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Biodiversity of the Huautla Cave System, Oaxaca, Mexico

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Abstract: Sistema Huautla is the deepest cave system in the Americas at 1560 m and the fifth longest in Mexico at 89,000 m, and it is a mostly vertical network of interconnected passages. The surface landscape is rugged, ranging from 3500 to 2500 masl, intersected by streams and deep gorges. There are numerous dolinas, from hundreds to tens of meters in width and depth. The weather is basically temperate subhumid with summer rains. The average yearly rainfall is approximately 2500 mm, with a monthly average of 35 mm for the driest times of the year and up to 500 mm for the wettest month. All these conditions play an important role for achieving the highest terrestrial troglobite diversity in Mexico, containing a total of 35 species, of which 27 are possible troglobites (16 described), including numerous arachnids, millipedes, springtails, silverfish, and a single described species of beetles. With those numbers, Sistema Huautla is one of the richest cave systems in the world.

Keywords: troglobitics; arachnids; insects; millipedes

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1. Introduction

Caves are some of the most adverse environments on earth, as the restricted access to food and the extreme conditions of darkness and humidity make these habitats very challenging for living organisms [1]. Despite this, many taxa have colonized these subterranean environments, including arthropods and vertebrates [2,3]. Some of these animals have become fully established in cave systems; therefore, they have evolved specific morphological adaptations (troglomorphisms) such as cuticular depigmentation, elongation of appendages, and reduction or loss of eyes [4]. Troglobitic animals (those who exhibit troglomorphisms) are excellent models for studies of the evolution, e.g., cave adaptations such as morphological convergences among distant lineages [5–8].

Caves are extremely important in terms of diversity, due to the number of endemic species inhabiting these environments [2]. For example, in the class Arachnida, troglobites are known for 9 of the 11 extant orders; only Thelyphonida (vinegaroons) and Solifugae (camel spiders or wind scorpions) lack cave representatives [9], and the Huautla System has a fair representation of all other Arachnida groups.

Cave explorations in the Systema Huautla have taken place since the mid-1960s, and multiple discoveries in terms of speleology but also in biological diversity have been reported [1–8]. However, this exploration is yet to be completed as new expeditions recently have concluded in extending the length of the system (see http://www.mexicancaves.org/maps/0104 (accessed on 27 August 2021)) and have also increased the number of new species inhabiting the system [1,2,8,9].

As part of the Special Issue "Hotspots of Subterranean Biodiversity" in the Diversity journal, we have decided to put together a list of the numerous taxa inhabiting one of the most important cave systems in Mexico revisiting all of the available literature. This list exemplifies the large biological diversity of the system, and furthermore, this resource can

be used as reference for future works not only on diversity but evolution, conservation, and inspiration for cave exploration in the several unexplored cave systems in Mexico.

2. Sistema Huautla

This is the deepest cave system in the Americas at 1560 m, and the fifth longest in Mexico at 89,000 m, and it is a mostly vertical network of interconnected passages, a few of which can be traversed by humans, but there are undoubtedly many narrow cracks and crevices inaccessible to cavers. Located at Huautla de Jiménez, on the Sierra Mazateca in the northwestern part of the State of Oaxaca, the caves have been explored by skilled speleologists since 1966, with international and local support. The topography of the cave is formed by multiple pits, stretch passages, and crevices (See http://www.mexicancaves.org/maps/0104 (accessed on 27 August 2021).

The Sierra Mazateca is basically a massive Cretaceous karst formation, up to 5000 m thick in some areas, overlain by older intrusive volcanic rocks. The landscape is rugged, ranging from 3500 to 2500 masl, intersected by streams and deep gorges. There are numerous dolinas, from hundreds to tens of meters in width and depth. Rural land in Mexico is mostly owned by the community living there (called "ejidos"), and permission is required from the local authorities before any exploration.

The weather is basically temperate subhumid, with a marked dry season from March to May. The average yearly rainfall is approximately 2500 mm, with a monthly average of 35 mm for the driest times of the years and up to 500 mm for the wettest month. The average monthly temperature is 23.6 °C, and the minimum average monthly temperature is 9.4 °C for the coldest month of the year and 13 °C for the warmest month, whereas the monthly daily average is of 14 °C for the coldest month and 29 °C for the warmest month [10].

The major caves are each associated with one of the larger dolinas, and the walls of the dolinas also have side entrances and pits at varying depths. There are at least 28 entrances and 6 major caves. The system continues to be pushed to new depths and lengths on a yearly basis. The six major caves in the system are: Sótano de San Agustín, Sótano del Río Iglesia, La Grieta, Sótano de Agua de Carrizo, Li Nita, and Nita Nanta (Figure 1). The Huautla system contains 50 species, with possibly 27 or more troglobites total (16 described), including arachnids, millipedes, springtails, silverfish, and a beetle [11–14]. In Li Nita, a new troglobitic scorpion of the genus *Typhlochactas* Mitchel, 1971 was collected in 2014. A small colony of vampire bats roosts not far inside one of the three entrances to Sótano del Río Iglesia and another unidentified bat colony roost just inside Sótano de San Agustín. In its deepest parts (~1000 m), Huautla system contains long, deep sumps, which makes the exploration and collecting even harder, as diving experience is needed. Three caves were impacted by garbage dumping, including medical waste with syringes, but the dumping has ceased, and the PESH cavers (Proyecto Espeleológico Sistema Huautla) have begun a clean-up effort [11–14].

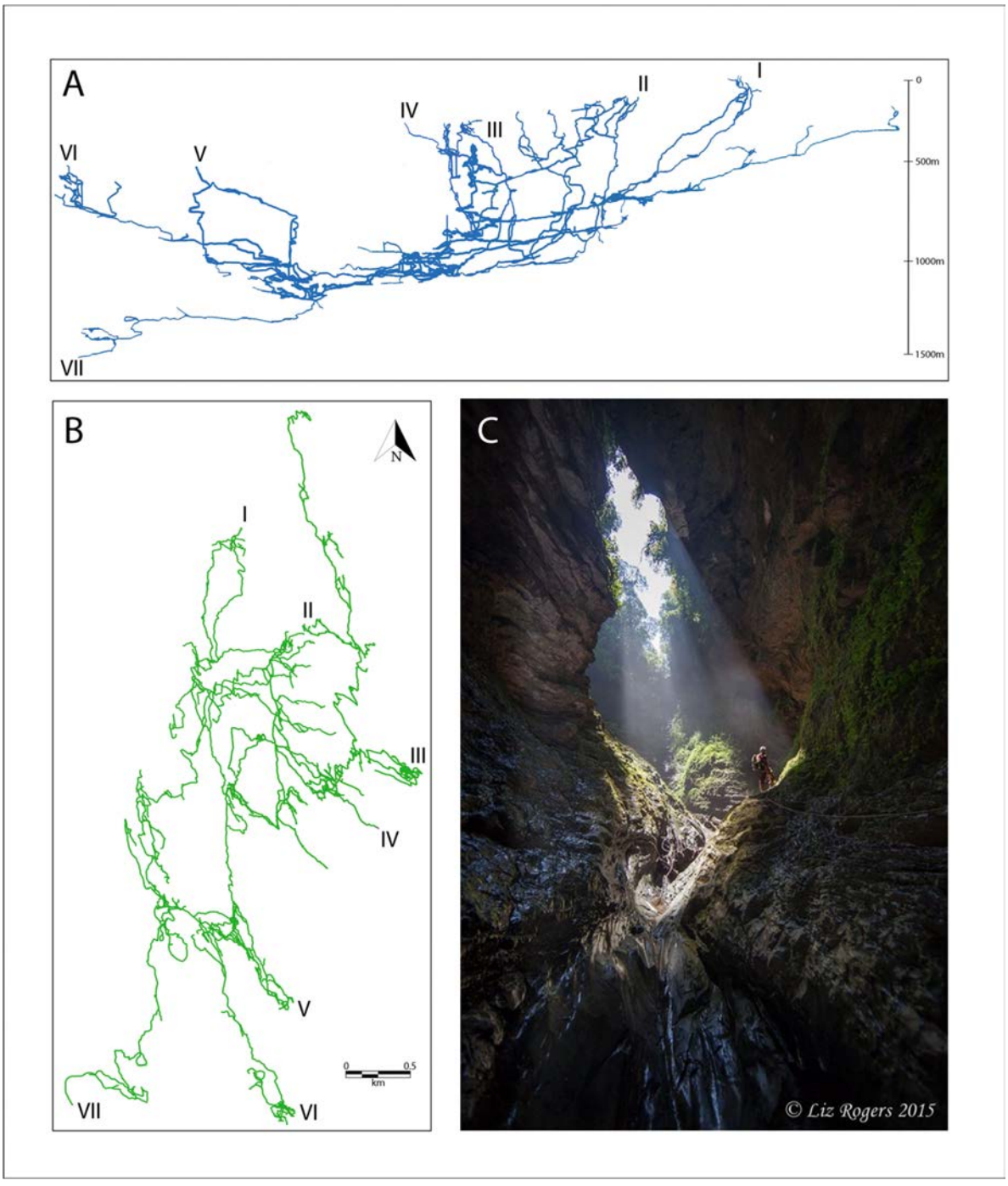

Figure 1. Sistema Huautla maps. (**A**) profile view, (**B**) plan view, (**C**) Sótano de San Agustín entrance. I, Nita Nanta entrance. II, Li Nita entrance. III, La Grieta entrance. IV, Sótano de Carrizo entrance. V, Sótano de San Agustín entrance. VI, Río Iglesia entrance. VII, Sump 9. Cave maps provided by William Steele. Photo on Figure C taken by Liz Rogers, 2015.

3. Biological Diversity

Although troglobionts have been collected in the Huautla Cave System since the beginning explorations, it has only been in the past eight years that real collecting efforts have been conducted by a group of arachnologists from the National Arachnid Collection at Universidad Nacional Autónoma de México (CNAN, UNAM). We were kindly invited by the organizers of the PESH expeditions on a yearly basis, exploring over 40 caves in the area. The PESH Expeditions are organized in the months of April–May of each year, during the dry season to minimize the risk of being trapped underground by flooding;

the entire expedition lasts one month, with about 100 cavers from around the world participating. We usually participate during the third week of the expedition, when the speleologists have already rigged several of the deeper caves; therefore, we can concentrate our efforts strictly on collecting with minimal time spent securing ropes. Usually, three to four members go into a cave with the support of several speleologists, and two or three remain collecting on the surface so that we can understand better the origin and evolutions of the troglobionts inside a given cave. Some species, such as the highly troglomorphic scorpion *Alacran tartarus* Francke, 1982, have been collected as shallow as −60 m and as deep as −920 m in several different caves; therefore, presumably, it moves into the deeper, common passage region of the system and can then disperse upwards through the numerous shafts. However, others, such as the troglobitic tarantula *Hemirrhagus grieta* (Gertsch, 1982), are confined to the middle depths (from −300 to −600 m) of a single cave (Cueva de La Grieta).

It is remarkable that no stygobionts have been collected in the system, even though there have been numerous diving expeditions to explore the deepest sumps, from both ends, i.e., from inside the cave and from the resurgence 7 km away. There are several reports, photographs and at least one video showing *Alacran* walking/running underwater; and the only other living animals reported at those depths are tadpoles (immature anurans), undoubtedly carried down during the flash floods of the rainy season. The tips of the pedipalp fingers in *Alacran* have sharp elongated hooks, which presumably can be an adaptation to catch those slippery prey items underwater, although nobody has seen a scorpion feeding on a tadpole underwater (or anywhere else).

The Arachnid collection in Mexico City has 19 species of the 27 known troglobionts in the Huautla Cave System, earning it one of the top ranks as the most diverse explored underground biotas in the world [15,16]. Sistema Huautla is the third-most diverse cave in Mexico, after Cueva de la Mina, Tamaulipas (24 troglobionts out of 60 species), and Sistema Purificación, also in Tamaulipas (19 troglobionts out of 103 species), followed in fourth place by Sistema de los Sabinos, San Luis Potosi, with 14 troglobionts out of 127 species (William Elliott, pers. comm.). A detailed list of the troglobionts in Sistema Huautla is given in Table 1. Underground collecting during the rainy season may increase the number of recorded troglobionts for all cave systems, as many terrestrial arthropods are known to overwinter in inactive stages during the drier and colder winter months, such as mites and ticks (Acari); however, due to the risk of flooding, this task is basically impossible to achieve.

It is important to emphasize that in the Huautla Cave System, seven different species of troglomorphic tarantulas of the genus *Hemirrhagus* Simon, 1903 have been collected thus far (several still undescribed): two of them from the same cave (La Grieta), though they are found at different depths and have not been collected together. The other five species are from separate entrances into the system and do not appear to be closely related, presumably representing independent invasions from epigean ancestor(s).

At least two species of bats (Mammalia: Chiroptera) have been photographed from caves in the Sistema Huautla; one is a leaf-nosed bat belonging to the family Phyllostomatidae. We have not been able to collect in the guano piles associated with those roosting areas, and it is likely there might be some additional troglobionts there.

4. Class Arachnida

4.1. Order Araneae

Spiders are among the most common arachnids into caves. According to available estimates, around 1000 troglomorphic spiders worldwide have been classified as troglobionts [9,17,18]. They are located from the entrance to the deepest galleries of the caves, although not all the species found in the caves are exclusive to the underground environments. Around 25–30% are accidental (trogloxenes) and appear in the entrance area; about 50% are regularly found in caves but also in the epigean environment (troglophiles); and between 20–25% are strictly cave inhabitants (troglobitic) [19,20]. In the Huautla Cave

System seven families, eleven genera and thirteen species of spiders have been recorded. The most diverse spider families are Pholcidae and Theraphosidae. In Mexico, pholcids spiders are the most common spider family found in caves, mainly in the entrances and median-depth zone of caves and grottoes. Huber (2018) [21] reported about 86 species of troglomorphic pholcid species worldwide, including 21 eyeless species and 21 species with strongly reduced eyes. Most troglomorphic pholcids spiders are representatives of only two genera: *Anopsicus* Chamberlin and Ivie, 1938 and *Metagonia* Simon, 1893 [21] with *Metagonia* represented in the Huautla Cave System (Table 1). Mexico is by far the richest country in terms of troglomorphic pholcids. This apparent dominance may partly be due to collectors' and taxonomists' biases [21], mainly towards the northern cave systems (e.g., Purification and Cuetzalan Cave Systems). Mygalomorph spiders are generally poorly represented in the cave faunas of the world. Mexico holds the second highest diversity of species of tarantulas worldwide behind Brazil, and Mexico is the richest country in tarantula cave species. The genus *Hemirrhagus* is endemic to Mexico and has 27 described species, with epigean, troglophile, and troglobitic species [22]. In the Huautla Cave System, *Hemirrhagus grieta* Gertsch, 1982 and *H. billsteelei* Mendoza and Francke, 2018 have been described; however, an additional five probably new species have been recently collected (Table 1; Figures 2A,D and 3D). Although important contributions about the spider fauna of the cave system have been published in the last five years, the Huautla Cave System is still poorly known and explored with respect to their spider fauna diversity.

4.2. Order Opiliones

In Mexico, a total of 265 species of harvestmen (Opiliones) has been recorded, representing the four extant suborders ([23] and Cruz-López, pers. obsv.). The Mexican fauna of Opiliones is remarkable because about 20% are troglobites or troglophiles, and estimates indicate that there is still a high percentage of undescribed species for the country, especially those that inhabit different cave systems [23].

Until 2003, only two species of Stygnopsidae were reported for the Huautla system; *Hoplobunus mexicanus* (Roewer, 1915) and *Karos gratiosus* Goodnight and Goodnight, 1971 [24]. However, recent taxonomic revisions of several genera of Stygnopsidae have revealed that the original taxonomic determinations made by Goodnight and Goodnight during 1953–1973 are erroneous [25,26]. Currently, *H. mexicanus* is in fact an undescribed species of *Stygnopsis* Sørensen, 1932 (Figure 2C), and all previous records published of *K. gratiosus* now correspond to *Huasteca kardia* Cruz-López and Francke, 2019. Additionally, Cruz-López et al. (2019) [27] described the endemic genus *Minisge* Cruz-López, Monjaraz-Ruedas and Francke, 2019, which includes two highly troglomorphic species: the shallower *Minisge sagai* Cruz-López, Monjaraz-Ruedas and Francke, 2019 (Figure 3F) and the deeper *Minisge kanoni* Cruz-López, Monjaraz-Ruedas and Francke, 2019. It is hypothesized [27] that both species of *Minisge* colonized the Huautla System independently, with *M. kanoni* being the oldest one, colonizing the caves about 3.3 Mya ago, whereas the colonization by *M. sagai* occurred very recently. It is remarkable that this species inhabiting the shallow regions of the cave system does not present a large genetic diversification or structure, among the populations in the many caves it has been found.

Figure 2. Troglobiont fauna of Sistema Huautla. (**A**) *Hemirrhagus* sp., (**B**) *Paraphrynus grubbsi* Cokendolpher and Sissom, 2001, (**C**) *Stygnopsis* sp., (**D**) *Hemirrhagus billsteelei* Mendoza and Francke, 2018, (**E**) *Rhachodesmus digitatus* Causey, 1971. Photos by Jean Krejca, Figure (**D**) taken and modified from Mendoza and Francke, 2018.

Figure 3. Troglobiont fauna of Sistema Huautla. (**A**) *Typhlochactas* sp., (**B**) *Sphaeriodesmus iglesia* Shear, 1986, (**C**) *Typhlochactas* sp. collecting method, (**D**) *Hemirrhagus grieta* Gertsch, 1982, (**E**) *Alacran tartarus* Francke, 1982, (**F**) *Minisge sagai* Cruz-López et al. 2019. Photos by Jean Krejca and CNAN-IBUNAM historic record.

Another remarkable species inhabiting the Huautla System is an undescribed species of an undescribed genus of the subfamily Gagrellinae (Eupnoi: Sclerosomatidae), which seems to be closely related to *Parageaya* Mello-Leitão, 1933, but currently, only considered as a member of Gagrellinae with troglomorphic features such as body pale color. Other record of troglomorphic species in the system is an undescribed *Stygnomma* Roewer, 1912. However, since the revision of Stygnommatidae by Pérez-González (2009) [28], *Stygnomma* was recognized as a polyphyletic assemblage, with the fauna of southern Mexico belonging in fact to members to the family Biantidae, but, unfortunately, a taxonomic act has not yet been formalized for this group.

Finally, near of the entrances of several caves, we have found specimens of an undescribed species of *Isaeus* Sørensen, 1932, but this species does not exhibit any troglomorphic features.

4.3. Order Amblypygi

Whip spiders are conspicuous arachnids that are very common in caves and most of the times very easy to spot by people visiting caves. The case of the Sistema Huautla is not different, and there are at least two different species reported in several caves of the system belonging to the genus *Paraphrynus* Moreno, 1940. The only species described as *Paraphrynus grubbsi* Cokendolpher and Sissom, 2001 (Figure 2B) was reported for several caves including Nita Lajao, Sótano de San Agustín, Cueva del Escorpión, etc., suggesting that this species is widely distributed in the system and can probably move from cave to cave. Additionally, Cokendolpher and Sissom (2001) [29] reported an undescribed species of *Paraphrynus* which was considerably smaller and morphologically distinct from *P. grubbsi* which has well-developed eyes, suggesting that it could be an epigean species not adapted to caves which lives in the surroundings of Sistema Huautla and can be found occasionally in the caves [29].

4.4. Order Pseudoscorpiones

A few small pseudoscorpions have been collected in the Huautla Cave System [13], but they have not been fully identified yet.

4.5. Order Schizomida

Short-tailed whip scorpions are represented in the cave system by a single species *Baalrog magico* (Monjaraz-Ruedas and Francke, 2018), which was originally described under the genus *Stenochrus* Chamberlin, 1922 and then transferred to the newly described genus *Baalrog* Monjaraz-Ruedas, Prendini and Francke, 2019, which harbors species restricted to the cave environment. Other members of genus *Baalrog* are distributed in cave systems in Valle Nacional, Oaxaca, and Atoyac, Veracruz [30]. Although there are other undescribed species of schizomids in the Sierra Mazateca outside the caves, those belong to different genera and are apparently not related to the species distributed inside Sistema Huautla [31].

4.6. Order Scorpiones

The Huautla Cave System is unusual among Mexican caves as it is the only one that harbors two species of troglobiont scorpions, both belonging to the family Typhlochactidae. *Typhlochactas* n. sp. is a small species about 2 cm long, totally eyeless and unpigmented, known from a single specimen collected about −100 m depth in one of the major caves (Figure 3A,C). The genus *Typhlochactas* has eight described troglomorphic species and a couple of new ones waiting to be described. This is the first record for the Huautla System [32].

The second one is *Alacran tartarus* (Figure 3E), which is about 8 cm long and is known from more than a dozen specimens collected in several caves in the system. It is a tan brown in color and is also completely eyeless. Two other species are known in the genus: one from the state of Puebla from a cave system that was presumably at one time interconnected to Systema Huautla and the other one from Oaxaca about 50 km away, both known from single collection events, as some caves in Mexico are not visited very frequently [33].

5. Class Diplopoda

Five endemic troglobitic species of millipedes belonging to four genera, four families, and four separate orders have been collected inside the Huautla Cave System. Perhaps, the most spectacular is a large yellow and bluish-green rhachodesmid which is quite abundant in the aptly named Millipede Cave (Figures 2E and 3B).

6. Class Insecta

There are five orders of insects reported from the Huautla Cave System, none of which are very abundant. There are two species of ground-dwelling beetles, two species of springtails, and one of each cave cricket, silverfish and dipluran (Table 1). Videos taken

inside several of the caves in the system show flying insects glowing from the lights of the cavers, but as far as we know, they have not been collected and identified.

Table 1. A detailed list of the troglobionts in Sistema Huautla is given. Abbreviations: TB, troglobiont; SB, stygobiont; TP, troglophile.

Class	Order	Family	TB or SB	TP	Genus	Species	Authors	Source	Endemic
Arachnida	Amblypygi	Phrynidae	1		*Paraphrynus*	*grubbsi*	Cokendolpher and Sissom, 2001	[29]	yes
	Amblypygi	Phrynidae		1	*Paraphrynus*	sp. nov.		[29]	yes
	Araneae	Ctenidae		?	*Ctenus*	sp.		[15]	yes?
	Araneae	Dipluridae		?	Undet.	undet.		[18]	yes?
	Araneae	Euctenizidae		?	*Aptostychus*	*sabinae*	Valdez-Mondragón and Cortes-Roldan, 2016	[34]	yes?
	Araneae	Mysmenidae		?	*Maymena*	sp.		[15]	yes?
	Araneae	Nesticidae		1	*Eidmannella*	*pallida*	(Emerton, 1875)	[15]	?
	Araneae	Nesticidae		1	*Gaucelmus*	*calidus*	(Gertsch, 1971)	[15]	yes?
	Araneae	Pholcidae		?	*Ixchela*	*panchovillai*	Valdez-Mondragón, 2020	[20]	yes
	Araneae	Pholcidae		?	*Modisimus*	sp. nov.		[15]	yes?
	Araneae	Pholcidae		?	*Metagonia*	sp. nov		[15]	yes?
	Araneae	Pholcidae		?	*Pholcophora*	sp. nov.		[15]	yes?
	Araneae	Theraphosidae	1		*Hemirrhagus*	*grieta*	Gertsch, 1982	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	*billsteelei*	Mendoza and Francke, 2018	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	sp. nov.	(Basketball Cave)	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	sp. nov.	(Church Cave)	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	sp. nov.	(Thirty Skeleton Cave)	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	sp. nov.	(Li Nita Cave)	[22]	yes
	Araneae	Theraphosidae	1		*Hemirrhagus*	sp. nov.	(Nita Nanta Cave)	[22]	yes
	Opiliones	Sclerosomatidae/ Gagrellinae	1		Gen. nov.	sp. nov.	(aff. *Parageaya*)	[26]	yes
	Opiliones	Stygnommatidae	1		*Stygnomma*	sp. nov.	new	[26]	yes
	Opiliones	Stygnopsidae	1		*Huasteca*	*kardia*	Cruz-Lopez and Francke, 2019	[26]	yes
	Opiliones	Stygnopsidae	1		*Minisge*	*kanoni*	Cruz-Lopez et al., 2019	[27]	yes
	Opiliones	Stygnopsidae	1		*Minisge*	*sagai*	Cruz-Lopez et al., 2019	[27]	yes
	Opiliones	Stygnopsidae	1		*Stygnopsis*	sp. nov.		[26]	yes
	Pseudoscorpiones	Chernetidae?	1		Undet.	undet.		[13]	yes
	Schizomida	Hubbardiidae	1		*Baalrog*	*magico*	(Monjaraz-Ruedas and Francke, 2018)	[31]	yes
	Scorpiones	Typhlochactidae	1		*Alacran*	*tartarus*	Francke, 1982	[33]	yes
	Scorpiones	Typhlochactidae	1		*Typhlochactas*	sp. nov	(Li Nita Cave)	[13]	yes
Diplopoda	Chordoneumatida	Cleidogonidae	1		*Cleidogona*	*baroqua*	Shear, 1982	[35]	yes
	Polydesmida	Sphaeriodesmidae	1		*Sphaeriodesmus*	*grubbsi*	Shear, 1986	[35]	yes
	Polydesmida	Sphaeriodesmidae	1		*Sphaeriodesmus*	*iglesia*	Shear, 1986	[35]	yes
	Rhachodesmidae	Rhachodesmidae	1		*Rhachodesmus*	*digitatus*	Causey, 1971	[35]	yes
	Spirostrepsida	Cambalidae	1		*Mexicambala*	*fishi*	Causey, 1971	[36]	yes
Insecta	Coleoptera	Carabidae		1	*Mexisphodrus*	*urquijoi*	(Hendrichs et al., 1978)	[36]	yes?
	Coleoptera	Staphylinidae		1	*Belonuchus*	sp.		[36]	yes?
	Collembola	Entomobryidae	1		*Pseudosinella*	*bonita*	Christiansen, 1973	[36]	yes
	Collembola	Entomobryidae	1		*Pseudosinella*	*huautla*	Christiansen, 1982	[37]	yes

Table 1. *Cont.*

Class	Order	Family	TB or SB	TP	Genus	Species	Authors	Source	Endemic
	Diplura	Campodeidae		1	Undet.	sp.		[11]	yes?
	Zygentoma	Nicoletiidae	1		*Anelpistina*	*specusprofundi*	Espinasa and Fisher, 2006	[38]	yes
	Orthoptera	Rhaphidophoridae		1	Undet.	undet.		video PESH 2019	yes?
Crustacea	Isopoda	Trichoniscidae		1	Undet.	undet.		Reddell, MexBio Files	yes
	Isopoda	Armadillidae		1	Undet.	undet.		Bill Steele, per. Com.	yes
			27 35 total	8					

: ? = there is no enough data about the biological ecology of the species. Yes? = there is no enough data about geographical distribution.

7. Class Crustacea

As mentioned earlier, no stygobionts have been observed in the Huautla Cave System, and there are two unidentified species of rolly-pollies (Isopoda) found in the cave, neither one with troglomorphic features.

8. Conservation

As we have shown, caves are important harbors of biodiversity and should be considered as habitats of high priority for conservation due the high number of endemic species inhabiting them. Their importance for evolutionary studies makes them natural laboratories for the study of evolution. Caves are important water reservoirs, which help maintain stability on the entire environments, as they store and provide water during the dry seasons. In recent years, we have noticed an increase in cave conservation activities in three areas. First, several cave entrances were used to dump garbage by the local residents; however, that practice has been actively discouraged by members of the PESH Expeditions, and in many cases, it has ceased altogether. Second, these same expedition participants have played a significant role in cleaning up some of those cave entrances that had been severely affected. Finally, some of the cave entrances are now protected by locked fences, and access is only allowed with the proper authorization from the local authorities. None of the cave entrances are commercially exploited, and very few speleologists visit the caves, as they are technically challenging and remote. Cave explorations as well as research should emphasize the importance of conservation, combating the myths behind caves as they are highly perpetuated in the communities as places of evil, which only results in the destruction of these important environments. Finally, an extensive multidisciplinary effort is necessary to incorporate Huautla System into conservation agendas, in order to propose the system as a protected area given the biological relevance mentioned above. In addition, one of the most important points for the conservation of cave species is the wide gap of knowledge that exists on the species inhabiting these systems, since generally only very few observations during explorations were reported from Huautla System.

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