

New record of *Pseudis minuta* Günther, 1858 (Anura: Hylidae) in South Santa Fe Province, Argentina

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In Argentina, the genus *Pseudis* is represented by two species: *Pseudis minuta* Günther, 1858 and *P. platensis* Gallardo, 1961 (Frost, 2018). The lesser swimming frog, *P. minuta*, is a small aquatic anuran with males that not exceed 40 mm in snout-vent length (SVL), and females that not exceed 48 mm long (Ghirardi and López, 2017). It has long hind limbs, with well-developed interdigital membranes extending to the base of the terminal disc, and a broad head with prominent eyes of dorsal position (Ghirardi and López, 2017). *Pseudis minuta* males are easily differentiated from *P. platensis* by the presence of a double lateral vocal sac (Garda et al., 2010). According to Manzano et al. (2004), the reproductive period of *P. minuta* covers from July to April. Melchior et al. (2004), registered vocalizations of the same species from August to April and amplexus in the period from October to February (except January). Finally, Zank et al. (2010), reported *P. minuta* male calls from May to November and amplexus from August to November. Different reproductive periods can be attributed to geographic distribution and abiotic factors such as air temperature and relative humidity (Zank et al., 2010). Both species attach their eggs to aquatic vegetation and the tadpoles develop in lentic environments (Garda and Canatella, 2007). The most conspicuous feature of this genus is the fact their tadpoles are much larger than adults frogs and the longest tadpoles of any anuran

genus (Ceï, 1981; Garda and Canatella, 2007; Garda et al., 2010). *Pseudis minuta* is a generalist-opportunistic predator with a broad feeding niche and it usually feeds on aquatic preys with large individual biomasses (Huckembeck et al., 2014). According to the IUCN Red List of Threatened Species the conservation status of *P. minuta* is classified as “Least Concern” (Kwet et al., 2004), and “Not Threatened” for populations of Argentina (Vaira et al., 2012).

The currently known distribution area of *P. minuta* encompasses Uruguay, extreme southern Brazil and northeastern Argentina (Frost, 2018). In terms of ecoregions, *P. minuta* occurs in the Paranaense Rainforest, Araucaria Rainforest, Chaco Savannah, Humid Chaco, Espinal, Humid Pampa, Mesopotamian Savannah and Flood Savannah of Paraná (Lavilla, 2005). In Argentina, the species occur in the provinces of Buenos Aires, Corrientes, Entre Ríos, Misiones, Santa Fe, and Santiago del Estero (Gallardo, 1987; Kwet et al.,



Figure 1. Adult male of *Pseudis minuta* with the characteristic double and lateral vocal sac from the southwest of Santa Fe province, Argentina. Photo by J. Vera-Candiotti.

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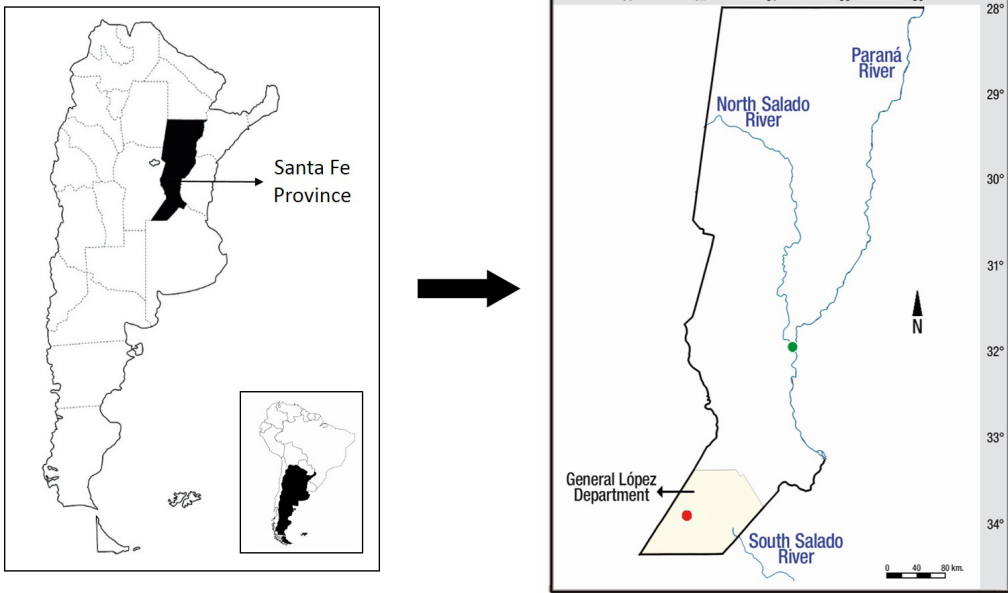


Figure 2. Location of the new record of *Pseudis minuta* in Santa Fe province, Argentina (red dot). The nearest previously reported locality (Colastiné Sur) is also indicated (green dot).

2004; Vaira et al., 2012). It has been mainly associated with large rivers, protected areas, and lands used for cattle breeding (Manzano et al., 2004; Guzmán and Raffo, 2011; Agostini, 2013). Although it can also be found in anthropized, rural or semi-urban environments (Ghirardi and López, 2017).

Within Santa Fe province, the species has been so far reported in Helvecia, Recreo, Rincón, Colastiné Sur and Santa Fe Capital (Museu de Zoologia da Universidade Estadual de Campinas, Museo Provincial de Ciencias Naturales Florentino Ameghino, Carnegie Museum of Natural History) (Table 1). According to a recent publication of amphibians of Santa Fe, the known distribution of *P. minuta* encompasses the North Salado river basin and the Paraná River basin, without mention of the southwestern area of the province nor General López Department (Ghirardi and López, 2017). It is important to note that the North Salado river (or Santa Fe Salado river) crosses the province from northwest to centre-east and flows into the Paraná river. At the south of Santa Fe province, near the limit with Buenos Aires province, there are a several ponds and wetlands that constitute the headwaters of an homonym river, the Buenos Aires Salado river (or South Salado River), which flows into La Plata river after crossing Buenos

Aires province (Giraut et al., 2007). *Pseudis minuta* has been registered in the Buenos Aires Salado river basin but only in the province of Buenos Aires section of the river (Manzano et al., 2004).

There are some studies on assemblages of anurans in natural environments and ponds of farmland within the *P. minuta* distribution range, that not register its presence during field samplings. In a protected area of Entre Ríos (Argentina), *P. minuta* previously cited for the National Park was not found, probably due to the extreme drought registered during the study period (Gangenova et al., 2012). On the other hand, Agostini et al. (2016) examined anuran assemblages in Pampas region of Argentina, during a 10 year project, and *P. minuta* was only mentioned based on specimens held at herpetological collections. Its absence after 10 years of surveys was probably due to the effects of pesticides as well as the presence of different stress factors in those croplands (Agostini, 2013; Agostini et al., 2016).

We provide here the first record of *Pseudis minuta* for General López Department, southwestern Santa Fe province, and field observations of the species in an agroecosystems from the Pampa ecoregion.

The study area is located along National Route N° 33, 25 km southwest of Venado Tuerto city, General

Table 1. Locality, geographical coordinates and reference specimens of *Pseudis minuta* previously reported in Santa Fe province, Argentina.

Locality	Geographical coordinates	Reference specimens
Helvecia	31°05' S, 60°05' W	UNICAMP ZUEC-AMP 10458
Recreo	31°30' S, 60°44' W	MFA ZV-An 766
Rincón	31°53' S, 60°53' W	CM Herps 38001
Santa Fe	31°38' S, 60°42' W	MFA ZV-An 774
Colastiné Sur	31°64' S, 60°62' W	MFA ZV-An 770

López Department, Santa Fe, Argentina (33°52'31.0'' S, 062°13'16.2'' W). The fieldwork was carried out on a permanent pond of 8.4 ha of total area and 48 cm of maximum depth with aquatic vegetation, as part of a long-term project of anuran associated to agroecosystems from the south region of Santa Fe, Argentina. Corn and soybean crops, 70 and 100 m of distance, respectively surrounded the pond. The area belongs to the "Pampas" ecoregion and is characterized by an extensive system of fresh or brackish water lagoons, flat relief and reduced drainage, subject to periodic flooding and a hydrographic network, in general with little development (Burkart et al., 1999). The original vegetation is temperate grassland (small bushes, grass and gramineous), alternating with halophilic grasslands with saltgrass and "espartillo". In areas near low lands and the edges of water bodies, rushes and sedges are developed (Burkart et al., 1999). Crop and livestock production are the dominant economic activity in the area, based on an intensive model both in terms of land use and technology application (Viglizzo et al., 2003).

On 23 October 2016 at 7:33 p.m., a male of *P. minuta* that was calling at sunset, floating among the vegetation was collected by hand (Fig. 1). The specimen was measured (33.47 mm SVL), weighed (5.04 g), identified by the diagnostic double lateral vocal sac, and euthanized according to the reference guidelines for research with laboratory, farm and wild animals from the National Scientific and Technical Research Council of Argentina (CONICET, 2005). The individual was deposited in the herpetological collection of Museo Provincial de Ciencias Naturales "Florentino Ameghino" (voucher number MFA-ZV-An: 861), Santa Fe city, Argentina. Other anuran species registered at the site were *Boana pulchella*, *Leptodactylus latrans*, *L. latinasus*, *Odontophrynus americanus*, *Rhinella arenarum* and *R. fernandezae*.

This new record extends the geographic distribution of *P. minuta* to approximately 280 km directly southwest from the nearest previous record, namely Colastiné Sur, Santa Fe (Fig. 2). This finding constitutes the first record of the species for General López Department, and the first documented observation of the species in a landscape within Pampa ecoregion in the Santa Fe province. Colastiné Sur is immersed in an extensive and complex floodplain with a wide heterogeneity of habitats, and large lagoons belonging to one of the most biodiverse areas of Santa Fe province, the ecoregion "Delta and Paraná Islands" (Burkart et al., 1999; Marchetti et al., 2012; Ghirardi and López, 2017). In contrast, a reduced number of habitats suitable for amphibian life and a generally lower diversity of species (Peltzer et al., 2006) characterize the agricultural landscape where the present study took place. Among the ecoregions of Santa Fe province, Pampean region is the one with the lowest richness of amphibian species (Ghirardi and López, 2017). The present finding support previous data about the presence of *P. minuta* in the Buenos Aires Salado river basin (Manzano et al., 2004), in this case, within the limits of Santa Fe province, in the low pampa corresponding to the area of the headwaters of the river.

Our study updates and expands the knowledge about one of the amphibians of Santa Fe province, Argentina and provides information from a little-studied area. It is necessary to detect the key local factors that allow the growth and development of *P. minuta* in order to ensure its long-term permanence in the region. In addition, the information may be useful not only for environments dominated by intensive agriculture in Argentina but also for similar degraded areas in other countries, and to advance in concrete actions of conservation of amphibians in agroecosystems.

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References

- Agostini, M.G. (2013): Ecotoxicología de anfibios en agroecosistemas del noreste de la Región Pampeana. PhD thesis, University of La Plata, Buenos Aires, Argentina.
- Agostini, M.G., Saibene, P.E., Roesler, I., Bilenca, D. (2016): Amphibians of northwestern Buenos Aires province, Argentina: checklist, range extensions and comments on conservation. *Check List* **12**: 1–10.
- Burkart, R., Bárbaro, N.O., Sánchez, R.O., Gómez, D.A. (1999): Eco-regiones de la Argentina. Administración de Parques Nacionales. Secretaría de Recursos Naturales y Desarrollo Sustentable. Presidencia de la Nación.
- Cei, J.M. (1981): Amphibians of Argentina. *Monitore Zoologico Italiano. Monographia* **2**: 1–609.
- CONICET. (2005): Reference ethical framework for biomedical research: Ethical principles for research with laboratory, farm and wild animals. National Scientific and Technical Research Council of Argentina. Res. #1047. Buenos Aires: Anexo II.
- Frost, D.R. (2018): Amphibian Species of the World: an Online Reference. Version 6.0. American Museum of Natural History, New York, USA. Available at <http://research.amnh.org/herpetology/amphibia/index.html>. Accessed on 17 April 2018.
- Gallardo, J.M. (1987): Anfibios argentinos. Guía para su identificación. Librería Agropecuaria S.A. Buenos Aires, Argentina.
- Gangenova, E., Guzmán, A., Marangoni, F. (2012): Diversidad de anfibios anuros del Parque Nacional El Palmar (Provincia de Entre Ríos, Argentina). *Cuadernos de Herpetología* **26**: 13–20.
- Garda, A.A., Cannatella, D.C. (2007): Phylogeny and biogeography of paradoxical frogs (Anura, Hylidae, Pseudae) inferred from 12S and 16 S mitochondrial DNA. *Molecular Phylogenetics and Evolution* **44**: 104–114.
- Garda, A.A., Santana, D.J., São Pedro, V.A. (2010): Taxonomic characterization of *Paradoxical frogs* (Anura, Hylidae, Pseudae): geographic distribution, external morphology, and morphometry. *Zootaxa* **2666**: 1–28.
- Ghirardi, R., López, J.A. (2017): Anfibios de Santa Fe. Ediciones UNL. Universidad Nacional del Litoral, Santa Fe, Argentina.
- Giraut, M.A., Lupano, C.F., Soldano, A., Rey, C.A. (2007): Cartografía hídrica superficial digital de la provincia de Santa Fe. Sistema Nacional de Información Hídrica, Subsecretaría de Recursos Hídricos, Buenos Aires, Argentina.
- Guzmán, A., Raffo, L. (2011): Guía de los anfibios del Parque Nacional El Palmar y la Reserva Natural Otamendi. Editorial Administración de Parques Nacionales. Buenos Aires, Argentina.
- Huckembeck, S., Loebmann, D., Albertoni, E.F., Hefler, S.M., Oliveira, M.C.L.M., Garcia, A.M. (2014): Feeding ecology and basal food sources that sustain the Paradoxical frog *Pseudis minuta*: a multiple approach combining stomach content, prey availability, and stable isotopes. *Hydrobiologia* **740**: 253–264.
- Kwet, A., Lavilla, E., Faivovich, J., Langone, J. (2004): *Pseudis minuta*. The IUCN Red List of Threatened Species. Version 2016-2. Available at <http://www.iucnredlist.org>. Accessed on 14 September 2016.
- Lavilla, E.O. (2005): Anfibios de la Reserva El Bagual. In: Historia natural y paisaje de la Reserva El Bagual, Formosa, Argentina. Inventario de la fauna de vertebrados y de la flora vascular de un área del Chaco Húmedo, p. 119–153. Di Giacomo, A.G., Krapovickas, S.F., Ed., Aves Argentinas/Asociación Ornitológica del Plata, Buenos Aires, Argentina.
- Manzano, A.S., Baldo, D., Barg, M. (2004): Anfibios del Litoral Fluvial Argentino. INSUGEO, Miscelánea 12. In: Temas de la Biodiversidad del Litoral fluvial argentino, p. 271–290. Aceñolaza, F.G., Coord., Tucumán, Argentina.
- Marchetti, Z.Y., Giraudo, A.R., Ramonell, C.G., Barberis, I.M. (2012): Humedales del río Paraná con grandes lagunas. In: Obra colectiva. Inventario de los humedales de Argentina. Sistemas de paisajes de humedales del Corredor Fluvial Paraná-Paraguay, p. 187–198. Proyecto GEF 4206 - PNUD/ARG/10/003. Secretaría de Ambiente y Desarrollo Sustentable, Jefatura de Gabinete. Ministerio de la Nación. Buenos Aires, Argentina.
- Melchioris, J., Di-Bernardo, M., Pontes, G., Oliveira, R., Solé, M., Kwet, A. (2004): Reproduction of *Pseudis minuta* (Anura, Hylidae) in southern Brazil. *Phyllomedusa: Journal of Herpetology* **3**: 61–68.
- Peltzer, P.M., Lajmanovich, R.C., Attademo, A.M., Beltzer, A.H. (2006): Diversity of anurans across agricultural ponds in Argentina. *Biodiversity and Conservation* **15**: 3499–3513.
- Vaira, M., Akmentins, M., Attademo, M., Baldo, D., Barrasso, D., Barrionuevo, S., et al. (2012): Categorización del estado de conservación de los anfibios de la República Argentina. *Cuadernos de Herpetología* **26**: 131–159.
- Viglizzo, E.F., Pordomingo, A.J., Castro, M.G., Lertora, F.A. (2003): Environmental assessment of agriculture at a regional scale in the Pampas of Argentina. *Environmental Monitoring and Assessment* **87**: 169–195.