

Distribution of cave-dwelling pseudoscorpions (Arachnida) in Brazil

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INTRODUCTION

In Brazil, there are 173 described species in 16 families and 66 genera of Pseudoscorpiones (Table 1). Thirty of these species present subterranean populations in 12 genera and 10 families recorded for 106 caves. We present an overview of the distribution of pseudoscorpion families and genera, with the new occurrences and the new records based on literature data and collections. For the presentation of the map, we consider the state political divisions of Brazil, the biogeographical provinces (Morrone, 2014), and the karstic/non-karstic areas.



Table 1. Brazilian pseudoscorpion families with number of genera and described species. The underlined families are those occurring in caves.

Families	Genera number	Species number	Families	Genera number	Species number
Atemnidae	3	4	Geogarypidae	1	4
Bochicidae	1	4	Ideoroncidae	2	11
Cheiridiidae	2	4	Lechytidae	1	1
Cheliferidae	4	5	Olpidae	5	14
Chernetidae	24	65	Pseudochiridiidae	1	1
Chthoniidae	4	19	Syarinidae	4	10
Feaellidae	1	1	Tridenchthoniidae	6	9
Garypinidae	1	1	Withiidae	6	17

RESULTS

We analyzed 781 lots comprising 1518 individuals from 239 caves, of which only 31 caves already had published records of pseudoscorpions. We summarized the distribution of cave-dwelling pseudoscorpion fauna in Brazil for 314 caves across seven biogeo-

graphical regions and 13 states.

We recorded for the first time in Brazilian caves two families with three Genera: Atemnidae (*Brazilatemnus* Muchmore, 1975, *Paratemnoides* Harvey, 1991) and Geogarypidae (*Geogarypus* Chamberlin, 1930). Despite these, some other genera for previously recorded families were found for the first time (*Neocheiridium* Beier, 1932, *Lagynochthonius* Beier, 1951, *Tyrannochthonius* Chamberlin, 1929, *Olpium* Beier, 1931, *Pachypolium* Beier, 1931, *Ideoblothrus* Balzan, 1892 and *Heterolophus* Tömösváry, 1884) and we expanded the distribution range for all other families and genera (Table 2) with the exception of Pseudochiridiidae (*Pseudochiridium* With, 1906). Chernetidae, Olpiidae and Chthoniidae showed the highest number of records and are more widespread than others. Figure 1 show the comparison of new and literature records and Figure 2 presents the map with the new records.

Families - Genera (Biogeographical provinces)	BA	CE	GO	MG	MS	MT	PA	PR	RS	SC	SE	SP	TO
Atemnidae - <i>Brazilatemnus</i> sp. (PFP)												◊	
Atemnidae - <i>Paratemnoides</i> sp. (CEP)			◊	◊									
Bochicidae - <i>Speleobochica</i> sp. (ATP, CAP, PFP)	●			○								○	
Cheiridiidae - <i>Cheiridium</i> sp. (CAP, CEP, PFP)	●		◊	◊		◊						◊	
Cheiridiidae - <i>Neocheiridium</i> sp. (ATP, CEP, PFP)			◊	◊								◊	
Chernetidae - <i>Maxchernes</i> sp. (ATP)												●	
Chernetidae - <i>Speleaochernes</i> sp. (AFP, ATP, CAP, CEP, PFP, XTP)	●	◊	●	●	●	◊	●	○		○	◊	●	◊
Chernetidae - <i>Zaona</i> sp. (CEP)					○								
Chernetidae - Unidentified genera (CEP, PAP, PFP)	◊		◊	◊			◊		◊			◊	
Chthoniidae - <i>Lagynochthonius</i> sp. (PFP)				◊									
Chthoniidae - <i>Pseudochthonius</i> sp. (ATP, CAP, CEP, PFP)	●		◊	●	◊			○				●	
Chthoniidae - <i>Tyrannochthonius</i> sp. (CEP)				◊	◊								
Geogarypidae - <i>Geogarypus</i> sp. (CAP, CEP, PFP)	◊		◊	◊									
Ideoroncidae - <i>Ideoroncus</i> sp. (AFP, ATP, CAP, CEP, PFP)	◊			◊				○				●	
Lechytidae - <i>Lechytia</i> sp. (CAP, CEP)	◊				○								
Olpidae - <i>Olpium</i> sp. (CAP, CEP, PFP, XTP)	◊	◊	◊				◊						
Olpidae - <i>Pachypolium</i> sp. (ATP, CAP, CEP, PFP)	◊	◊	◊	◊								◊	
Olpidae - <i>Progarypus</i> sp. (ATP, CAP, CEP, PFP)	●		◊	●		◊						●	
Pseudochiridiidae - <i>Pseudochiridium</i> sp. (CEP)	○												
Syarinidae - <i>Ideoblothrus</i> sp. (CAP)	◊												
Syarinidae - <i>Nannobisium</i> sp. (CAP, XTP)	◊						●					◊	
Tridenchthoniidae - <i>Cryptoditha</i> sp. (CEP, PFP)				●								◊	
Tridenchthoniidae - <i>Heterolophus</i> sp. (PFP)												◊	

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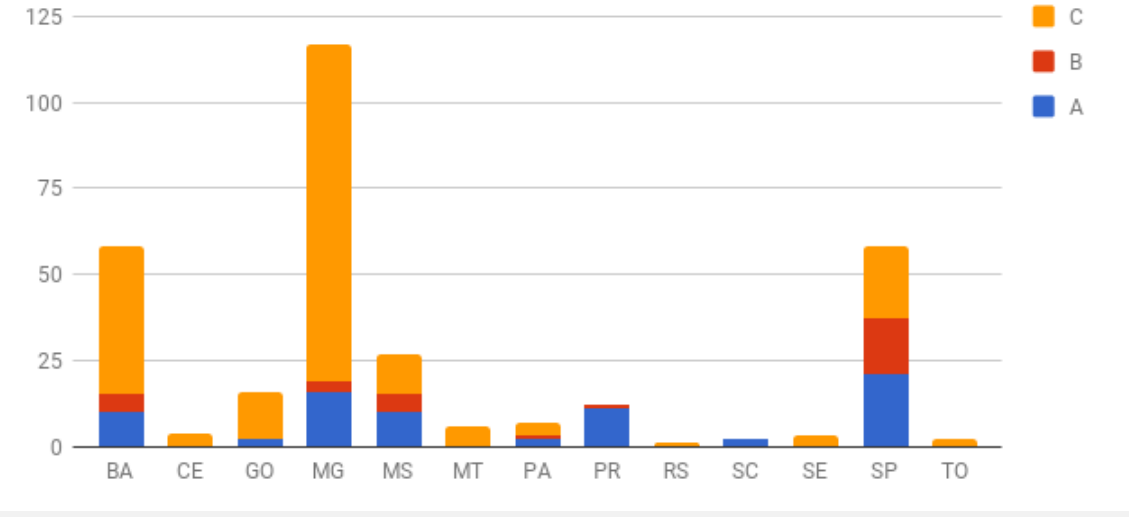


Figure 1. Brazilian States with the number of sampled caves with pseudoscorpions: (A) Mahnert 2001 and not resampled; (B) caves with known pseudoscorpion occurrence, but resampled and records of Andrade & Mahnert 2003, Ratton et al. 2012, Von Schimonsky et al. 2014 and Viana, Souza & Ferreira 2018; (C) new records from the present work. State abbreviations: BA – Bahia, CE – Ceará, GO – Goiás, MG – Minas Gerais, MS – Mato Grosso do Sul, MT – Mato Grosso, PA – Pará, PR – Paraná, RS – Rio Grande do Sul, SE – Sergipe, SP – São Paulo, TO – Tocantins.

(Von Schimonsky et al. 2014), increasing it to 173 species. Although this fauna is the fifth-most diverse in the world, the number of species described can be considered relatively low for a mega-diverse country. The difficulty of collecting these organisms due to their tiny size and cryptobiotic habits can explain this apparently low richness, combined with the taxonomic

DISCUSSION

In the past few years only three new species were added to pseudoscorpion Brazilian fauna: *Speleobochica iuiu* Ratton, Mahnert & Ferreira, 2012, *S. goliath* Viana, Souza & Ferreira, 2018 and *Iporangella orchama* Harvey, Andrade & Pinto-da-Rocha, 2016 (Feaellidae), besides a new record of *Pseudochiridium* aff. *insulae* Hoff, 1964

impediment and many areas in Brazil without comprehensive sampling (de Carvalho et al. 2007). It is noteworthy that caves are a promising environment to look for new taxa records. This habitat offers favorable conditions for pseudoscorpions, with its lower abiotic variation (Trajano & Bichuette 2010; Reddell 2012). Among the 16 families that occur in Brazil, 13 have been found in caves; 12 were recorded in this work. Most specimens of family Chernetidae in Brazilian caves belong to the genus *Speleaochernes*, which currently includes eight named species (Mahnert 2001). In our records, some samples were identified to species level, and concerning the species considered trogllobites in literature, none have had their range increased, except *Pseudochthonius biseriatus*, which was found in another cave (Lapa do Cipó) in the same region of Minas Gerais state.

Figure 2. Map showing the all new records of families and genera sampled in Brazilian caves [Chthoniidae: *Lagynochthonius* (light blue diamond), *Pseudochthonius* (mid blue diamond) and *Tyrannochthonius* (dark blue diamond); Olpiidae: *Olpium* (light red diamond), *Pachypolium* (mid red diamond) and *Progarypus* (dark red diamond); Cheiridiidae: *Cheiridium* (light green diamond) and *Neocheiridium* (dark green diamond); Ideoroncidae: *Ideoroncus* (black circle); Bochicidae: *Speleobochica* (White circle); Lechytidae: *Lechytia* (yellow circle); Syarinidae: *Ideoblothrus* (light blue circle) and *Nannobisium* (dark blue circle); Tridenchthoniidae: *Cryptoditha* (dark green circle) and *Heterolophus* (light green circle); Atemnidae: *Brazilatemnus* (dark blue triangle) and *Paratemnoides* (light blue triangle); Geogarypidae: *Geogarypus* (green triangle); Chernetidae: *Maxchernes* (right red triangle) and *Speleaochernes* (left red triangle)], along the biogeographical provinces which these occur (detached in grey scale) and Brazilian states (in white lines). The map also shows the karst regions in Brazil detached in brown.

Concerning the number of positively sampled caves with literature records of pseudoscorpions (314), it may seem small compared to the total number of about 17,500 registered caves in Centro Nacional de Pesquisa e Conservação de Cavernas (CECAV 2017), but it is worth noting that many cave records in this database are derived from consulting works, and some caves registered by consultants may no longer exist. Many caves are endangered, under threat from mining, hydroelectric power plants, agriculture, and rampant tourism (Gallão & Bichuette 2018), with the exception of some caves inside parks, but even these suffer from lack of supervision and are often abandoned. All these threats and the change in Brazilian cave legislation in recent years concern us about the conservation of the speleological heritage. Despite all effort for samples from all those caves, the absence of new occurrences for trogllobitic species reinforces the endemism and fragility of this fauna. The ranges of all families recorded have considerably increased, and some genera are associated with subterranean environment. However, there is still no clear pattern of distribution for cave-dwellers pseudoscorpions in Brazil, although some genera have restricted occurrence areas.

Table 2. Brazilian cave-dwelling pseudoscorpion families/genera that occur in each State sampled, with biogeographical regions in parenthesis. Open circles (○) indicate the literature register summarized in Mahnert (2001), supplemented by Andrade & Mahnert (2003), Ratton et al. (2012), Von Schimonsky et al. (2014) and Viana, Souza & Ferreira (2018). Closed circles (●) indicate new occurrences of previously recorded pseudoscorpion families/genera in caves. Open diamonds (◊) indicate all unprecedented records. States abbreviations: BA – Bahia, CE – Ceará, GO – Goiás, MG – Minas Gerais, MS – Mato Grosso do Sul, MT – Mato Grosso, PA – Pará, PR – Paraná, RS – Rio Grande do Sul, SE – Sergipe, SP – São Paulo, TO – Tocantins. Biogeographical regions abbreviations: AFP – Araucária Forest Province, ATP – Atlantic Province, CAP – Caatinga Province, CEP – Cerrado Province, PAP – Pampean Province, PFP – Parana Forest Province, XTP – Xingu-Tapajós Province.

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