

## SHORT COMMUNICATION

# Field observations of *Ambystoma altamirani* at near-freezing conditions in the Sierra de las Cruces, Mexico

Renato Sánchez-Sánchez,<sup>1</sup> Olga Méndez-Méndez,<sup>1</sup> Geoffrey R. Smith,<sup>2</sup> Raymundo Montoya-Ayala,<sup>3</sup> Guillermo Woolrich-Piña,<sup>4</sup> and Julio A. Lemos-Espinal<sup>1</sup>

<sup>1</sup> Facultad de Estudios Superiores Iztacala. Laboratorio de Ecología, UBIPRO. Av. Los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090, Mexico. E-mails: [renatosuperpuma@hotmail.com](mailto:renatosuperpuma@hotmail.com); [bipolarsashimi77@gmail.com](mailto:bipolarsashimi77@gmail.com), [lemos@unam.mx](mailto:lemos@unam.mx).

<sup>2</sup> Denison University, Department of Biology. Granville, Ohio 43023, USA. E-mail: [smithg@denison.edu](mailto:smithg@denison.edu).

<sup>3</sup> Facultad de Estudios Superiores Iztacala, Laboratorio de Cómputo, UBIPRO. Av. Los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090, Mexico. E-mail: [rmontoya@unam.mx](mailto:rmontoya@unam.mx).

<sup>4</sup> Tecnológico Nacional de México, Instituto Tecnológico Superior de Zacapoaxtla, División de Biología, Subdirección de Investigación y Posgrado, Laboratorio de Zoología y Ecofisiología. Carretera Acuario-Zacapoaxtla Km 8, Col. Totoltepec, Zacapoaxtla, C. P. 73680, Puebla, Mexico. E-mail: [gwoolrich@live.itsz.edu.mx](mailto:gwoolrich@live.itsz.edu.mx).

**Keywords:** Ice, Montane, Salamander, Stream.

**Palabras claves:** Arroyo, Hielo, Montaña, Salamandra.

**Palavras-chave:** Gelo, Montanha, Riacho, Salamandra.

Amphibian populations living at high elevations or latitudes often face harsh environmental conditions, including freezing winter temperatures. At the more northern extent of their distribution and at high elevations, salamanders in the genus *Ambystoma* have been observed at or near freezing temperatures. For example, Radi and Beachy (2013) observed larval *Ambystoma mavortium* Baird, 1850 active under ice in North Dakota, and *Ambystoma* often migrate during snow events at near or below

freezing temperatures (McClure 1943, Anderson 1967). Freezing of ponds and freezing temperatures can cause significant mortality for adult and larval *Ambystoma* [e.g., adult *A. maculatum* (Shaw, 1802) in North Carolina (Harris 1980) and larval *A. opacum* (Gravenhorst, 1807) in Connecticut (Herstoff and Urban 2014)]. In addition, at least some *Ambystoma* cannot tolerate freezing (Storey and Storey 1986).

The response of more southern *Ambystoma* to freezing conditions, such as populations in central Mexico, is unknown. Indeed, to our knowledge, no published observations of Mexican *Ambystoma* under freezing or near freezing conditions exist. As part of an on-going

Received 01 February 2022  
Accepted 30 March 2022  
Distributed June 2022


study of populations of the Mountain Stream Siredon, *Ambystoma altamirani* Dugès, 1895 in the mountains near Mexico City (Lemos-Espinal *et al.* 2016, Villanueva-Camacho *et al.* 2020, Villarreal-Hernández *et al.* 2020, Gómez-Franco *et al.* 2022), we have regularly visited and surveyed streams throughout the year. Here we report the first observation of *A. altamirani* during a freezing event.

On 27 December 2021, while surveying a population of *A. altamirani* at the Llano Las Navajas-Arroyo Los Axolotes (19°32'12.2" N, 99°29'52.7" W; 3479 m a.s.l.), Sierra de las Cruces, state of México, Mexico, we observed a 4- to 7-cm thick ice layer on the surface of the stream with only occasional small stretches free of ice. Large portions of the stream channel lacked water entirely. Water was concentrated in the deep and narrow parts of the stream and absent from shallow and wide sections.

At 10:10 h we observed a juvenile *A. altamirani* (~ 60 mm SVL) that looked to be in good condition (i.e., apparently healthy and alert). This individual was in a small section of the stream that had ice along the sides. Water temperature in the middle of the stream was 6.4°C, and the air temperature was 12.8°C. The stream at this point was 60 cm wide and 30 cm deep. The salamander was on the bottom of the stream in a small cavity of sand and dark brown mud away from the crevices and overhangs where inactive salamanders are typically found. The icy environmental conditions along with the thickness of the mud bottom of the stream prevented us from capturing the individual. We continuously surveyed a 1-km section of the stream from 10:00 to 14:00 h, taking water temperatures of around 3.4°C near the ice layer. The juvenile *A. altamirani* was the only amphibian that we observed during this survey.

We have been visiting this stream for seven years and have observed that the activity of this population decreases from November to February, sometimes with no observations in the months of December and January, probably due to freezing conditions (see Lemos-Espinal *et al.*

2016, Villanueva-Camacho *et al.* 2020, Villarreal-Hernández *et al.* 2020). According to the climate data from a nearby meteorological station 15231 (Iturbide Dam; National Water Commission, CONAGUA, accessed 06 January 2022) for the period 1977–2015, the lowest monthly average temperatures for the study area occur in November (8.0°C), December (6.9°C), January (6.8°C), and February (7.7°C). This is the first time that we have observed an active individual (i.e., not found in a crevice or under cover) in this stream with a thick layer of ice.

*Acknowledgments.*—We thank J. Rorabaugh and an anonymous reviewer for their helpful comments on the manuscript. Support for this study was provided by Dirección General de Asuntos del Personal Académico - Programa de Apoyo a Proyectos de Investigación e Innovación Tecnológica (DGAPA - PAPIIT), through the Project IN202021. Field work was conducted under permit number SGPA /DGVS/03662/20. 

## References

- Anderson, J. D. 1967. A comparison of the life histories of coastal and montane populations of *Ambystoma macrodactylum* in California. *American Midland Naturalist* 77: 323–355.
- Gómez-Franco, W., G. R. Smith, and J. A. Lemos-Espinal. 2022. The effects of livestock, proximity to trees, and aquatic characteristics on the abundance of *Ambystoma altamirani* within a stream. *Journal of Herpetology* 56: 56–59.
- Harris, R. N. 1980. The consequences of within-year timing of breeding in *Ambystoma maculatum*. *Copeia* 1980: 719–722.
- Herstoff, E. and M. C. Urban. 2014. Will pre-adaptation buffer the impacts of climate change on novel species interactions? *Ecography* 37: 111–119.
- Lemos-Espinal, J. A., G. R. Smith, A. Hernández-Ruíz, and R. Montoya-Ayala. 2016. Stream use and population characteristics of the endangered salamander, *Ambystoma altamirani*, from the Arroyo Los Axolotes, state of Mexico, Mexico. *Southwestern Naturalist* 61: 28–32.
- McClure, H. E. 1943. Salamanders and snow. *Ecology* 24: 265–266.

- Radi, A. and C. K. Beachy. 2013. *Ambystoma mavortium*. Behavior underneath the ice. *Herpetological Review* 44: 291–292.
- Storey, K. B. and J. M. Storey. 1986. Freeze tolerance and intolerance as strategies of winter survival in terrestrially-hibernating amphibians. *Comparative Biochemistry and Physiology* 83A: 613–617.
- Villanueva-Camacho, Z. A., G. R. Smith, R. Montoya-Ayala, and J. A. Lemos-Espinal. 2020. Distribution and population structure of *Ambystoma altamirani* from the Llano de Lobos, state of Mexico, Mexico. *Western North American Naturalist* 80: 228–235.
- Villarreal-Hernandez, V., G. R. Smith, R. Montoya-Ayala, and J. A. Lemos-Espinal. 2020. Abundance, distribution, population structure, and substrate use of *Ambystoma altamirani* along the Arroyo Los Axolotes, state of Mexico, Mexico. *Herpetological Conservation and Biology* 15: 188–197.

*Editor: Antoine Fouquet*