
https://doi.org/10.5281/zenodo.10598629

HOLOTIPUS NOTE
OPEN ACCESS Published on 2 February 2024


Figure 1.
Study area. (A) rescue zone green dot, (B) translocation zone red star and (C) recapture zone blue square. 1910 m of displacement between points B and C.





Received on
15 February 2023 / Accepted on
7 September 2023 / Published on
2 February 2024
Scientific Note

# Finding the way home: an unusual case of homing behaviour of *Hyloscirtus armatus* (Anura: Hylidae) in Bolivia

**Oliver Quinteros-Muñoz[1] and Edson Pérez[2]**

http://zoobank.org/urn:lsid:zoobank.org:pub:8A2713B7-8310-4CA1-BC1D-3784FC5FFEF4
https://doi.org/10.5281/zenodo.10598629

[1]Museo de Historia Natural Alcide d'Orbigny, Casilla 843, Cochabamba, Bolivia.

[2]Independent Researcher. C/Rafael Canedo, 310, Cochabamba, Bolivia.

*Corresponding author: ohlisin@gmail.com

**Abstract.**
Many factors are attributed to homing behaviour in anurans, including the extension of its home range and the search for new shelter and/or food. To date, homing behaviour remains poorly understood, especially within the family Hylidae. A rescue, marking, and translocation project of the endangered frog, *Hyloscirtus armatus* was carried out in December 2019, in Sehuencas, Carrasco National Park, Cochabamba, Bolivia. In February 2020, a marked individual of *H. armatus* was recaptured, which registered a displacement of more than 1900 meters between its translocation point to its recapture point. In this study, the homing ability of *H. armatus* is documented for the first time, and suggests that homing behaviour in this species is based on authentic navigation.

**Keywords: behaviour, Carrasco National Park, Hylidae, navigation, Yungas.**

## Introduction

Amphibians are one of the groups of vertebrates with a sedentary type of behaviour, which results in very short movements within their daily activities (Wells 2007; Pašukonis et al. 2013). Movements of greater displacement and duration can also be observed in amphibians, however, these may be considered either as a last response, given the potential energy costs, and/or directly related to the acquisition of new resources and the expansion of their range. These types of movements are challenging for individuals, as they must present some ways that allow them to return to their original location (Wells 2007).

According to Duellman & Trueb (1986), homing *b*ehaviour may be due to several factors, such as home range extension or the search for new shelter, and/or food. In anurans, studies on homing ability have been observed in Dendrobatidae (Pašukonis et al. 2013; Arcila-Perez et al. 2020). However, these types of studies are scarce for hylid species (see, *Acris crepitans*, Pyburn 1958 and Bellis 1959; *Dryophytes arenicolor*, Dole 1974; *D. andersonii*, Freda & Gonzalez 1986 and *Pseudacris cadaverina*, Kay 1989).

The Armed Treefrog, *Hyloscirtus armatus* (Boulenger 1902), is an endemic species to the humid cloud forest (Yungas) in Bolivia and is categorized as Vulnerable (Ministerio de Medio Ambiente y Aguas 2009). *Hyloscirtus armatus* is a robust-bodied species reaching up to 74.5 mm (snout-vent length). It has both aquatic and arboreal habits (Reichle & Aguayo 2006), and its distribution includes the Central Andes in Peru and Bolivia (Reichle & Aguayo 2006; Catenazzi et al. 2013). In Bolivia, this species has been recorded in the humid montane forests throughout the departments of Cochabamba, La Paz, and Santa Cruz, within an altitudinal range of 1000-2400 meters (Reichle & Aguayo 2006). Information on the natural history of *H. armatus* is quite limited, and nothing is known about its homing behaviour.

A herpetofauna rescue project was carried out in the Carrasco National Park, Cochabamba, Bolivia from September 2019 to November 2021. The project was executed under the current regulations for the management of wildlife established by the Plurinational State of Bolivia (Administrative Resolution of Ministry of Environment and Water VMABCCGDF/Nº 10). The aim of the rescue project was to mitigate the negative impact on amphibians and reptiles present in the study area, due to the decrease of vegetation cover and alteration of habitats resulting from the construction of a Hydroelectric Project. Our study was conducted at the locality of Sehuencas, Carrasco National Park (Fig. 1), which belongs to the ecological zone of Bolivian-Peruvian Yungas (Ibisch & Mérida 2003).

Twenty-eight individuals of the threatened species, *H. armatus* (Hylidae) were captured, marked, and released in a similar area 1910 m from the original locality (Fig. 1). Surveys were performed during the day and night in aquatic and terrestrial habitats (Crump & Scott 1994). All rescue, marking, and translocation protocols were supervised by officials of the Carrasco National Park and the Ministry of Environment and Water (Ministerio de Medio Ambiente y Agua).

The Visible Implant Elastomer Tags ® commercial kit (Northwest Marine Technology, Inc. Ben Nevis Loop Rd Shaw Island, WA, USA) were used for marking individual frogs.

Elastomer's preparation (VIE) was performed as specified by the manufacturer, and inoculation of the elastomers was carried out on the forelimbs and hindlimbs of each individual, using a unique colour-coding through the provided software (Northwest Marine Technology; http://www.nmt.us/support/software/viecodes/viecodes.htm) (Fig. 2B and C, white circle).

The marked individuals were examined by a veterinarian prior to the translocation process to avoid any injury or mobility issues. Each individual was monitored for 24 hours and their photographic record (dorsally and ventrally), SVL, and weight were taken.

The translocation of the twenty-eight *H. armatus* was carried out according to the activity patterns and habitat preferences of the rescued species. The individuals were translocated at Chaquisacha (17.417786° S, 65.244551° W; elevation 1602 m; Fig. 1, red star), Carrasco National Park. As part of the translocation process, biosafety protocols were followed to avoid any transmission of *Batracotrichium dendrobatidis* (Bd), since there are records of this pathogen in the study area (Barrionuevo et al., 2008).

On December 13, 2019, during the nocturnal herpetofauna rescue work, an adult female *H. armatus* (SVL=722 mm; Fig. 2A) was observed (17.412058°S, 65.264761°W; elevation 1511 m; Fig. 1) at 23:02 hours in a mountain stream near Sehuencas, Carrasco National Park, Cochabamba, Bolivia. This individual was marked and translocated to a stream in Chaquisacha (Fig. 1, 1118 meters between the rescue point and the translocation point) with the same characteristics as the rescue area, with both streams being in mountain ravines (Fig. 3 A and B).

On February 9, 2020, during herpetofauna monitoring work carried out in the rescue areas (17.412058°S, 65.264761°W; elevation 1424 m; Fig. 1), an adult female *H. armatus* (710 mm SVL; Fig. 2 A, B, C, and D) was observed perched on a rock in a stream at 19:58 hours near Chaquisacha, Carrasco National Park (Fig. 3C). At this point, the individual was not collected, only photographed *in situ*.

Once the individual was captured, data, such as SVL and body weight were recorded and dorsal and ventral photographs were taken. Through this documentation and review of the captured individual, the presence of elastomer marks (pink line) in the left hind limb were observed (Fig. 2 C and D). This information was verified with the marking database. The recaptured specimen corresponded to an individual that was originally collected and translocated in December 2019 in Chaquisacha.

According to the database generated from the translocated marked individuals, the recaptured individual travelled a distance of 1910 m from the translocation point in December 2019 in Chaquisacha (Fig. 1, red star) to the recapture point documented in February 2020 (Fig. 1). The distance travelled by the recaptured individual had an altitude range from 1620 meters at the translocation point (highest point) to 1370 m at the recapture point (lowest point). Both points (translocation and recapture) are separated by a dense cover of mature Yungas secondary forest. The stream in which the individual was translocated does not have any known connection within the hydrographic basin.

The recaptured specimen comes from a different area from which it was collected. We cannot rule out another type of orientation as the strategy responsible for the frog's return to its original location (mountain stream). Our data seems to support the existence of authentic navigation (homing ability) in *H. armatus* given the absence of a connection between the streams. We conclude that the movement likely occurred through the forest in a straight line, which is a type of displacement also being documented in the species (De la Riva. I., pers. comm.).

According to Griffin (1952), what was observed in *H. armatus* could be a Type III orientation, in which the individual exhibits authentic navigation, being able to return directly to its original location after being released in an unfamiliar area without recourse to local landmarks and without any remote sensory perception of the goal to which it is heading.

Wells (2007), proposed that in species with aquatic habits (specifically species living in streams) homing behaviour is due to an adaptive process in this type of habitat whereby the species can be dragged by the rising current and easily return to their original place of origin. This was already observed in members of the genus *Colostethus* and in individuals of *H. armatus* (Quinteros-Muñoz, pers. obs.).

Wells (2007), also mentioned that recapture rates in animals released in new localities may be higher than in those animals that were released in areas close to their original localities. However, studies carried out in Dendrobatids (e.g., *Andinobates bombetes*), suggest that the ability to move over large distances may decrease or be minimal at greater translocation distances (Arcila-Perez et al. 2020).

However, body size in anurans is not a factor that is directly related to homing capacity. According to Wells (2007), this ability has been recorded in large species of hylids and other frogs, registering displacements between 102 and more than 3000 meters (e.g., *Bufo bufo*, Heusser 1968; *Lithobates capito* Franz et al. 1988). The data reported by the aforementioned authors concurs with what was recorded in this work for *H. armatus*, which is a record of the greatest displacement (1910 m) known for the genus *Hyloscirtus* and for South America.

Navarro-Salcedo et al. (2022), studied the importance of parental care as a driver of homing capacity in *Ikakogi tayrona* (Centrolenidae), demonstrating that this capacity would be linked to a difference between the sexes, in which *I. tayrona* males have a greater homing capacity, achieving displacements of more than 300 m on their return home.

The results presented here underline that homing behaviour in amphibians is a very complex behaviour. In Bolivia, and elsewhere, little is known about this behaviour and additional studies are needed to understand the causes and factors affecting movement patterns between males and females and how these relate to homing behaviour.

Acknowledgments. The authors would like to thank the Carrasco National Park and its rangers for their important support for the conservation of our biological wealth. To I. De la Riva, A. Schulze and P. Cacciali for their valuable contributions during the preparation of this manuscript. R. Carpio and F. Onofre for their constant support during our fieldwork. To Carlos Caballero S.A. and TSK Electrónica y Electricidad, for their significant support during the realization of this work and their commitment to wildlife conservation in Bolivia. S. Barron and T. Rainville for English improvements.

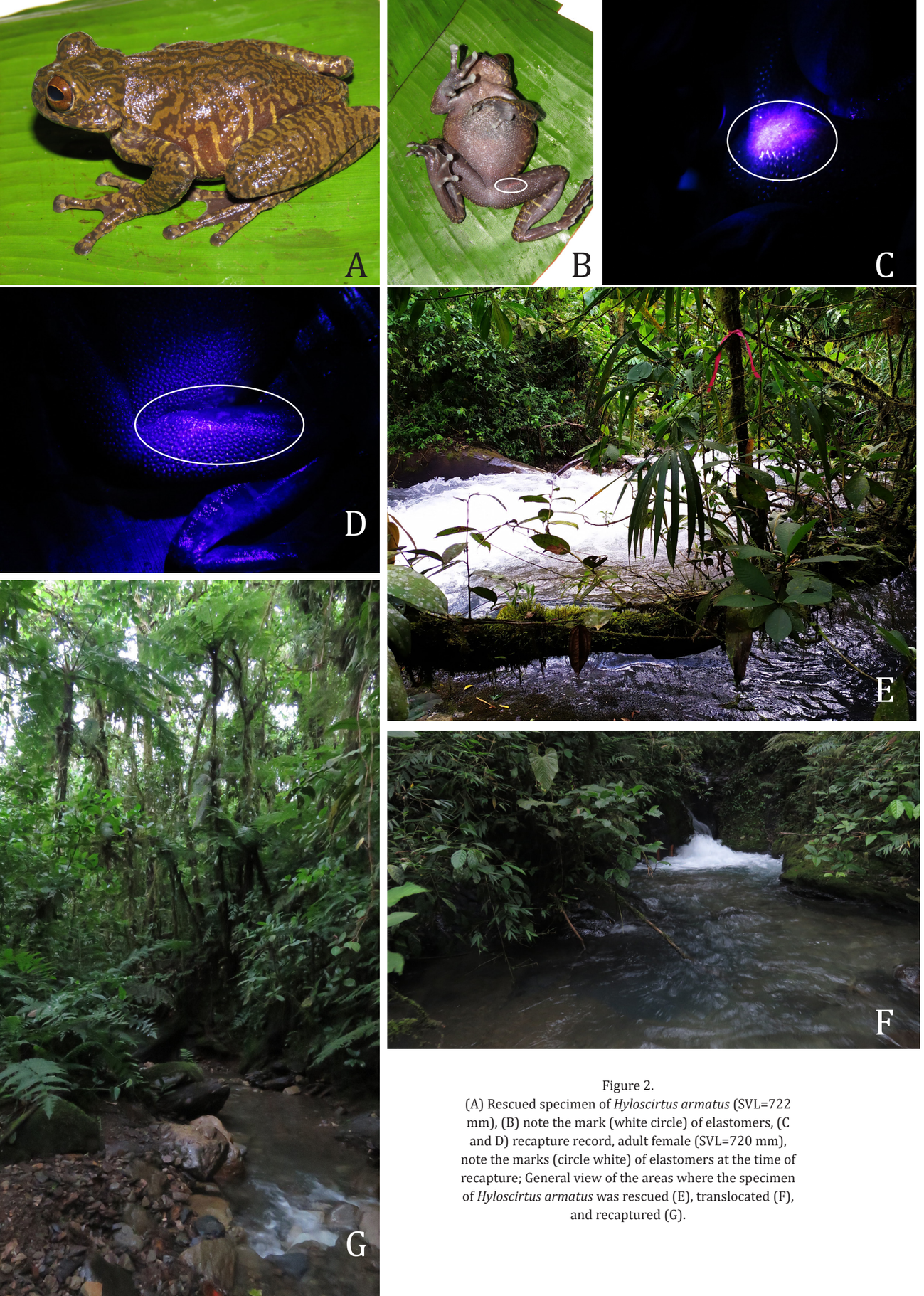



Figure 2.
(A) Rescued specimen of *Hyloscirtus armatus* (SVL=722 mm), (B) note the mark (white circle) of elastomers, (C and D) recapture record, adult female (SVL=720 mm), note the marks (circle white) of elastomers at the time of recapture; General view of the areas where the specimen of *Hyloscirtus armatus* was rescued (E), translocated (F), and recaptured (G).



## References


Arcila-Pérez, L.F., Atehortua-Vallejo, M.A. & Vargas-Salinas, F. (2020) Homing in the rubí poison frog *Andinobates bombetes* (Dendrobatidae). *Copeia* 108: 948–956. https://doi.org/10.1643/CE-19-284

Barrionuevo, J.S., Aguayo, R. & Lavilla, E.O. (2008) First record of chytridiomycosis in Bolivia (*Rhinella quechua*; Anura: Bufonidae). *Diseases of aquatic organisms* 82: 161–163. https://doi.org/10.3354/dao01980

Bellis, E.D. (1959) A study of movement of American toads in a Minnesota bog. *Copeia* 1959:173–74. https://doi.org/10.2307/1440082

Catenazzi, A., Lehr. & May, R.V. (2013) The amphibians and reptiles of Manu National Park and its buffer zone, Amazon basin and eastern slopes of the Andes, Peru. *Biota Neotropica* 13: 269–283. https://doi.org/10.1590/S1676-06032013000400024

Crump, M.L. & Scott, N.J. (1994) Visual encounter surveys, pp. 84–92. *In*: Heyer, W.R.; Donnelly, M.A.; McDiarmid, R.W.; Hayek, L.C. & Foster, M.S. (eds.), *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution Press, Washington, D.C., USA, 364 pp.

Dole, J.W. 1974. Home range in the canyon treefrog. Southwest. *Naturalist* 19:105–7. https://doi.org/10.2307/3669795

Duellman, W.E. & Trueb, L. (1986) *Biology of Amphibians*. The Johns Hopkins University Press, Baltimore, 670 pp. https://doi.org/10.2307/1445022

Franz, R., Dodd, C.K. & C. Jones. 1988. *Rana oreolata aesopus* (Florida gopher frog) Movement. *Herpetological Review* 19: 33.

Freda, J. & González, R.J. (1986) Daily movements of the treefrog, *Hyla andersoni*. *Journal of Herpetology* 20: 469–71. https://doi.org/10.2307/1564520

Griffin, D. R. (1952) Bird navigation. *Biological Reviews* 27: 359–390. https://doi.org/10.1111/j.1469-185X.1952.tb01509.x

Heusser, H. 1968. Die Liebensweise der Erdkröte (Bufo bufo L) Wanderungen und Sommerquartiere. *Revue Suisse de Zoologie* 75: 928-982.

Ibisch, P. L. & Mérida, G. (2003) *Biodiversidad la Riqueza de Bolivia: Estado de Conocimiento y Conservación*. Editorial FAN, Santa Cruz de la Sierra, Bolivia. 638 pp.

Kay, D.W. 1989. Movements and homing in the Canyon Tree Frog (*Hyla cadaverina*). *The Southwestern Naturalist* 34: 293-295.

Madison, D.M. (1969) Homing behavior of the red-cheeked salamander, *Plethodon jordani*. *Animal Behavior* 17: 25–39. https://doi.org/10.1016/0003-3472(69)90109-2

Ministerio de Medio Ambiente y Agua. (2009) L*ibro rojo de la fauna silvestre de vertebrados de Bolivia*. Ministerio de Medio Ambiente y Agua, La Paz, Bolivia. 571 pp.

Navarro-Salcedo, P., Arcila-Pérez, L.F., Pérez-González, J.L., Rueda-Solano, L.A., Rada, M. & Vargas-Salinas, F. (2022) Sex difference in homing: males but not females return home despite offspring mortality in I*kakogi tayrona*, a glassfrog with prolonged maternal care. *Behavioral Ecology and Sociobiology* 76: 1–13. https://doi.org/10.1007/s00265-021-03107-z

Pašukonis, A., Ringler, M., Brandl, H. B., Mangione, R., Ringler, E. & Hödl, W. (2013) The homing frog: high homing performance in a territorial dendrobatid frog *Allobates femoralis* (Dendrobatidae). *Ethology* 119: 762–768. https://doi.org/10.1111/eth.12116

Pyburn, W.F. (1958) Size and movements of a local population of cricket frogs (*Acris crepitans*). *Texas Journal of Science* 10: 325–42.

Reichle, S. & Aguayo, R. (2006) *Guía de Anfibios en la ruta "Caminando en las Nubes" Parque Nacional Carrasco*. Conservación Internacional. Santa Cruz, Bolivia, 73 pp.

Wells, K.D. (2007) The ecology and behavior of amphibians. *In*: *The Ecology and Behavior of Amphibians*. University of Chicago press. https://doi.org/10.7208/chicago/9780226893334.001.0001

*Holotipus*
*is an open access, peer-reviewed scientific journal devoted to Zoology, Systematics and Taxonomy. Special issues are dedicated to editorials and scientific papers focused on Art and Biology.*

*Submitting papers should be addressed to Publisher, Chief Editor or Managing Editor.*
*holotipus@holotipus.it*

Designed, published and printed in Italy by Holotipus publisher & ActionKlavier studio, Corso Peschiera 315/A, 10141 Torino.

Holotipus rivista di zoologia sistematica e tassonomia ISSN 2704-7547

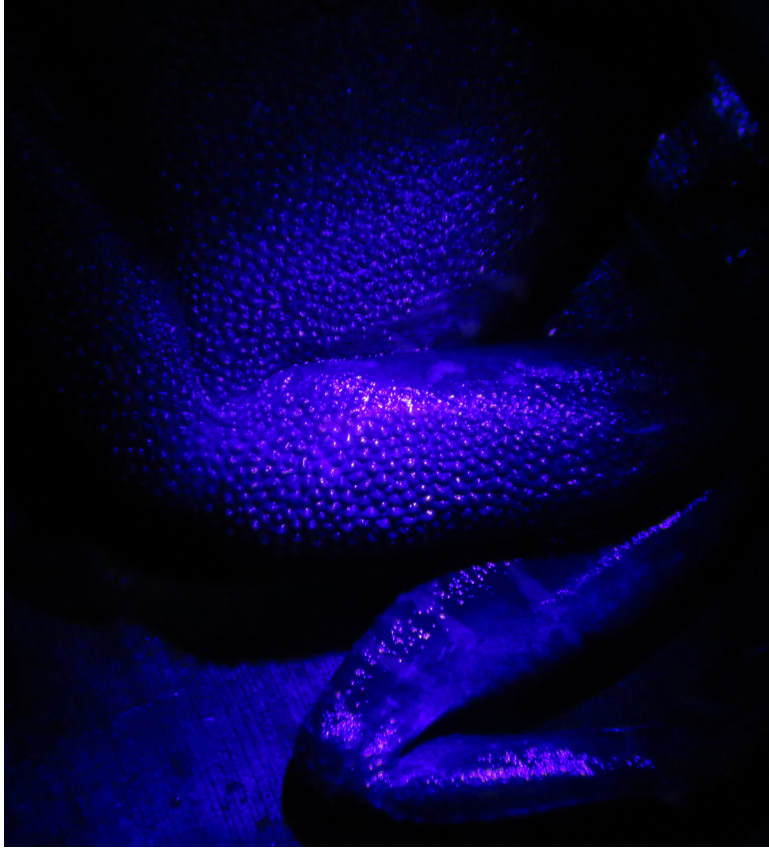


**Main sponsor**
CRÄMER & WOLLWEBER GARTEN- UND LANDSCHAFTSBAU GMBH
CEO: Markus Wollweber, DE
https://craemer-wollweber.de
email: info@craemer-und-wollweber.de

*We permanently archive all published articles on LOCKSS, Biotaxa and Zenodo. However, you can find the latest volume available on holotipus.it/archive/.*

*We would love to receive your manuscript.*
*You can find all the related guidelines on holotipus.it/publication-norms/.*
*Please do not forget to have a look at our Editorial policy.*





Front cover image
Rescued specimen of *Hyloscirtus armatus*.



Cite as Quinteros-Muñoz, O. & Pérez, E. (2024) Finding the way home: an unusual case of homing behaviour of *Hyloscirtus armatus* (Anura: Hylidae) in Bolivia. Holotipus rivista di zoologia sistematica e tassonomia V(1). https://doi.org/10.5281/zenodo.10598629.

ISSN 2704-7547
Holotipus (online)