Identification of a new population of *Anelpistina inappendicata*  
(Insecta: Zygentoma: Nicoletiidae)

Luis Espinasa\(^1,2\), Katherine Parker\(^1\) & Solomon A. Sloat\(^1\)

\(^1\) School of Science, Marist College, 3399 North Rd, Poughkeepsie, New York 12601, USA  
\(^2\) luis.espinasa@marist.edu (corresponding author)

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The “Grutas de Cacahuamilpa” National Park in Guerrero, Mexico, is best known for the Cacahuamilpa Cavern, the most visited show cave in Mexico. However, there is a plethora of other interesting caves in the region. The park is located in the Sierra Madre del Sur. This section of the Sierra Madre del Sur is made mostly of limestone. Caves abound and there is a tremendous diversity in types of caves. There are, for example, massive river caves such as Chontacoatlan and San Jeronimo, both over 5 km long. There are also fossil, dry caves perched high in the mountain, such as Cacahuamilpa and Acuitlapan, as well as flood prone muddy caves, like the spring of Agua Brava. For a description of the region’s geology and cave maps, see Bonet (1971). Additional descriptions and maps can be found in the bulletins of the Sociedad Mexicana de Exploraciones Subterraneas (SMES) and in the Association for Mexican Cave Studies (AMCS; [http://www.amcs-pubs.org/maps/Gro.html](http://www.amcs-pubs.org/maps/Gro.html)).

This area experienced the birth of biospeleology in Mexico in 1866. During the French invasion of Mexico, the zoologist Dominik Bilimek chaperoned the Empress Carlota, wife of Emperor Maximiliano von Habsburg, on her visit to Cacahuamilpa Cavern (Blasio and de Valadés 1996). Bilimek described its fauna (Bilimek 1867), which included the charismatic *Cryptocellus boneti* Bolivar, 1941, a ricinulid now recognized as an endemic, but common to many caves in the Cacahuamilpa area (L. Espinasa, personal observation). The order Ricinulei is one of the most seldom encountered and least known group of arachnids, with only about 60 species described worldwide (Prendini 2011). Additionally, Bilimek described the insect, *Anelpistina anophthalma* (Bilimek, 1867), which belongs to another seldom encountered group, the nicoletiids (Zygentoma, Nicoletiidae). Nicoletiids are related to the silverfish insects, but they are eyeless and depigmented. This nicoletiid was the first troglobiont to be described in Mexico.

In the Cacahuamilpa region, within just a 5 km radius, four different species of nicoletiids have been described inhabiting caves. Apart from *A. anophthalma*, there is *Squamigera latebricola* Espinasa, 1999 from Pozas Azules Cave, *A. mexicana* (Espinasa, 1991) from Zacatecolotla Cave, and *A. inappendicata* Espinasa, 1999 from Agua Brava.
Cave (Espinasa, 1991; Espinasa 1999a,b). It would appear that speciation for nicoletiids within the Cacahuamilpa karstic region is high, with most of these species endemic to single cave systems. Could it be that each species is narrowly adapted to a unique niche and restricted to a certain and specific type of cave? The Cacahuamilpa area is host to several environmentally different caves that would appear to be able to support a diverse array of specialist troglobitic nicoletiids.

During a trip to Acuitlapan Cave on April 11, 1991, two nicoletiid specimens were collected; an adult male and an immature female. Acuitlapan cave is a fossil cave perched high on Cerro del Tepozonal Mountain. Tepozonal Mountain is a 600 m high karstic feature. This shark fin shaped mogote rises high above the surrounding land. At the beginning of this study it was unclear if the Acuitlapan specimens belonged to any of the previously described species or represented an undescribed taxon. Therefore, its morphology was examined under a Motic K series stereo-microscope (Figures 1 and 2). The new specimens were identified as belonging to the Cubacubaninae subfamily. Furthermore, it was determined that they have stylets on urosternite II, but lack scales, sensory pegs in the appendix dorsalis, or conspicuous lateral lobes bearing numerous glandular pores on the labium. As such, its generic allocation is within the genus *Anelpistina* Silvestri, 1905 (=*Cubacubana* Wygodzinsky and Hollinger, 1977; syn. = *Neonicoletia* Paclt, 1979; syn.) as defined by Espinasa et al. (2007). That the Acuitlapan specimens did not belong to *Squamigera latebricola* was easily determined, since the genus *Squamigera* has scales (Espinasa, 1999a), which are absent in *Anelpistina*. It was also determined that these specimens are not *A. anophthalma*, due to the fact that the Acuitlapan male specimens lack articulated appendages in urosternum IV (Figure 2A), which are present in *A. anophthalma*. Likewise, *A. mexicana* was eliminated because this species has only four macrochaetae on its mandibles, and the point of insertion of the parameres in urosternum IX is shallow. Acuitlapan specimens have many more macrochaetae on their mandibles (Figure 1C) and the point of insertion of their parameres in urosternum IX is deep (Figure 2B).

The last remaining species that has been described for the region is *A. inappendicata*. This species inhabits Agua Brava Cave, which also happens to be the nearest cave to Acuitlapan Cave that is inhabited by a nicoletiid. The map of Agua Brava Cave can be found at [http://www.amcs-pubs.org/maps/2952.pdf](http://www.amcs-pubs.org/maps/2952.pdf) and the map of Acuitlapan Cave at [http://www.amcs-pubs.org/maps/2785.pdf](http://www.amcs-pubs.org/maps/2785.pdf). Their topographic maps show that the passages of these caves trend toward each other, with their deepest chambers being about 1400 m apart and with an altitudinal difference of about 350 m.
Figure 1. Similarity between the Acuitlapan Cave specimens (photographs) and *Anelpistina inappendicata* from Agua Brava Cave (line drawings). A: head; B: labium; and C: mandible. Photographs by Luis Espinasa.
Figure 2. Similarity between the Acuitlapan Cave specimens (photographs) and *Anelpistina inappendicata* from Agua Brava Cave (line drawings). A: hind leg and abdomen; B: genital area; and C: spines on cerci. Arrow points to urosternum IV, which lacks articulated appendages. Photographs by Luis Espinasa.
Since both caves are located on Tepozonal Mountain, it would seem likely that the two populations belong to the same species. But when considering the environments within these caves, they are drastically different. Acuitlapan Cave is a fossil and mostly dry cave perched high in the mountain. To reach the deepest chambers where specimens are found, one has to climb a 4 m wall and squeeze through a small, 50 cm wide hole. This probably prevents the passage of most bats. In the deepest chambers there is little soil, detritus, bat guano, or any evident sources of food. Agua Brava Cave offers a drastically different environment. It is at the bottom of the valley and during the rainy season it becomes a spring, and the cave is often flooded. During the dry season, humidity is still very high and its galleries are completely covered with thick and very sticky mud. Specimens of *A. inappendicata* in Agua Brava are found crawling over this mud while the new specimens of Acuitlapan Cave were found under dry rocks. If nicoletiid species are specialists restricted to narrow environmental conditions, the populations in these two caves may represent different species.

To resolve if the Acuitlapan specimens were *A. inappendicata*, body parts were compared against published illustrations of the body structures of *A. inappendicata* (Espinasa, 1999b). They shared in common a head with about 8 + 8 macrochaetae on the border of insertion of the antenna (Figure 1A), a labium with long and thin appendages (Figure 1B), a mandible with more than four macrochaetae (Figure 1C), legs that are very long and thin (Figure 2A), a point of insertion of parameres in urosternum IX deep, with parameres attaining about one third of stylets IX (Figure 2B), and a cercus with many small pegs of subequal shape and size (Figure 2C). All these characters are diagnostic of *A. inappendicata*. We therefore conclude that both Acuitlapan and Agua Brava are inhabited by the same species.

The results of this study do not support that all nicoletiid cave species are specialists restricted to narrow environments. On the contrary, *A. inappendicata* is shown to be a generalist, capable of coping with extremely different conditions varying in humidity, substrate conditions, and availability of food. It is actually surprising that *A. inappendicata* has not been found throughout the Cacahuamilpa area. The area has been extensively visited by us and other researchers since Bilimek in 1866, so their absence in most caves appears to be a real phenomenon and not a lack of sampling efforts.

In conclusion, it appears that the reasons behind such high nicoletiid diversity in the Cacahuamilpa area, with endemism restricted to small areas or even single caves, has to do with reasons other than simply diverse environmental conditions and at least some species being specialists, narrowly restricted to specific niches. One of many possibilities is that the Cacahuamilpa karstic region, despite being comprised of continuous limestone, has many biogeographical barriers that prevent the dispersal of troglobitic nicoletiids. These barriers could prevent migration both through caves and the epikarst. Other reasons are likely as well, such as exclusion due to competition with other species, environmental restrictive conditions other than those conditions studied, geological and evolutionary history, among others. It also remains to be explained why the cave endemic *Cryptocellus boneti* has been able to disperse broadly throughout the area, while nicoletiid
insects are restricted to few or even single caves. Future studies may address the causes for the biogeographical patterns in the biologically rich area of Cacahuamilpa.

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Literature Cited


