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Research Note

Nematode Parasites of *Leptodactylus elenae* and *Leptodactylus podicipinus* (Anura: Leptodactylidae) from Corrientes, Argentina

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ABSTRACT: Two species of leptodactylid frogs, the marbled white-lipped frog, *Leptodactylus elenae*, and the pointed belly frog, *Leptodactylus podicipinus,* collected in Corrientes Province, Argentina, were examined for nematode parasites. Four adult species of nematodes belonging to 2 families (Cosmocercidae and Rhabdiasidae) were found parasitizing lungs and intestines: *Aplectana delirae* and *Cosmocerca podicipinus* in *L. elenae*; and *Cosmocerca parva*, *Cosmocerca podicipinus*, and *Rhabdias* sp. in *L. podicipinus*. This is the first report of nematode parasites for *L. elenae* and the second for *L. podicipinus* in Argentina. *Aplectana delirae* and *Rhabdias* sp. represent new host records.

KEY WORDS: *Leptodactylus*, nematode parasites, *Rhabdias*, *Cosmocerca*, *Aplectana*, Corrientes, Argentina.

In Argentina, there are 37 known species of leptodactylid amphibians (Vaira et al., 2012). Of these, 19 occur in Corrientes Province and belong to the genera *Leptodactylus* Fitzinger, 1826, *Physalaemus* Fitzinger, 1826, and *Pseudopaludicola* Miranda-Riveiro, 1926. Previous studies of nematode parasites in leptodactylid anurans in Corrientes Province have included reports for the species *Leptodactylus bufonius* Boulenger, 1894, *Leptodactylus chaquensis* Cei, 1950, *Leptodactylus latinasus* Jiménez de la Espada, 1875, *Leptodactylus latrans* (Steffen, 1815), *Leptodactylus podicipinus* (Cope, 1862), *Physalaemus albonotatus* (Steindachner, 1864), *Physalaemus santafecinus* Barrio, 1965, *Pseudopaludicola falcipes* (Hensel, 1867), and *Pseudopaludicola boliviana* Parker, 1927 (Schuurmans Stekhoven, 1952; González and Hamann, 2004, 2006a, 2009a, 2010a, b, 2012a, b, 2013; Hamann, González, and Kehr 2006; Hamann, Kehr, and González 2006, 2012; Schaefer et al., 2006). To date, there are no reports of nematode parasites in *L. elenae*, whereas the only report in *L. podicipinus* corresponds to larvae of the superfamily Seuratoidea Hall, 1916 (González and Hamann, 2010b).

The aim of the present work is to provide records of nematode parasites for both the marbled white-lipped frog, *Leptodactylus elenae* Heyer, 1978, and the pointed belly frog, *Leptodactylus podicipinus*, which were collected in Corrientes Province, Argentina.

We examined a total of 13 specimens: 6 *L. elenae* (4 males, 2 females) and 7 *L. podicipinus* (2 males, 5 females) near the city of Corrientes, Province of Corrientes, Argentina (27°28′S; 58°50′W), between January 2002 and December 2003. Amphibian taxonomy is in accordance with Frost (2014). Hosts were transported alive to the laboratory and killed in a chloroform solution. At necropsy, host sex was determined, and the lungs, esophagus, stomach, small intestine, large intestine, bladder, and body cavity of each specimen were examined. Nematodes observed in vivo were counted and then killed in hot distilled water, fixed in 70% ethanol, and cleared in lactophenol. Specimens were examined as temporary mounts. Prevalence and mean intensity were calculated according to Bush et al. (1997). Nematodes were deposited in the Colección Helmintológica of the Centro de Ecología Aplicada del Litoral, Corrientes, Argentina (CECOAL); amphibians were deposited in the Colección Herpetológica of the CECOAL (*L. elenae*: CH-CECOAL 3269; *L. podicipinus*: CH-CECOAL 2639).

In *L. podicipinus* we found 3 adult nematode species, 1 belonging to the family Rhabdiasidae Railliet, 1915 (*Rhabdias* sp.), and 2 to the Cosmocercidae Travassos, 1925 (*Cosmocerca parva* Travassos, 1925, and *Cosmocerca podicipinus* Baker et Vaucher, 1984); in *L. elenae* we found 2 species both belonging to the family Cosmocercidae (*Cosmocerca parva* and *Aplectana delirae* [Fabio, 1971] Baker, 1980).

Rhabdias sp.

Host: Leptodactylus podicipinus.

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Prevalence and mean intensity: One of 7 (14%); total number of parasites 1 (1 female).

Site of infection: Lung.

Other reported hosts and geographic range in South America: See the recent review by Campião et al. (2014).

Specimens deposited: CECOAL 05042103.

Remarks: In this study, a more precise identification of this worm was not possible because only 1 specimen was found. Nematode parasites of the genus *Rhabdias* have been reported in Argentina in the bufonids *Rhinella arenarum* (Hensel, 1867) (see Gutiérrez, 1945), *Rhinella bergi* (Céspedez, 2000) (see González and Hamann, 2007b), *Rhinella fernandezae* (Gallardo, 1957) (see Hamann et al., 2013), and *Rhinella schneideri* (Werner, 1894) (see González and Hamann, 2008). Members of this genus have also been reported in the leptodactylids *Leptodactylus bufonius* (see González and Hamann, 2006a; Hamann et al., 2012), *Leptodactylus chaquensis* Cei, 1950 (see Hamann, Kehr, and González, 2006), and *Physalaemus biligonigerus* (Cope, 1861) (see Gutiérrez et al., 2005), and in an odontophrynid, *Odontophrynus americanus* (Duméril et Bibron, 1841) (see González and Hamann, 2009b). Members of the Rhabdiasidae are common lung parasites of amphibians and reptiles, and infection in amphibians is thought to occur via skin penetration by infective larvae (Anderson, 2000). This is the first report of members of the genus *Rhabdias* in *L. podicipinus*.

Cosmocerca parva Travassos, 1925

Host: Leptodactylus podicipinus.

Prevalence and mean intensity: Two of 7 (29%); 4; total number of parasites 8 (7 females, 1 male).

Site of infection: Large intestine.

Additional hosts from Argentina: Dendropsophus sanborni (Schmidt, 1944) (see González and Hamann, 2011), *Hypsiboas raniceps* Cope, 1862 (see González and Hamann, 2011), *Leptodactylus bufonius* (see González and Hamann, 2006a; Hamann et al., 2012), *Leptodactylus chaquensis* (see Hamann, Kehr, and González, 2006; Schaefer et al., 2006), *Leptodactylus latinasus* see Hamann, González, and Kehr, 2006), *Odontophrynus americanus* (see González and Hamann, 2009a), *Physalaemus albonotatus* (see González and Hamann, 2012a), *Physalaemus santafecinus* (see González and Hamann, 2010a), *Rhinella bergi* (Céspedez, 2000) (see González and Hamann, 2007b), *Rhinella fernandezae* (Gallardo, 1957) (see González and Hamann, 2007a; Hamann et al., 2013), *Rhinella major* (Müller et Hellmich, 1936) (see Mordeglia and Digiani, 1998; González and Hamann, 2006b), *Rhinella schneideri* (see González and Hamann, 2008), *Scinax acuminatus* (Cope, 1862) (see González and Hamann, 2008), and *Scinax nasicus* (Cope, 1862) (see Hamann et al., 2009, 2010).

Type host and type locality: Elosia nasus Günther, 1866 (= *Hylodes nasus* [Lichtenstein, 1823]), Angra dos Reis, Rio de Janiero, Brazil (Travassos, 1925).

Other reported hosts and geographic range in South America: See the recent review by Campião et al. (2014).

Specimens deposited: CECOAL 02103139 (3 females), CECOAL 03033625 (1 male).

Remarks: Cosmocerca parva is a parasitic nematode frequently found in Argentinean amphibians. It has been recorded in 14 species of the families Bufonidae, Hylidae, Leptodactylidae, and Odontophrynidae (see González and Hamann, 2012a; Hamann et al., 2012, 2013). Specimens were identified on the basis of the following characteristics: by the total length of male (1.41 mm) and females (3.9 ± 0.73 mm), by the fact that the tail of females is slender and tapering gradually to a spikelike posterior portion, by its number of plectanes (6 pairs) and adcloacal papillae (3+1), and mainly by the length of its spicules and gubernaculum (75.0 and 80.0 μm, respectively). These features are consistent with those provided by Baker and Vaucher (1984) and González and Hamann (2012a) for *C. parva* collected in other leptodactylid, bufonid, and hylid hosts. This species shows broad variation in the number of pairs of plectane and rosette papillae in the males from different hosts, as well as in the number of punctuations forming the inner and outer circles of the rosette papillae (González et al., 2012). Cosmocercid nematodes have a direct life cycle and infection occurs by skin penetration of infective larvae (Anderson, 2000). This report adds a new leptodactylid species to the known hosts of this nematode.

Cosmocerca podicipinus Baker et Vaucher, 1984

Hosts: Leptodactylus elenae, *L. podicipinus*.

Prevalence and mean intensity: L. elenae: 1 of 6 (17%); total number of parasites 11 (10 females, 1 male); *L. podicipinus*: 3 of 7 (43%); 7.66 ± 5.5; total number of parasites 23 (20 females, 3 males).

Site of infection: Large intestine.

Additional hosts from Argentina: Dendropsophus nanus (Boulenger, 1889) (see González and Hamann, 2011), *Leptodactylus bufonius* (see González and Hamann, 2006a; Hamann et al., 2012), *Leptodactylus chaquensis* (see Hamann, Kehr, and González, 2006; Schaefer et al., 2006), *Leptodactylus latinasus* (see Hamann, González, and Kehr, 2006), *Odontophrynus americanus* (see González and Hamann, 2009a), *Physalaemus albonotatus* (see González and Hamann, 2012a), *Physalaemus santafecinus* (see González and Hamann, 2010a), *Pseudopaludicola boliviana* (see González and Hamann, 2012b), *Pseudopaludicola falcipes* (see González and Hamann, 2004; 2009b), *Rhinella bergi* (see González and Hamann, 2007b), *Rhinella fernandezae* (see González and Hamann, 2007a; Hamann et al., 2013), *Rhinella major* (see González and Hamann, 2006b), *Rhinella schneideri* (see González and Hamann, 2008), *Scinax nasicus* (see Hamann et al., 2010).

Type host and type locality: Leptodactylus podicipinus, Capitan Bado, Amambay Province, Paraguay (Baker and Vaucher, 1984).

Other reported hosts and geographic range in South America: See the recent review by Campião et al. (2014).

Specimens deposited: CECOAL 03013336 (10 females, 1 male).

Remarks: Like the previous species, this cosmocercid has also been reported in 14 species of Argentinean amphibians: 4 bufonids, 1 odontophrynid, 7 leptodactylids, and 2 hylids (see González and Hamann, 2012a; Hamann et al., 2012, 2013). This species is frequently distinguished from other species by possessing 5 pairs of plectanes in 2 longitudinal rows that are fused together by distinct sclerotized supports. Other distinctive characters are 3 pairs of markedly elevated adcloacal papillae in males and a markedly thickened proximal half of the female tail (Baker and Vaucher, 1984). In this study, all specimens were found in the intestine of the host; however, some studies have also found adult males in the host's lungs (González and Hamann, 2009b, 2012b). We add 2 leptodactylid species to the list of hosts infected by this cosmocercid.

Aplectana delirae **(Fabio, 1971) Baker, 1980**

Host: Leptodactylus elenae.

Prevalence and mean intensity: Two of 6 (33%); 5; total number of parasites 10 (4 females, 6 males).

Site of infection: Large intestine.

Additional hosts from Argentina: Leptodactylus chaquensis (see Schaefer et al., 2006), *Rhinella major* (see González and Hamann, 2006b).

Type host and type locality: Rhinella ornata (Spix, 1824) (= *Bufo crucifer*), Rio de Janeiro, Brazil (Fabio, 1971).

Other reported hosts and geographic range in South America: See the recent review of Campião et al. (2014).

Specimens deposited: CECOAL 02123269 (3 females, 2 males).

Remarks: This species belongs to the group of previously identified *Aplectana* spp., which are characterized by lacking a gubernaculum. These are *Aplectana akhrami* (Islam, Farooq et Khanum, 1979) Baker, 1987, *Aplectana artigasi* Puga et Torres, 1997, *Aplectana chilensis* Lent et Freitas, 1948, *Aplectana crossodactyli* Baker, 1980, *Aplectana crucifer* Travassos, 1925, *Aplectana meridionalis* Lent et Freitas, 1948, *Aplectana papillifera* (Araujo, 1977) Baker, 1980, *Aplectana praeputialis* (Skrjabin, 1916) Travassos, 1931, *Aplectana tarija* Ramallo, Bursey and Goldberg, 2007, and *Aplectana vercammeni* Le Van Hoa, 1962 (see Bursey et al., 2011). These specimens were identified on the basis of the following characteristics: the length and shape of their spicules (152.5 ± 10.6 µm and weakly developed and by the presence of a capitulum that gradually tapers from wide to blunt at the distal end), by having a large unpaired adcloacal papillae in the anterior lip of cloaca, and by possessing 5 pairs of postcloacal papillae (Fabio, 1971). This cosmocercid has a direct life cycle, and infection occurs by ingestion of eggs (Anderson, 2000). This is the first report of *A. delirae* in *L. elenae*.

Previous reports of parasitic nematodes of *L. elenae* include the following species from Paraguay: *Aplectana elenae* Baker et Vaucher, 1986, *Aplectana hylambatis* (Baylis, 1927) Travassos, 1931, *Aplectana paraelenae* Baker et Vaucher, 1986, and *Cosmocerca parva*, *Cosmocerca podicipinus*, and *Oxyascaris oxyascaris* Travassos, 1920 (Campião et al., 2014). Campião et al. (2014) in their revision did not report the species described by Baker and Vaucher (1988),

Schrankiana formosula, and consequently the total number of nematode species recorded for this host in Paraguay was seven. For *L. podicipinus*, the species *Cosmocerca podicipinus* and *Cosmocerca ornata* (Dujardin, 1845) Diesing, 1861, have been reported from Paraguay and *Cosmocerca brasiliense* Travassos, 1925, from Guyana. From Brazil *Aplectana* sp. and *Aplectana travassosi* (Gomes et Motta, 1967) Baker, 1980, have been reported, as have *Cosmocerca parva*, *Cosmocerca podicipinus*, Cosmocercidae gen. sp., *Oswaldocruzia lopesi* Freitas et Lent, 1938, *Physalopteroides venancioi* (Lent, Freitas et Proença, 1946) Sobolev, 1949, and *Rhabdias* sp. (see Campião et al., 2014).

The aforementioned studies and the present study show a high number of species of cosmocercid nematodes in *L. elenae* (6 of 7 species in anurans from Paraguay are cosmocercids; 2 of 2 in this study) and in *L. podicipinus* (2 of 2 in Paraguay; 1 of 1 in Guyana; 5 of 8 in Brazil; 2 of 3 in this study). Leptodactylid frogs are common hosts of nematode species that have a direct life cycle (see Hamann, González, and Kehr, 2006; Hamann, Kehr, and González, 2006, 2012), and this occurs because these anurans stay in contact for long periods with the terrestrial environment, thus allowing contact with the infective stages of different nematode species (e.g., *Rhabdias* sp. and *Cosmocerca* spp.)

Fewer species of nematode parasites were found in this study compared to records published for other countries (e.g., *L. elenae*: 2 species in this study vs. 7 species in Paraguayan hosts; and for *L. podicipinus*: 3 species in this study vs. 8 species in Brazilian hosts; Campião et al., 2014). It is likely that future research in additional localities and including larger sample sizes of host specimens will contribute to expansion the list of nematode parasites in Argentinean leptodactylid hosts. This study contributes to the knowledge of the nematode parasites of amphibians from Corrientes Province, and it is the tenth report for the family Leptodactylidae from this province.

LITERATURE CITED

Anderson, R. C. 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, 2nd ed. CABI Publishing, Wallingford, Oxford, U.K. 650 pp.

Baker, M. R., and C. Vaucher. 1984. Parasitic helminths from Paraguay VI: *Cosmocerca* Diesing, 1861 (Nematoda: Cosmocercoidea) from frogs. Revue Suisse de Zoologie 91:925–934.

Baker, M. R., and C. Vaucher. 1988. Parasitic helminths from Paraguay XV: Atractidae (Nematoda: Cosmocercoidea) from frogs. Revue Suisse de Zoologie 95: 421–431.

Bursey, C. R., S. R. Goldberg, and F. Kraus. 2011. New species of *Aplectana* (Nematoda: Cosmocercidae) in *Sphenomorphus pratti* from Papua New Guinea. Journal of Parasitology 97:654–660.

Bush, A. J., K. D. Lafferty, J. M. Lotz, and A. W. Shostak. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. Journal of Parasitology 83:575–583.

Campião, K. M., D. H. Morais, O. Tavares Dias, A. Aguiar, G. M. Toledo, L. E. Roland Tavares, and R. Da Silva. 2014. Checklist of helminth parasites of amphibians from South America. Zootaxa 3843:1–93.

Fabio, S. P. 1971. Sobre uma espécie do gênero *Neyraplectana* Ballesteros Márquez, 1945 (Nematoda, Cosmocercoidea). Atas Sociedade de Biologia do Rio de Janeiro 15:11–13.

Frost, D. R. 2014. Amphibian Species of the World: An Online Reference. Version 6.0 [Internet]. American Museum of Natural History, New York. Electronic database accessible at http://research.amnh.org/herpetology/amphibia/index.html. Accessed 2014 Sep.

González, C. E., and M. I. Hamann. 2004. Primer registro de *Cosmocerca podicipinus* Baker y Vaucher, 1984 (Nematoda, Cosmocercidae) en *Pseudopaludicola falcipes* (Hensel, 1867) (Amphibia, Leptodactylidae) en Argentina. FACENA 20:65–72.

González, C. E., and M. I. Hamann. 2006a. Helmintos parásitos de *Leptodactylus bufonius* Boulenger, 1894 (Anura: Leptodactylidae) de Corrientes, Argentina. Revista Española de Herpetología 20:39–46.

González, C. E., and M. I. Hamann. 2006b. Nematodes parásitos de *Chaunus granulosus major* (Müller y Hellmich, 1936) (Anura: Bufonidae) en Corrientes, Argentina. Cuadernos de Herpetología 20:43–49.

González, C. E., and M. I. Hamann. 2007a. Nematode parasites of two species of *Chaunus* (Anura: Bufonidae) from Corrientes, Argentina. Zootaxa 1393:27–34.

González, C. E., and M. I. Hamann. 2007b. *Chaunus bergi* (NCN). Endoparasites. Herpetological Review 38:181.

González, C. E., and M. I. Hamann. 2008. Nematode parasites of two anurans species, *Rhinella schneideri* (Bufonidae) and *Scinax acuminatus* (Hylidae), from Corrientes, Argentina. Revista de Biología Tropical 56: 2147–2161.

González, C. E., and M. I. Hamann. 2009a. Seasonal occurrence of *Cosmocerca podicipinus* (Nematoda: Cosmocercidae) in *Pseudopaludicola falcipes* (Anura: Leiuperidae) from the agricultural area in Corrientes, Argentina. Revista Ibero-Latinoamericana de Parasitología 68:173–179.

González, C. E., and M. I. Hamann. 2009b. First report of nematodes in the common lesser escuerzo *Odontophrynus americanus* (Duméril and Bibron, 1841) (Amphibia: Cycloramphidae) from Corrientes, Argentina. Comparative Parasitology 76:122–126.

González, C. E., and M. I. Hamann. 2010a. First report of nematode parasites of *Physalaemus santafecinus* (Anura: Leiuperidae) from Corrientes, Argentina. Revista Mexicana de Biodiversidad 81:677–687.

González, C. E., and M. I. Hamann. 2010b. Larval nematodes found in amphibians from northeastern Argentina. Brazilian Journal of Biology 70:1089–1092.

González, C. E., and M. I. Hamann. 2011. Cosmocercid nematodes of three species of frogs (Anura: Hylidae) from Corrientes, Argentina. Comparative Parasitology 78:212–216.

González, C. E., and M. I. Hamann. 2012a. First report of nematode parasites of *Physalaemus albonotatus* (Steindachner, 1864) (Anura: Leiuperidae) from Corrientes, Argentina. Neotropical Helminthology 6:9–23.

González, C. E., and M. I. Hamann. 2012b. Seasonal occurrence of *Cosmocerca podicipinus* (Nematoda: Cosmocercidae) in *Pseudopaludicola boliviana* (Anura: Leiuperidae) from natural environments in Corrientes, Argentina, and aspects of its population structure. Parasitology Research 111:1923–1928.

González, C. E., and M. I. Hamann. 2013. First record of larvae of *Brevimulticaecum* sp. (Nematoda: Heterocheilidae) in amphibians from Northern Argentina. Brazilian Journal of Biology 73:451–452.

González, C. E., M. I. Hamann, and C. Salgado. 2012. Study of helminth parasites of amphibians by Scanning Electron Microscopy. Pages 267–294 *in* V. Kazmiruk, ed. The Scanning Electron Microscope. InTech Open Access Publisher, Rijeka, Croatia.

Gutiérrez, C., A. Attademo, S. Guerrero, P. Peltzer, and R. Lajmanovich. 2005. *Physalaemus biligonigerus* (Falseeyed Frog). Endoparasites. Herpetological Review 36:161–162.

Gutiérrez, R. O. 1945. Contribución al conocimiento de los nematodes, parásitos de anfibios argentinos. Ph.D. thesis. Universidad Nacional de La Plata. 37 pp.

Hamann, M. I., C. E. González, and A. I. Kehr. 2006. Helminth community structure of the oven frog *Leptodactylus latinasus* (Anura, Leptodactylidae) from Corrientes, Argentina. Acta Parasitologica 51:294–299.

Hamann, M. I., A. I. Kehr, and C. E. González. 2006. Species affinity and infracommunity ordination of helminths of *Leptodactylus chaquensis* (Anura: Leptodactylidae) in two contrasting environments from northeastern Argentina. Journal of Parasitology 92: 1171–1179.

Hamann, M. I., A. I. Kehr, and C. E. González. 2010. Helminth community structure of *Scinax nasicus* (Anura: Hylidae) from a South American subtropical area. Diseases of Aquatic Organisms 93:71–82.

Hamann, M. I., A. I. Kehr, and C. E. González. 2012. Community structure of helminth parasites of *Leptodactylus bufonius* (Anura: Leptodactylidae) from northeastern Argentina. Zoological Studies 51: 1454–1463.

Hamann, M. I., A. I. Kehr, and C. E. González. 2013. Helminth communities in the burrowing toad, *Rhinella fernandezae*, from northeastern Argentina. Biologia 68: 1155–1162.

Hamann, M. I., A. I. Kehr, C. E. González, M. I. Duré, and E. F. Schaefer. 2009. Parasite and reproductive features of *Scinax nasicus* (Anura: Hylidae) from a South American subtropical area. Interciencia 34: 214–218.

Mordeglia, C., and M. C. Digiani. 1998. *Cosmocerca parva* Travassos, 1925 (Nematoda: Cosmocercidae) in toads from Argentina. Memórias do Instituto Oswaldo Cruz 93:737–738.

Schaefer, E. F., M. I. Hamann, A. I. Kehr, C. E. González, and M. I. Duré. 2006. Trophic, reproductive and parasitological aspects of the ecology of *Leptodactylus chaquensis* (Anura: Leptodactylidae) in Argentina. Herpetological Journal 16:387–394.

Schuurmans Stekhoven, J. H. 1952. Nemátodos parasitarios de anfibios, pájaros y mamíferos de la República Argentina. Acta Zoológica Lilloana 10: 315–400.

Travassos, L. 1925. Contribução ao conhecimento da fauna helmintológica dos batráchios do Brasil. Nematódeos intestinais. Sciencia Medica 3:673–687.

Vaira, M., M. Akmentis, M. Attademo, D. Baldo, D. Barrasso, S. Barrionuevo, N. Basoo, B. Blotto, S. Cairo, R. Cajade, J. Céspedez, V. Corbalán, P. Chilote, M. Duré, C. Falcione, D. Ferraro, R. Gutiérrez, M. Ingaramo, C. Junges, R. Lajmanovich, J. Lescano, F. Marangoni, L. Martinazzo, R. Marti, L. Moreno, G. Natale, J. Pérez Iglesias, P. Peltzer, L. Quiroga, S. Rosset, E. Sanabria, L. Sánchez, E. Schaefer, C. Úbeda, and V. Zaracho. 2012. Categorización del estado de conservación de los anfibios de la República Argentina. Cuadernos de Herpetología 26:131–159.