

# Range extension of the Giant Salamander, *Pseudoeurycea gigantea* (Taylor 1938) (Caudata: Pletodontidae), and some aspects of its natural history within Hidalgo state, Mexico

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**Abstract:** This study documents the most northerly known distribution of the giant salamander, *Pseudoeurycea gigantea*, and provides new details on aspects of its natural history based on specimens of this species collected within Hidalgo state, Mexico.

**Key words:** Sierra Madre Oriental, diet, endemic, Caudata, critically endangered

The Giant Salamander, *Pseudoeurycea gigantea* (Caudata: Plethodontidae) belongs to the *P. bellii* complex of Mexico and Central America. This group is composed of relatively large terrestrial species, and is conspicuous by the presence of a series of bright orange dorsal spots. Until recently, *P. bellii* and *P. gigantea* were considered to represent a single species, *P. bellii*, and natural history data in the literature for these species were correspondingly mixed (Parra-Olea *et al.* 2005).

The first four records of this species were collected by Dunn (1926) in Jalapa, Veracruz (2215 m above sea level [a.s.l.]), but he identified these specimens as *Oedipus bellii*. Taylor (1938) collected two more specimens in Cofre de Perote at an elevation of 3048 m a.s.l. Taylor observed that his specimens were similar to specimens collected by Dunn and these six specimens differed significantly from those specimens determined as *O. bellii*, therefore, Taylor designated these specimens as a new species, *O. giganteus* (Taylor 1938). Later, Taylor (1944) placed this species within the genus *Pseudoeurycea* and amended the specific epithet to *gigantea*.

This nomenclature remained stable for over 30 years until Wake and Lynch (1976) considered that the characteristics of the specimens analyzed by Taylor (1938) were not enough to diagnose the specimens as a new species. Therefore, they considered all of Taylor's and Dunn's specimens to belong to *P. bellii*, and *P. gigantea* was relegated to a synonym of *P. bellii*. Finally, Parra-Olea *et al.* (2001, 2005) reanalyzed the morphological characteristics of the specimens previously placed as *P. gigantea* and included new molecular analyses, eventually concluding that *P. gigantea* is a valid species (Parra-Olea *et al.* 2005).

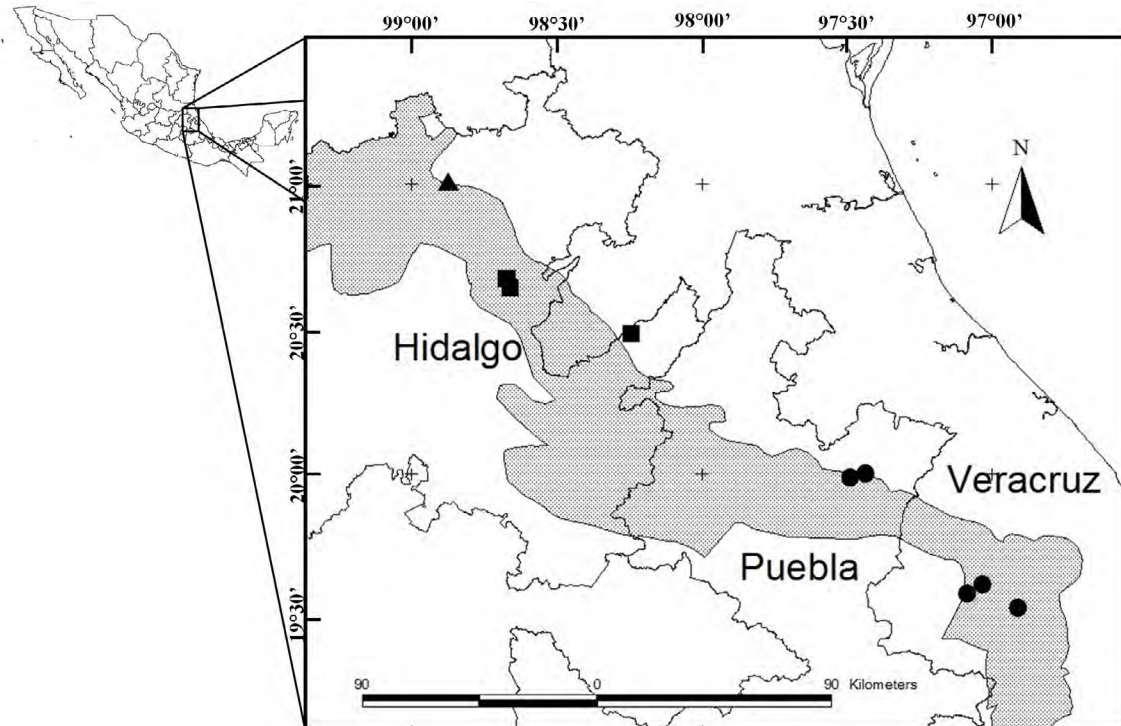
*Pseudoeurycea gigantea* is endemic to the Sierra Madre Oriental, and has been found in cloud forest, tropical forest, and pine forest from 915 m (Reese and Frischein 1950) to 3048 m a.s.l. (Taylor 1938) at sites from north-central Veracruz, northern Puebla, and eastern Hidalgo state (Figure 1, squares and circles; Taylor 1938; Smith and Taylor 1948; Parra-Olea *et al.* 2001; Parra-Olea *et al.* 2005; Vite-Silva *et al.* 2010; CONABIO 2011). The species can exploit a range of microhabitats, at least during the day; individuals have been found under rocks and logs with sufficient moisture (Taylor 1938). Specimens from Veracruz have been found to feed on worms and beetles (Coleoptera; Guzmán-Guzmán 2011). Within Hidalgo state, specimens have been found in the localities of San Bartolo Tutotepec (one specimen; Vite-Silva *et al.* 2010) and Zacualtipán de los Ángeles (three specimens; unpublished data; Figure 1, squares). Given that efforts to survey the herpetofauna in this state have been extensive for over 10 years (Ramírez-Bautista *et al.* 2010), the presence of so few confirmed specimens of this species indicates that it is very scarce within Hidalgo and very little is known of its natural history.

During surveys of the herpetofauna from northern Hidalgo, in municipality of Tepehuacán de Guerrero (21°00'18" N, 098°52'12" W) we found a specimen (CIB-4299; Figure 2) active on 13 February 2012 at around 21:15 h. The specimen was verified by Uriel Hernández-Salinas. Our specimen differs from *P. bellii*, in that lacks orange spots on the parietal region, which has only 11 costal grooves, and that when folding the legs to the body, these are separated only by one costal groove. This specimen represents the northernmost confirmed record of its distribution (Figure 1, Triangle), extending its range ca. 47.7 km northwest from the nearest previously known site, Zacualtipán de los Angeles (Parra-Olea *et al.* 2005; unpublished data). In addition, this specimen is the largest in body size reported so far (total length 327 mm), surpassing the size records of the previously largest known specimen (314 mm) from San Bartolo Tutotepec (Vite-Silva *et al.* 2010). We then analyzed all specimens (CIB-1713; CIB-1825; CIB-1777; CIB-2549) stored in the collection of amphibians and reptiles at the Centro de Investigaciones Biológicas (CIB) of the Universidad

Autónoma del Estado de Hidalgo (UAEH) to obtain further information on the natural history of *P. gigantea*.

This study indicates that within Hidalgo, *P. gigantea* inhabits cloud forests and pine forest at elevations from 1420 m to 2062 m a.s.l. from the north to the west. This is a rare species in the state, as only five specimens have been recorded in over ten years (CIB-1713; CIB-1825; CIB-1777; CIB-2549; CIB-4299). Our specimen (CIB-4299) was found active at night on a rock-wall at an elevation of 10 m above the ground so this

species apparently has both nocturnal and saxicolous habits. We based this behavior on other specimens (CIB-1825; CIB-1777) that have been found in the state under rocks at night. It has been previously noted that during the day specimens hide in dark places, such as under rocks, logs, and crevices (Taylor 1938). Adult specimens can be found in both intact and disturbed areas on agricultural land (Taylor 1938). In February 2008, a juvenile measuring 16 mm in total length (CIB-1713) was found in the municipality of Zacualtipán. This



**Figure 1.** The gray shaded region represents the Sierra Madre Oriental. Squares represent existing records of specimens of *P. gigantea* within Hidalgo State; circles are localities for historical records from other states; and the triangle represents the location of the new record.



**Figure 2.** Female *Pseudoeurycea gigantea* from Tepehuacán de Guerrero, Hidalgo. Photo by Christian Berriozabal-Islas.



suggests that the reproductive period for *P. gigantea* possibly occurs in early winter. Within the state, juveniles of *P. gigantea* only have occurred in conserved sites. Analysis of stomach contents from the preserved adults revealed cave crickets, grasshoppers (Orthoptera), cockroaches (Blattodea), and ants (Formicidae).

According to the IUCN (2012) *P. gigantea* is considered as a critically endangered species, but is not considered under any risk category for its protection under existing Mexican law (SEMARNAT 2010). The robust body size of the species implies that its preferred microhabitats are especially vulnerable to effects from loss of vegetation cover by deforestation in ways that may be less problematic for smaller species (Reca et al. 1994; Vitt and Caldwell 2009). In addition, general environmental disturbances can cause a reduction in local moisture content, further limiting the microhabitats available for the species to use. The restricted distribution of the species and steady environmental degradation in which the species inhabits, as well as its apparent rarity within appropriate habitats, strongly suggest that this species should be considered as endangered by the Government of Mexico. Wilson et al. (2013) considered this species to have an Environmental Vulnerability Score (EVS) of 16 based on ecological distribution, restricted area of distribution, and reproductive mode (EVS range 3–19, with a low risk values 3–9, medium 10–13, high 14–19; see Wilson et al. 2013). Hidalgo state has 13 vegetation types, and *P. gigantea* has been recorded only in two types, pine forest and, cloud forest; however, these environments have been strongly damaged (CONABIO 2010) by land use practices, such as those associated with pasture or cropland. Overall, this suggests that *P. gigantea* could be in critical need of active conservation measures, including protection of known habitats in Hidalgo where the species occurs.

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## LITERATURE CITED

- CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad). 2010. *El Bosque Mesófilo de Montaña en México: Amenazas y Oportunidades para su Conservación y Manejo Sostenible*. México D.F.: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 197 pp. ([http://www.biodiversidad.gob.mx/ecosistemas/pdf/BMM\\_parte%201.pdf](http://www.biodiversidad.gob.mx/ecosistemas/pdf/BMM_parte%201.pdf)).
- CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad). 2011. *La Biodiversidad de Puebla: Estudio del Estado*. Mexico D.F.: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Gobierno del Estado Puebla, Benemérita Universidad Autónoma de Puebla. 440 pp.
- Dunn, E.R. 1926. *The Salamanders of the family Pletodontidae*. Smith College 50th Anniversary Publication VII. Northampton, MA. 446 pp.
- Guzmán-Guzmán, S. 2011. *Anfibios y Reptiles de Veracruz Guía*

- Ilustrada*. Veracruz, Mexico. Consejo Veracruzano de Investigación Científica y Desarrollo Tecnológico. 231 pp.
- IUCN 2012. *IUCN Red List of Threatened Species*. Version 2012.2. Electrónica database accessible at <http://www.iucnredlist.org/>. Captured on 27 November 2013.
- Parra-Olea, G., T.J. Papenfuss, and D.B. Wake. 2001. New species of lungless salamanders of the genus *Pseudoeurycea* (Amphibia: Caudata: Plethodontidae) from Veracruz, Mexico. *Natural History Museum the University of Kansas. Scientific Papers* 20: 1–9 (<http://biostor.org/reference/97422>).
- Parra-Olea, G., M. Garcia-Paris, T.J. Papenfuss, and D.B. Wake. 2005. Systematics of the *Pseudoeurycea bellii* (Caudata: Plethodontidae) species Complex. *Herpetologica* 61(2):145–158. (doi: [10.1655/03-02](https://doi.org/10.1655/03-02)).
- Ramírez-Bautista, A., U. Hernández-Salinas, F. Mendoza-Quijano, R. Cruz-Elizalde, B.P. Stephenson, V.D. Vite-Silva and A. Leyte-Manrique. 2010. *Lista Anotada de Anfibios y Reptiles del Estado de Hidalgo, México*. Mexico D.F.: Universidad Autónoma del Estado de Hidalgo, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 104 pp.
- Reca, A., C. Úbeda and D. Grigera. 1994. Conservación de la fauna de tetrapodos I. Un índice para su evaluación. *Mastozoología Neotropical* 1: 17–28 ([http://www.sarem.org.ar/wp-content/uploads/2012/11/SAREM\\_MastNeotrop\\_1-1\\_03\\_Reca.pdf](http://www.sarem.org.ar/wp-content/uploads/2012/11/SAREM_MastNeotrop_1-1_03_Reca.pdf)).
- Reese, R.W., and I.L. Firschein. 1950. Herpetological results of the university of Illinois field expedition, spring 1949. *Transactions of the Kansas Academy of Science* 53: 43–54 (doi: [10.2307/3625676](https://doi.org/10.2307/3625676)).
- SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2010. Norma Oficial Mexicana Nom-059-Ecol-2010. Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario oficial (Segunda edición, 30-dic.) 77 pp. ([http://www.profepa.gob.mx/innovaportal/file/435/1/NOM\\_059\\_SEMARNAT\\_2010.pdf](http://www.profepa.gob.mx/innovaportal/file/435/1/NOM_059_SEMARNAT_2010.pdf)).
- Smith, H.M., and E.H. Taylor. 1948. An annotated checklist and key to the amphibian of Mexico. Smithsonian Institution. *United States National Museum Bulletin* 194: 118 pp. (doi: [10.5479/si.03629236.194](https://doi.org/10.5479/si.03629236.194)).
- Taylor, E.H. 1938. Concerning Mexican Salamanders. *The University of Kansas Science Bulletin*. 25: 266–269 (<http://www.biodiversitylibrary.org/page/4409559>).
- Taylor, E.H. 1944. The genera of plethodont salamanders in Mexico. Plate I. *The University of Kansas Sciences Bulletin*. 30(12): 209 pp. (<http://www.biodiversitylibrary.org/page/2994667>).
- Vite-Silva, V.D., I. Goyenechea and M. Aguilar-López. 2010. *Pseudoeurycea gigantea* (Giant Salamander) maximum size. *Natural History. Herpetological Review* 41: 470.
- Vitt, L.J. and J.P. Caldwell. 2009. *Herpetology. An Introductory Biology of Amphibians and Reptiles. Third edition*, San Diego: Academic Press, Elsevier 697 pp.
- Wake, D.B., and J.F. Lynch. 1976. The distribution, ecology, and evolutionary history of plethodontid salamanders in tropical America. *Contributions Science Bulletin Natural History Museum* 25: 1–65.
- Wilson, L.D., L.D. Johnson, and V. Mata-Silva. 2013. A conservation reassessment of the amphibians of Mexico based on the EVS measure. *Amphibian and Reptile Conservation* 7(1):97–127 ([http://www.redlist-arc.org/Article-PDFs/Special%20Mexico%20Issue\\_ARC\\_7%281%29-97-127\\_high\\_res.pdf](http://www.redlist-arc.org/Article-PDFs/Special%20Mexico%20Issue_ARC_7%281%29-97-127_high_res.pdf)).

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