavernas com visitação do Parque Nacional da Chapada Diamantina com enfoque socieconômico e meio físico, elaborado*. IBAMA. https://repositorio.icmbio.gov.br/handle/cecav/620

Loureiro, F. T. (2017). *Uso do patrimônio espeleológico na APA Marimbus-Iraquara: Chapada Diamantina - BA* [Monograph, Universidade Federal de Ouro Preto]. http://www.monografias.ufop.br/handle/35400000/886

Marques-da-Silva, E., & Fischer, M. L. (2005). Distribuição das espécies do gênero Loxosceles Heinecken & Lowe, 1835 (Araneae; Sicariidae) no Estado do Paraná. *Revista da Sociedade Brasileira de Medicina Tropical*, *38*(4), 331-335. https://doi.org/10.1590/S0037-86822005000400010

Ministério da Saúde. (2001). *Manual de diagnóstico e tratamento de acidentes por animais peçonhentos* (2ª ed.). Fundação Nacional de Saúde. https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/a/animais-peconhentos/aguas-vivas-e-caravelas/publicacoes/manual-de-diagnostico-e-tratamento-de-acidentes-por-animais-peconhentos.pdf/view

QGIS Development Team. (2024). *QGIS Geographic Information System. Open Source Geospatial Foundation Project*. http://qgis.osgeo.org

Ribas, L. M. L. R., & Carvalho, L. C. (2009). Cavidade natural subterrânea: natureza jurídica. *Interações*, *10*(1), 83-93. https://doi.org/10.1590/S1518-70122009000100009

Rinaldi, I. M. P., Forti, L. C., & Stropa, A. (1997). On the development of the brown spider *Loxosceles gaucho* Gertsch (Araneae, Sicariidae): the nympho-imaginal period. *Revista Brasileira de Zoologia*, *14*(3), 697-706. https://doi.org/10.1590/S0101-81751997000300018

Sampaio, V. S., Gomes, A. A., Silva, I. M., Sachett, J., Ferreira, L. C. L., . . . Monteiro, W. M. (2016). Low health system performance, indigenous status and antivenom underdosage correlate with spider envenoming severity in the remote Brazilian Amazon. *PLoS ONE*, *11*(5), e0156386. https://doi.org/10.1371/journal.pone.0156386

Sandidge, J. S. (2003). Scavenging by brown recluse spiders. *Nature*, *426*, 30. https://doi.org/10.1038/426030a

Sandidge, J. (2004). Predation by cosmopolitan spiders upon the medically significant pest species *Loxosceles reclusa* (Araneae: Sicariidae): Limited possibilities for biological control. *Journal of Economic Entomology*, *97*(2), 230-234. https://pubmed.ncbi.nlm.nih.gov/15154440/

Santos, L. M. A. (2006). *Do diamante ao turismo, o espaço produzido no município de Lençóis* [Masters' thesis, Federal University of Bahia]. https://repositorio.ufba.br/handle/ri/19314

Sbragia, I. A., & Cardoso, A. (2008). Quiropterofauna (Mammalia: Chiroptera) cavernícola da Chapada Diamantina, Bahia, Brasil. *Chiroptera Neotropical*, *14*(1), 360-365. https://repositorio.icmbio.gov.br/handle/cecav/543

Silva Jr., J. F. (2008, 15 set.). Serra das Paridas: patrimônio arqueológico e genético na Chapada. *Agrosoft Brasil.* http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/373042

Silva-Magalhães, R., Silva-Araújo, A. L., Peres-Damásio, P., Pereira, E. H. T., Souza, R. O., . . . Guerra-Duarte, C. (2024). *Loxosceles amazonica* Brown Spider venom: Insights into enzymatic activities, immunorecognition, and novel phospholipase D isoforms. *Biochimie*, *227*(Part A), 86-98. https://doi.org/10.1016/j.biochi.2024.06.012

Sociedade Brasileira de Espeleologia (SBE). (n. d.). *Cadastro Nacional de Cavernas (CNC)*. https://sbecnc.org.br/Default.aspx

Souza-Silva, M., & Ferreira, R. L. (2014). *Loxosceles* spiders (Araneae Sicariidae) preying on invertebrates in Brazilian caves. *Speleobiology Notes*, (6), 27-32. http://www.biologiasubterranea.com.br/workspace/uploads/artigos/loxosceles-preys-in-caves.pdf

SpeciesLink. (n. d.). https://specieslink.net/search

Trajano, E. (1986). Fauna cavernícola brasileira: composição e caracterização preliminar. *Revista Brasileira de Zoologia*, *3*(8), 533-561. https://doi.org/10.1590/S0101-81751986000400004

Trajano, E., & Gnaspini-Neto, P. (1990). Composição da fauna cavernícola brasileira, com uma análise preliminar dos táxons. *Revista Brasileira de Zoologia*, *7*(3), 383-407. https://doi.org/10.1590/S0101-81751990000300017

Trajano, E., & Moreira, J. R. A. (1991). Estudo da fauna de cavernas da Província Espeleológica Arenítica Altamira-Itaituba Pará. *Revista Brasileira de Biologia*, *51*(1), 13-29. https://repositorio.icmbio.gov.br/handle/cecav/767

Trajano, E., & Carvalho, M. R. (2017). Towards a biologically meaningful classification of subterranean organisms: a critical analysis of the Schiner-Racovitza system from a historical perspective, difficulties of its application and implications for conservation. *Subterranean Biology*, *22*, 1–26. https://doi.org/10.3897/subtbiol.22.9759

Velloso, A. L., Sampaio, E. V. S. B., & Pareyn, F. G. C. (Orgs.). (2002). *Ecorregiões: propostas para o bioma Caatinga*. Associação Plantas do Nordeste/Instituto de Conservação Ambiental. https://www.bdpa.cnptia.embrapa.br/consulta/busca?b=ad&id=313581&biblioteca=CPAMN&busca=autoria:%22PAREYN,%20F.%20G.%22&qFacets=autoria:%22PAREYN,%20F.%20G.%22&sort=&paginacao=t&paginaAtual=1

Vetter, R. S. (2011). Scavenging by spiders (Araneae) and its relationship to pest management of the brown recluse spider. *Journal of Economic Entomology*, *104*(3), 986–989. https://doi.org/10.1603/EC10428

Vetter, R. (2015). *The brown recluse spider.* Comstock Publishing Associates.

World Spider Catalog. (2024). Version 20.0. Natural History Museum Bern. https://wsc.nmbe.ch/statistics/

AUTHORS' CONTRIBUTIONS

J. Andrade-de-Sácontributed to the application of statistical techniques (formal analysis), conducting a research and investigation process (investigation) and writing (original draft); T. K. Brazil contributed to the conceptualization and writing (original draft, review & editing); Y. F.Mise contributed to the application of statistical techniques (formal analysis) and development or design of methods (methodology); R. M. Lira-da-Silva contributed to the ideas (conceptualization), management and coordination responsibility for the research activity, planning and execution (project administration), supervision and writing (review & editing).