

SHORT COMMUNICATION

# Observations of two invertebrate parasites on *Ambystoma altamirani* (Caudata: Ambystomatidae) from the Sierra de las Cruces, Mexico

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**Palavras-chave:** Bivalves, Ectoparasitas, *Placobdella*, Relação forética, Salamandra, Sanguessugas, Sphaeriidae.

One of the most conspicuous species of *Ambystoma* in the Valley of Mexico is the Mountain Stream Siredon (*Ambystoma altamirani* Dugès, 1895), which is distributed in the Sierra de las Cruces, a mountain range that runs from the northwest part of the state of Mexico, south to western Mexico City and northwestern Morelos. *Ambystoma altamirani* is listed as endangered by the IUCN (IUCN 2022) and as threatened by the Mexican government (SEMARNAT 2019) (see Heredia-Bobadilla and Sunny 2021 for further discussion of conservation status). Throughout its distribution, this species is negatively affected by the introduction of Rainbow Trout (Estrella-Zamora *et al.* 2018, Guerrero de la Paz *et al.* 2020). Additional threats to populations of *A. altamirani* include urban sprawl associated with the growth of

Mexico City, which, consequently, results in excessive water use and drying and contamination of streams; climate change; and excessive use of fertilizers in agricultural lands (see Heredia-Bobadilla and Sunny 2021, Castillo-Manjarrez and Guadarrama-Martínez 2022).

*Ambystoma altamirani* is preyed upon by non-native Rainbow Trout [*Oncorhynchus mykiss* (Walbaum, 1792)] (Estrella-Zamora *et al.* 2018) and the snake *Thamnophis scaliger* Jan, 1863 (Villarreal-Hernández *et al.* 2019). To our knowledge, no reports exist of other natural enemies, such as parasites, affecting this axolotl. In this note, we report observations of invertebrates attached externally to *A. altamirani*, which may represent ectoparasitic or phoretic relationships.

From December 2021 to November 2022, we visited the Arroyo los Axolotes, municipality of Isidro Fabela, Mexico, every other week as part of continuing ecological studies of populations of *A. altamirani* in the Sierra de las Cruces (Lemos-Espinal *et al.* 2015, 2016b, Villarreal Hernández *et al.* 2020, Gómez Franco *et al.*

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2022, Sánchez-Sánchez *et al.* 2022). The Arroyo los Axolotes runs through grasslands that are frequently grazed by cattle, horses, and sheep (Gómez-Franco *et al.* 2022) (Figure 1), but in general, anthropogenic activities and their impacts appear limited (Lemos-Espinal *et al.* 2016a,b). During these visits we recorded five individuals of *A. altamirani* with leeches (*Placobdella* cf. *mexicana* Moore, 1898) or bivalves of the family Sphaeriidae. Voucher specimens were deposited in the Herpetological Collection of Laboratorio de Ecología UBIPRO (LEUBIPRO): one bivalve Family Sphaeriidae [LEUBIPRO-15314]; three leeches *Placobdella* cf. *mexicana* [LEUBIPRO-15315]; and 15 leeches *P. cf. mexicana* [LEUBIPRO-15316]. All specimens in LEUBIPRO-15315 and 15316, were removed from the same individual.

The first individual was a gilled female (65 mm SVL; 150 mm TL; 17.5 g BM) observed on 18 March 2022. This salamander had an adult bivalve attached to the second toe of its left hindlimb. The bivalve was removed, and the salamander was released in the place where it was captured.

On 27 July 2022, two individuals were found with invertebrates attached, one with a bivalve and the other with a leech. A female without gills (69 mm SVL; TL 136 mm; 12.04 g BM) had an adult bivalve attached to the third toe of the left forelimb (Figure 2A). The second individual was a female with small remnants of gills (74 mm SVL; 147 mm TL; 13.12 g BM) that had a leech attached to the fourth toe of the right hindlimb (Figure 2B). The bivalve and leech were removed, and the salamanders were released where they were captured.

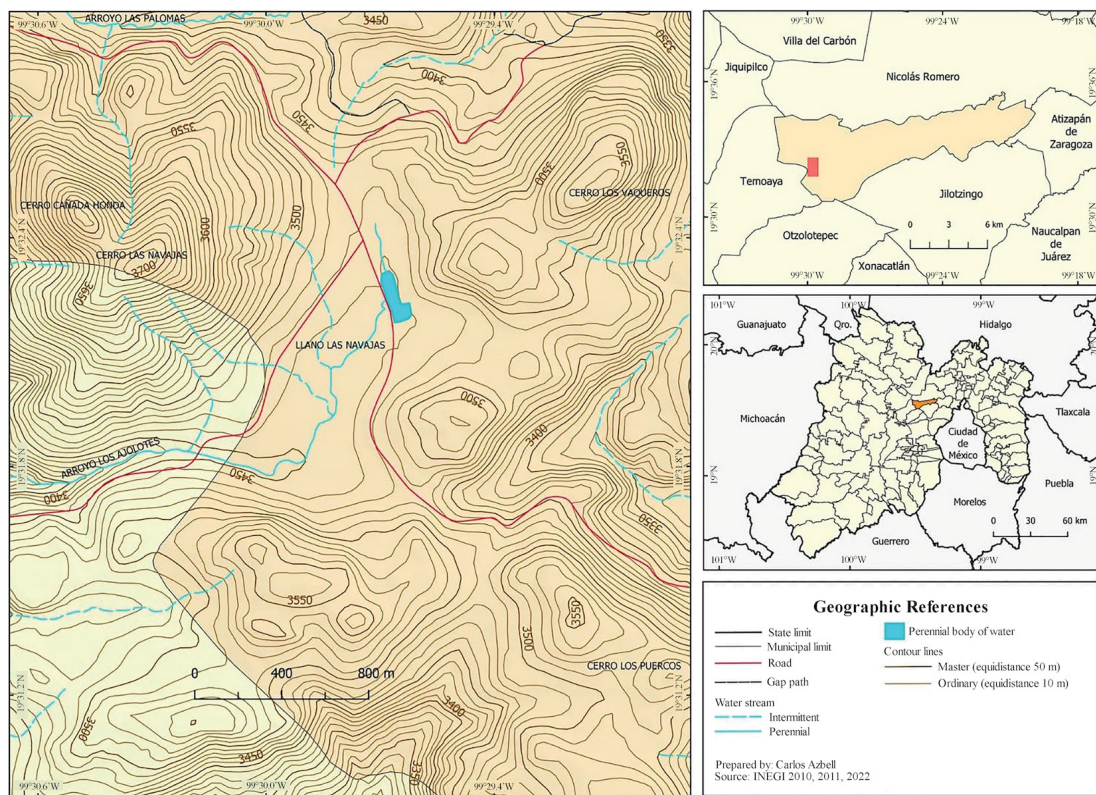


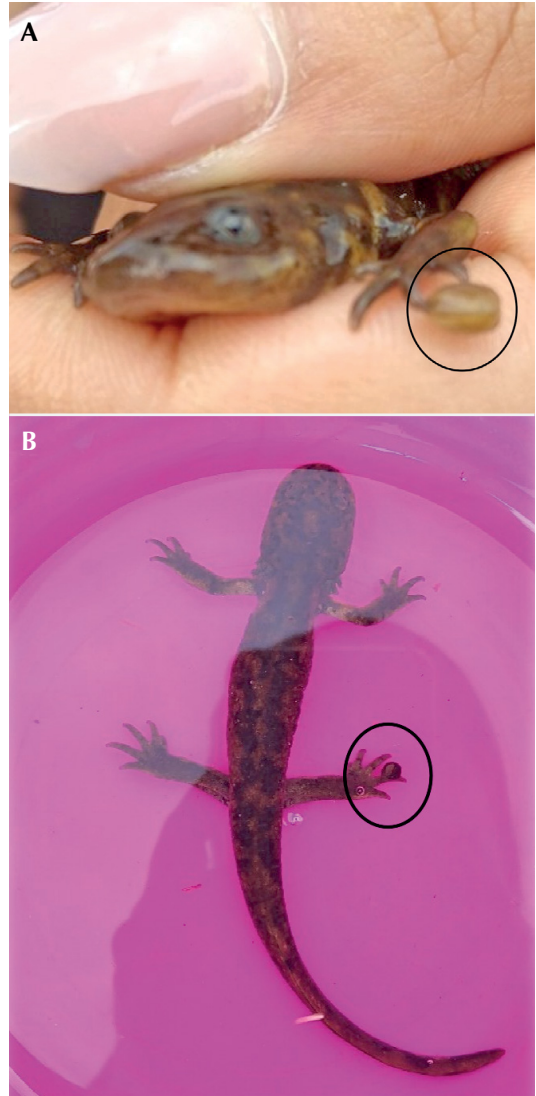
Figure 1. Map of the study area modified from INEGI (2010, 2011, 2022).

On 24 August 2022, we found two more salamanders with leeches attached. The first was an adult (i.e., without gills) male (92 mm SVL; 153 mm TL; 16.7 g BM) with two leeches attached to its tail and another two leeches in each armpit. The other individual was an adult male (80 mm SVL; 140 mm TL; 14.83 g BM) that had a leech attached to the middle of its back. All leeches were removed, and the salamanders were released where they were captured.

On 22 September 2022, we recaptured the first male captured on 24 August. At this time it no longer had any leeches attached and had increased in body mass from 16.7 g on 24 August 2022 to 25 g on 22 September 2022. We subsequently recaptured this individual on 06 October 2022, when it had 15 leeches attached to its torso, forelimbs, and near the cloaca (Figure 3). Its body mass had declined to 15.7 g. The loss of body mass it had suffered in just two weeks was evident to the naked eye. We speculate that the dramatic loss of body mass was due to heavy parasitism by *Placobdella* cf. *mexicana*. The levels of infestation by leeches on *Ambystoma* and other salamanders can be very high and can even result in mortality (Carpenter 1953, Gill 1978).

Our observations suggest that *A. altamirani* can serve as hosts for leeches and adult bivalve molluscs. It is not surprising that they are hosts to leeches because larval and adult *Ambystoma* are known to be hosts of various species of leeches (e.g., Pough 1971, 1972, Platt *et al.* 1993, Rossell and Zebchazy 1997), including other species of *Placobdella* (Bolek and Janovy 2005, Rhoden and Bolek 2012). Our observation of the recaptured individual suggests that leeches could pose a threat to individuals of *A. altamirani* and possibly to the population if leeches become abundant. Further investigation of the abundance and impact of leeches on *A. altamirani* and their relationship to environmental conditions would be fruitful.

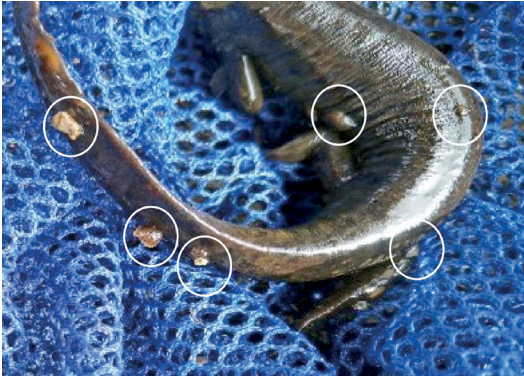
Our observations of *A. altamirani* hosting adult bivalves from the family Sphaeriidae is, to



**Figure 2.** An adult bivalve from the family Sphaeriidae (A) and a leech (*Placobdella* cf. *mexicana*) (B) from individuals of *Ambystoma altamirani*.

our knowledge, the first observation of such a relationship in Mexican *Ambystoma*. Previous observations of sphaerids attaching to the toes of *Ambystoma laterale* were made in Nova Scotia, Canada (Davis and Gilhen 1982). We speculate that the relationship between bivalves





**Figure 3.** An *Ambystoma altamirani* heavily infested with leeches (*Placobdella* cf. *mexicana*).

and salamanders is either accidental or phoretic. It seems likely that bivalves are not receiving nutritive resources from the salamanders, but instead they may be dispersed by the salamanders (see Darwin 1882, Davis and Gilhen 1982, Wood *et al.* 2008, Kappes and Haase 2012). In addition to the interactions of adult bivalves and salamanders, salamanders can serve as hosts of the glochidia of bivalves (Watters 1997, Watters and O'Dee 1998). Further investigation of a possible relationship between bivalves and salamanders, and any cost for the salamander or benefit for the bivalves, would be of interest. For example, attachment of bivalves on the toes of salamanders can result in swelling (Davis and Gilhen 1982) or damage to or loss of toes (Darwin 1882, Wood *et al.* 2008).

In addition to further studies exploring the potential costs of these two parasites on *A. altamirani*, it would be valuable to compare the incidence of parasites among populations of *A. altamirani* and in other Mexican *Ambystoma*, especially at sites with greater anthropogenic impacts. The Arroyo los Axolotes is relatively undisturbed by human activities (Lemos-Espinal *et al.* 2016a,b); however, other populations in the Llano de Lobos occur in much more disturbed sites (Villanueva Carvalho *et al.* 2020). In

addition, many of the habitats in which *A. altamirani* and other Mexican *Ambystoma* occur are threatened by changes in the quantity and quality of water due to human activities (Monroy-Vilchis *et al.* 2015, Heredia-Bobadilla and Sunny 2021).

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