A new species of *Cosmocercoides* (Nematoda; Cosmocercidae) and other helminths in *Leptodactylus latrans* (Anura; Leptodactylidae) from Argentina

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Abstract: *Cosmocercoides latrans* n. sp. (Cosmocercidae) from the small intestine of *Leptodactylus latrans* (Anura: Leptodactylidae) from Northeastern Province of Buenos Aires, Argentina is described. The new species can be distinguished from their congeners by a combination of the characters, among which stands out the number of rosette papillae, the lack of gubernaculum and the presence of lateral alae in both sexes. There are over 20 species in the genus *Cosmocercoides*, and *Cosmocercoides latrans* n. sp. represents the third species from the Neotropical realm and the second for Argentina. Additionally, seven previously known taxa are reported; *Pseudoacanthocephalus* *cf.* *lutzi*, *Catadiscus uruguayensis*, *Rauschiella palmipedis*, *Aplectana hylambatis*, *Cosmocerca parva*, *Schrankiana* sp. and *Rhabdias elegans*; providing literature records and information on distribution and host-parasite relationships.

Key words: helminths, *Leptodactylus latrans*, *Cosmocercoides latrans* n. sp., anura, Argentina.

INTRODUCTION

Previous reports of endoparasites in *Leptodactylus latrans* (Steffen, 1815) have been summarized in checklists from South America (Campião et al. 2014, Fernandes & Kohn 2014) and Argentina (González & Hamann 2015). These reports, mainly as isolated records of a taxonomic nature, include several species of acanthocephalans, digeneans, cestodes and nematodes parasitizing this large frog species. The criolla frog, as it is commonly known, inhabits flooded fields and temporary or permanent shallow ponds and is also common to find in periurban places and crops. It is widely distributed in South America, being present in Trinidad and Tobago, Colombia, southern Venezuela, the savanna areas of Guyana, Brazil, northeastern Bolivia, eastern Paraguay, Argentina, and Uruguay (Heyer et al. 2010). Being an opportunistic feeder, its diet is generalist and determined by the availability of prey in the environment (Duellman & Trueb 1994).

Among nematodes, is frequent to find specimens belonging to *Cosmocercoides*. Members of this family are parasites of the digestive tract of amphibians and reptiles. It includes the Subfamily Cosmocercinae Railliet, 1916 that contains 9 genera: *Cosmocerca* Diesing, 1861, *Aplectana* Railliet & Henry, 1916, *Oxysomatium* Railliet & Henry, 1916, *Cosmocercella* Steiner, 1924, *Raillietnema* Travassos, 1927, *Oxyascaris* Travassos, 1920, *Cosmocercoides* Wilkie, 1930 *Paradollfusnema*
Baker, 1982 and Neocosmocercella Baker & Vaucher, 1983 (Bursey et al. 2011).

The genus Cosmocercoides includes species that commonly parasitize amphibians and reptiles, but also occasionally occur in land snails and slugs (Chen et al. 2018). The aims of the present work are (1) to describe a new species of Cosmocercoides and (2) to increase the knowledge of the diversity of helminths parasites of the Criolla frog, L. latrans.

MATERIALS AND METHODS

Fourty-eight L. latrans (15 females, 23 males, 10 sexually undifferentiated) were captured by active search at night using the visual encounter survey technique (REV) (Crump & Scott 1994) between 2011 and 2012 in the surroundings of La Plata city, Buenos Aires Province, Argentina with authorization of the Dirección de Flora y Fauna, M.A.A.BA (Exp n° 225500-11319/10). The frogs were transported alive to the laboratory, then euthanized with an overdose of 20% benzocaine, and all organs were examined using a Stemi 2000-C Zeiss stereoscope.

Helminths were fixed in 5% formalin and preserved in 70% ethyl alcohol. Trematodes were stained with a 1:6 dilution in 96% ethanol of hydrochloric carmine, dehydrated, cleared in xilol and mounted in Canada balsam. Acanthocephalans and nematodes were cleared in Aman’s lactophenol and examined as temporary mounts. The systematic determination of the helminths was carried out following specific keys (Yamaguti 1961, 1963, Petrochenko 1971a, b, Anderson et al. 1974, Gibson et al. 2002, Jones et al. 2005, Bray et al. 2008) and drawings were made with the aid of a drawing tube. Measurements are given in micrometres (μm) unless otherwise stated, as the mean followed by the standard deviation, and the range in parentheses. The values of prevalence, mean intensity and intensity of infection were calculated following the criteria given by Bush et al. (1997).

For scanning electron microscopy (SEM), helminths were dehydrated in a series of alcohols (70 °, 80 °, 90 °, 95 ° and 100 °), dried by the critical point method (Baltec CP-30), metallized with a gold-palladium bath (Metallizer: JEOL Finecoat ion sputter JFC1100) and then photographed with an Electronic Scanner Microscope Jeol® JSV 6063 LV from the La Plata Museum. Helminths were deposited in the Helminthological Collection of the Museo de La Plata (MLP-He).

RESULTS

Of the 48 frogs examined, 34 (71 %) were infected with at least one parasite. Eight helminth taxa (one acanthocephalan, two digeneans and five nematodes) were found.

Cosmocercidae (Raillet, 1916) Travassos, 1925

Cosmocercoides latrans n. sp. (Figs. 1-2)
Type host: Leptodactylus latrans (Steffen, 1815), Criolla Frog (Leptodactylidae).
Site of infection: small intestine.
Type locality: Establecimiento Santa Ana (35°02’23, 2°S; 57°48’58, 2°W), Buenos Aires, Argentina.

Type material: Holotype MLP-He 7626; Allotype MLP-He 7627; Paratypes, MLP-He 7628, 7629.
Voucher specimens: MLP-He 76230.
Prevalence, mean intensity and intensity of infection: 4% (2 of 48), 79.5 ± 35.7 (29-130), 159.
Etymology: The specific name refers to the specific name of the host where the specimens were found.
**Figure 1.** Scanning electron micrographs of *Cosmocercoides latrans* n. sp. a- Male anterior end. b- Male posterior end, ventrolateral view. c- Detail of the rosette papilla. Abbreviations: *= cephalic papilla; a= amphid; la= lateral alae; sp= somatic papilla; p= postcloacal papillae; rp= rosette papilla.

**Figure 2.** *Cosmocercoides latrans* n. sp. a- Female, general view. b- Female anterior end, lateral view. c- Male posterior end, lateral view. d- Male, in face view. e- Male, posterior end, ventral view. Abbreviations: ap= adcloacal papilla; b= bulb; dl= dorsal lip; e= esophagus; ep= excretory pore; la= lateral alae; le= larvated egg; nr= nerve ring; p= pharynx; me= morulated egg; pcp= postcloacal caudal papillae; rp= rosette papilla; s= spicule; t= tail; up= unpaired papilla; v= vulva; vl= ventral lip. Scale bars: A= 600 μm; B= 241.5 μm; C =100 μm; D= 40 μm; E= 500 μm.
Description

General morphology: Small, stout nematodes. Sexual dimorphism evident, males half-length of females. Lateral alae present in both males and females, extending from the anterior esophageal region to the tail. Cuticle transversely striated, somatic papillae present. Mouth with three prominent lips, dorsal lip with two sessile papillae, each ventrolateral lip with one ventral sessile papilla and one lateral amphid. Shallow mouth cavity, short pharynx, cylindrical corpus, short isthmus and valved bulb present. Excretory pore anterior to esophageal bulb.

Male (holotype and 14 paratypes, 6 specimens studied by SEM): Length 2.17 ± 0.37 (1.48-2.68 mm); width at midbody 0.26± 0.06 (0.19-0.37mm). Esophagus: pharynx 34.71 ± 3.82 (28.56-45.22) by 23.23 ± 6 (16.6-43), corpus 284.24 ± 26.6 (250-338), isthmus 43.6 ± 6.9 (35.7-59.5), bulb length 74.37 ± 6.17 (59.5-83.3), bulb width 81.78 ± 9.12 (66.64-102.34). Nerve ring 148.38 ± 17.87 (119-192.78) and excretory pore 290.35 ± 40.72 (230.86-347.76) from anterior end. Tail 284.93 ± 46.23 (178.5-364.14) long, tapering to sharp point. Spicules robust, equal (95.2-154.7) long. Gubernaculum absent. Caudal papillae in the following arrangement: 3-4 pairs of precloacal rosette papillae, ventral and arranged in two rows; 1 pair of simple adcloacal papillae and 1 unpaired papilla on the anterior border of the cloaca, 2 pairs of simple and ventral postcloacal papillae in the middle region of the tail and 2 pairs defining a long and acute tip-tale, ventrolateral in position (6-8:3:8). Each rosette papillae presented one circle of punctuations around the central papillae.

Female (allotype and 19 paratypes): Length 3.76 ± 0.5 (2.63-4.59 mm); width at vulva 0.35 ± 0.05 (0.24-0.45 mm). Esophagus: pharynx 37.24 ± 3.11 (33.32-47.6) by 31.78 ± 5.89 (19.04-45.22), corpus 319.34 ± 27.08 (252.59-362.25), isthmus 44.8 ± 4.4 (35.7-50), bulb length 98.65 ± 11.67 (76.16-131), bulb width 106.5 ± 15.36 (78.54-142.8). Nerve ring 150.13 ± 32.65 (95.2-265.65) and excretory pore 331.13 ± 45.54 (217.35-406.14) from anterior end. Vulva 2 ± 0.35 (1.4-2.75 mm from anterior end; 50% of body length from anterior end). Tail long and sharp 408.4 ± 61.26 (252.28-483) in length. Eggs, oval, thin-shelled and in different stages of development; eggs near vulva containing fully developed larvae 84.67 ± 6.66 (73.78-98.5) long and 48.67 ± 8.14 (33.08-73.78) wide.

Aplectana hylambatis (Baylis, 1927) Travassos, 1931 (Fig. 3a, b, c)

Site of infection: Small and large intestine.
Prevalence, mean intensity and intensity of infection: 4.2% (2 of 48), 7.5 ± 4.6 (1-14), 23.
Voucher specimens: MLP-He 7631.

Other reported hosts and geographic range in South America: Aplectana hylambatis is a generalist species that parasitizes a wide range of amphibian hosts. In the Neotropical region, has been observed in different countries (Peru, Paraguay, Uruguay, Brazil) and anuran families, for example, Bufonidae, Ceratophrydae, Hylidae, Leptodactylidae, Leuperidae and Microhylidae (González et al. 2013, Campião et al. 2014, 2016, Aguiar et al. 2015). In Argentina, it is the species of parasitic nematodes of amphibians with the greatest geographical distribution and was found parasitizing Bufonidae, Leptodactylidae and Hylidae from Buenos Aires, Córdoba, Corrientes, Formosa, Salta and San Juan Provinces (González et al. 2013, González & Hamann 2015, Draghi et al. 2015). In Argentina, it is the species of parasitic nematodes of amphibians with the greatest geographical distribution and was found parasitizing Bufonidae, Leptodactylidae and Hylidae from Buenos Aires, Córdoba, Corrientes, Formosa, Salta and San Juan Provinces (González et al. 2013, González & Hamann 2015, Draghi et al. 2015).

Remarks: For the specific identification we consider the review of the genus Aplectana carried out by Baker (1980) and the subsequent synonyms and descriptions performed by Baker & Vaucher (1986), González et al. (2013) and Piñeiro Gomez et al. (2017).
The arrangement of the caudal papillae in males (6:8; 4+1: 8) as well as the characteristic morphology of the spicules with a distal portion, the size of the spicules and gubernaculum (221.3 and 71.4, respectively) and the postecuatorial vulva with festooned edges allowed the identification. The finding of A. hylambatis parasitizing L. latrans represents a new host record for Argentine amphibians.

Cosmocerca parva Travassos, 1925 (Fig. 3d, e, f)

Site of infection: Small and large intestine.
Prevalence and intensity of infection: 2% (1 of 48), 23.
Voucher specimens: MLP-He 7632.
Other reported hosts and geographic range in South America: Cosmocerca parva was originally described parasitizing Hylodes nasus (Lichtenstein, 1823) (Anura, Hylodidae) (cited as Elosia nasus) from Angra dos Reis, Rio de Janeiro, Brazil. Since its original description, it has been found parasitizing several amphibian species from Argentina, Brazil, Colombia, Guyana, Paraguay, and Peru (see Campião et al. 2014). In our country, has been found parasitizing 14 amphibian species included in Bufonidae, Odontophrynidae, Hylidae and Leptodactylidae, constituting one of the most common nematode species found parasitizing amphibians (González & Hamann 2015). All reports were made in the Province of Corrientes (Mordeglia & Digiani 1998, González & Hamann 2006, 2009, 2011, 2016, Hamann et al. 2006b, 2010, Schaefer et al. 2006).

Remarks: The presence of the lateral alae, the arrangement of the plectanes and papillae (5-6 pairs of precloacal papillae, 2-4 pairs of adcloacal plus 1 unpaired papilla on the anterior lip of the cloaca and 5 pairs of post-cloacal) and the size of the spicules and gubernaculum (104 and 63, respectively) allowed the allocation of our
specimens to the species *C. parva*. The rest of the morphometric characters are also consistent with those established for the species in other hosts (see Baker & Vaucher 1984, Vicente et al. 1991, Mordeglia & Digiani 1998, González & Hamann 2006, 2007), with some differences that are considered as intraspecific variations. For example, the variability in the number of plectanes (5-7) and cloacal papillae and the absence of the unpaired papilla anterior to the rows of plectanes reported by Mordeglia & Digiani (1998).

This is the first record of this species from Buenos Aires Province, and constitutes the first time this species is found parasitizing *L. latrans* in Argentina, given that it was previously reported parasitizing this host species in Brazil (Santos & Amato 2013).

**Atractidae (Railliet, 1917) Travassos, 1919**

*Schrankiana* sp. (Fig. 4a, b, c)

*Site of infection*: Small and large intestine.

*Prevalence and intensity of infection*: 2 % (1 of 48), 25.

*Voucher specimens*: MLP-He 7633.

**Other hosts and geographic range in South America**: Members of the genus *Schrankiana* have been reported parasitizing almost exclusively South American leptodactylids. At present eight species are known, two of them in Argentina: S. schranki found parasitizing *Leptodactylus latinasus* Jimenez de la Espada, 1875, and S. chacoensis described from *Leptodactylus bufonius* Boulenger, 1894 (Hamann et al. 2006b, González & Hamann 2014).

**Remarks**: The specimens here studied were located in the genus *Schrankiana* owing to the monodelphic condition of the females, and the shape of spicules in the male (short and robust). Also, the esophagus is of cosmocercid type, with an entirely muscular corpus, a marked isthmus and a bulb with chitinous valves. Species of the genus *Schrankiana* are very similar, and can only be distinguished by metric characters such as the esophagus total length, the size of the vagina, cephalic morphological characters, lateral wing extension, vulva location, and male caudal characteristics (papillae and spicules) (Baker & Vaucher 1988).

More studies are needed to properly describe the cephalic morphology and the pattern of caudal papillae of males of the specimens here found. The present record is the first one of this genus parasitizing amphibians in Buenos Aires Province, Argentina.

**Rhabdiasidae Railliet, 1915**

*Rhabdias elegans* Gutiérrez, 1945 (Fig. 5d)

*Site of infection*: Lungs.

*Prevalence, mean intensity and intensity of infection*: 10.4 % (5 of 48), 1.4 ± 0.18 (1-3), 7.

*Voucher specimens*: MLP-He 7634.

**Other hosts and geographic range in South America**: *Rhabdias elegans* was originally described by Gutiérrez (1945) from specimens collected from the lungs of *R. arenarum* from Buenos Aires Province, Argentina. It has subsequently been found in several amphibian hosts of the Neotropical realm (for a list of host species for *Rhabdias* spp. see Draghi et al. 2015). In Argentina, it has been also found parasitizing *R. arenarum* from Salta (Sueldo & Ramírez 1976), *Rhinella major* (Müller & Hellmich 1936) from Chaco and Formosa Provinces (Hamann & González 2015) and *Rhinella diptycha* (Cope, 1862), *L. bufonius* and *Odontophrynus americanus* (Duménil & Bibron, 1841) from Corrientes Province (González & Hamann 2006, 2008, 2009, Hamann et al. 2012).

**Remarks**: Three species of *Rhabdias* from the Neotropical region lack lip structures: *R. elegans*, *Rhabdias alabialis* Kuzmin, Tkach &
Brooks, 2007 and *Rhabdias paraensis* Santos, Melo, Nascimento, Nascimento, Giese & Furtado, 2011. They are easily distinguished since *R. alabialis* presents a prominent dilatation in the middle portion of the muscular esophagus, a triangular buccal capsule in apical view and the vulva in equatorial position (Kuzmin et al. 2007), and *R. paraensis* presents conspicuous papillae in the cephalic region (Santos et al. 2011). The specimens here studied agree morphologically and morphometrically with those of *R. elegans* reported parasitizing Argentine amphibians because of the body length 3 (2.4-4) mm, absence of labial structures, cylindrical esophagus 440 (386-512), slightly post-equatorial position of the vulva and egg size (90-102 x 47-48).

The finding of *R. elegans* parasitizing *L. latrans* represents a new host record for this nematode species.

**Echinorhynchidae Cobbold, 1876**

*Pseudoacanthocephalus* cf. *lutzi* (Hamann, 1891) Arredondo & Gil de Pertierra, 2009 (Fig 4d, e, f)

**Site of infection:** Small and large intestine.

**Prevalence, mean intensity and intensity of infection:** 10.4 % (5 of 48), 4.2 ± 0.93 (1-12), 21

**Voucher specimens:** MLP-He 7635.
Other reported hosts and geographic range in South America: In South America *P. lutzi* has been recorded on numerous occasions parasitizing amphibians and reptiles from Uruguay (Cordero 1933), Peru (Tantaleán 1976, Tantaleán et al. 2005, Chero et al. 2016), Brazil and Paraguay (Smales 2007, Santos & Amato 2010). In Argentina, it was found parasitizing *R. arenarum* in Buenos Aires and Entre Ríos Provinces (Lajmanovich & Martínez de Ferrato 1995, Arredondo & Gil de Pertierra 2009), and *Physalaemus biligonigerus* (Cope, 1861) from Córdoba Province (Gutiérrez et al. 2005).

Remarks: Although the totality of the specimens recovered from *L. latrans* were females, characteristics such as the cylindrical trunk without spines, widened in the anterior region and rounded at its posterior end (6 x 1.05 mm); the cylindrical proboscis, with 16 longitudinal and alternating rows of 5-6 hooks each, progressively increasing in size towards the base; the cylindrical proboscis receptacle, with a double wall and cerebral ganglia near its base; digitiform to claviform lemnisci, not much longer than the receptacle; genital apparatus occupying an average of 9.9% of the total length of the trunk and composed of an uterine bell, uterus and vagina; ovoid eggs without polar extensions and the ventral and subterminal genital pore, allowed the identification.

The finding of *P. cf. lutzi* is the first record of this genus parasitizing *L. latrans.*

**Figure 5.** *Rauschiella palmipedis* a- ventral view. b- Detail of the cirrus sac. c- *Catadiscus uruguayensis*, ventral view. d- *Rhabdias elegans*, general view. Abbreviations: *a* = acetabulum; *c* = ceca; *cs* = cirrus sac; *e* = egg; *es* = esophagus; *m* = metraterm; *o* = ovary; *oo* = oral opening; *os* = oral sucker; *p* = pharynx; *pa* = pharynx appendages; *sv* = seminal vesicle; *t* = testis; *v* = vulva; *vf* = vitelline follicles. Scale bars: A=500 µm; B= 50 µm; C= 500 µm; D=50 µm.
Diplodiscidae Cohn, 1904

Catadiscus uruguayensis Freitas & Lent, 1939 (Fig. 5c)

**Site of infection:** Small and large intestine.

**Prevalence, mean intensity and intensity of infection:** 18.8 % (9 of 48), 4.78 ± 0.43 (1-13), 43.

**Voucher specimens:** MLP-He 7636.

**Other hosts and geographic range in South America:** *C. uruguayensis* was previously reported parasitizing amphibians from Uruguay (*L. latrans*) and Brazil (*L. latrans, Lysapsus limellum* Cope, 1862) (Freitas & Lent 1939, Freitas 1960 Travassos & Freitas 1964). In Argentina, was found parasitizing five host species: *Boana pulchella* (Duméril & Bibron, 1841) (cited as *Hypsiboas pulchellus*), *L. latrans* (cited as *Leptodactylus ocellatus*), *Pseudis minuta* Günther, 1858 (cited as *Lysapsus mantidactylus*) and *Erythrolamprus poecilogyrus* Wied-Neuwied, 1825 (Squamata, Colubridae) from different locations in the Buenos Aires Province; and *Phyllocephus azureus* (Cope, 1862) (cited as *Phyllocephus azureus*) from the Province of Chaco (Suriano 1970, Ostrowski de Núñez 1978, Lunaschi & Drago 2002, 2010).

**Remarks:** The specimens found in the present study respond, morphologically and morphometrically, to the descriptions of *C. uruguayensis* from *L. latrans* in Uruguay (Freitas & Lent 1939) and *L. latrans, B. pulchella* and *P. minuta* from Buenos Aires, Argentina (Suriano 1970, Ostrowski de Núñez 1978).

Macroderoididae McMullen, 1937

Rauschiella palmipedis (Lutz, 1928) Sullivan, 1977 (Fig. 5a, b)

**Site of infection:** Large and small intestine.

**Prevalence, mean intensity and intensity of infection:** 35.4% (17 of 48), 2.88 ± 0.15 (1-10), 45.

**Voucher specimens:** MLP-He 7637.

**Other hosts and geographic range in South America:** *Rauschiella palmipedis* has been found parasitizing amphibians belonging to Bufonidae, Leptodactylidae, Hylidae and Ranidae from Brazil, Costa Rica, Venezuela, Paraguay, Uruguay and Argentina (Sullivan 1977, Fernandes & Kohn 2014). In Argentina it was found parasitizing *L. latrans* from Buenos Aires Province (Savazzini 1930, Suriano 1970), *Leptodactylus chaquensis* Cel, 1950 and *Rhinella fernandezae* (Gallardo, 1957) from Corrientes Province (Hamann et al. 2006a, 2013, Schaefer et al. 2006) and *Melanophryniscus klappenbachi* Prigioni & Langone, 2000 from Chaco Province (Hamann et al. 2014).

The specimens found in the present study agree morphologically and morphometrically with the descriptions of *R. palmipedis* made by Savazzini (1930) and Sullivan (1977) in *L. latrans*, and reports in other hosts (such as Suriano 1970).

**DISCUSSION**

The genus *Cosmocercoides* can be distinguished from other genera of Cosmocercinae by the morphology of the male’s caudal papillae, described as rosette papillae without plectanas. In contrast, in the genus *Cosmocerca* the rosette papillae arise prominently of the cuticular surface, and are accompanied by plectanes. Males of the genera *Cosmocercella* and *Neocosmocercella* present vesiculated papillae; and those of *Paradollfusnema*, *Raillietnema*, *Aplectana*, *Oxyascaris* and *Oxysomatium* have short and mamiliform papillae (Anderson et al. 1974, Bursey et al. 2011). The rosette papillae present in males of *Cosmocercoides* are formed by circles of punctuations which do not protrude from the cuticular surface (González et al. 2012). In the specimens described in this study, this feature was confirmed by scanning electron microscope study.
At present, there are 25 nominal species of *Cosmocercoides* worldwide (Bursey et al. 2015, Chen et al. 2018, Tran et al. 2015). These species can be distinguished by combinations of male characters, among which that stand out the pattern of caudal papillae, the presence/absence of lateral alae (in both sexes), somatic papillae and gubernaculum, and the length of spicules, gubernaculum and tail (Bursey et al. 2015).

Among *Cosmocercoides* species, only three shares with *C. latrans* n. sp. the absence of gubernaculum. These species are *Cosmocercoides lilloi* Ramallo, Bursey & Goldberg, 2007 found parasitizing *Rhinella arenarum* (Hensel, 1867) from Salta Province, Argentina; *Cosmocercoides kumaoni* Arya, 1991 found parasitizing *Euphlyctis cyanophlyctis* (Schneider, 1799) (cited as *Rana cyanophlyctis*) from India and *Cosmocercoides microhylae* (Wan, Zhao & Chen, 1978) Baker, 1987 found parasitizing *Microhyla ornata* (Duméril & Bibron, 1841) from China. *Cosmocercoides lilloi* differs from the new species by lacking lateral alae and because its males possess a different pattern of caudal rosette papillae of 18-19:0:10 (precloacal: adcloacal: postcloacal). Also, the unpaired papilla on the anterior lip of the cloaca is not present (Ramallo et al. 2007). The specimens of *C. kumaoni* and *C. microhylae* present lateral alae and because its males possess a different pattern of caudal rosette papillae of 18-19:0:10 (precloacal: adcloacal: postcloacal). Also, the unpaired papilla on the anterior lip of the cloaca is not present (Ramallo et al. 2007). The specimens of *C. kumaoni* and *C. microhylae* present lateral alae but can be easily distinguished from *C. latrans* n. sp. by their shorter tail (130-150 and 157) and rosette papillae pattern, 24:2:10 and 20:0:0, respectively (Wang et al. 1978, Arya 1991).

Eleven *Cosmocercoides* spp. were reported in the Oriental Region, seven in the Sino-Japanese Region, three in the Nearctic Region, two in the Palaearctic Region and two in the Neotropical Region (Bursey et al. 2015, Chen et al. 2018, Tran et al. 2015). Of those in the Neotropical region *Cosmocercoides sauria* Ávila, Strussmann & da Silva, 2010 was found parasitizing the gymnophthalmid lizard *Iphisa elegans* Gray, 1851 in Brazil. *Cosmocercoides sauria* has 4 pairs of precloacal rosette papillae, but unlike the species here described, the males of *C. sauria* possesses gubernaculum and compared with the species here described are smaller (1.3 vs. 1.48-2.68) and have a shorter tail (54 vs. 178.5-364.14) (Ávila et al. 2010). The second species from this region, *C. lilloi*, was compared above.

The species here described present a pattern of caudal papillae of 6-8:3:8, which is not known for any species of the genus previously reported. This pattern allows us to conclude that it is a new species for science. *Cosmocercoides latrans* n. sp. represents the third species of the genus to be reported from Neotropical hosts, and the second one for Argentina.

The current identification of *Cosmocercoides* species remains mainly based on traditional methods, but, due to the similarity in their morphological characters, it is not easy to identify and distinguish some of them. To accomplish, recently authors as Tran et al. (2015) and Chen et al. (2018) have proposed the use of molecular techniques to sequence and analyze DNA. Unfortunately, it was not possible to apply these techniques in our material due to the specimens were originally fixed in formalin.

The life cycle of the new species is unknown, although according to studies carried out with *Cosmocercoides varibilis* (Harwood, 1930), the female lay eggs which develop into first stage larvae in the external environment, and molt twice to the infective third stage larvae, before they infect the host via skin penetration (Anderson 2000). Regarding other helminth species found parasitizing the criolla frog in our study, they are generalist species with an aquatic and indirect life cycle (*P. cf. lutzi*, *C. uruguayensis*, *R. palmipedis*), as well as nematodes species with direct life cycle (*C. latrans* n. sp., *A. hylambatis*, *C. parva*, *R. elegans*).
and Schrankiana sp.). Habitat and mobility (water-ground) of the host, associated with the search for prey and parental care of the foam nest, could favor the penetration of the infective stages of the helminths, resulting in a richer and diverse parasitic community (Hamann et al. 2013).

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REFERENCES
AGUIAR A, MORAIS DH, DA SILVA AF & DA SILVA RJ. 2015. The first report of Aplectana hylambatis (nematoda; Cosmocercidae) associated with Dermatocotus muelleri (Anura; Microhylidae) from Brazil. Herpetol Review 46: 336-338.
ANDERSON RC. 2000. Nematode parasites of vertebrates. Their development and transmission, 2nd ed. Wallingford, UK: CABI Publishing, 650 p.
ANDERSON RC, CHABAUD AG & WILLMON S. 1974. CIH keys to the nematode parasites of vertebrates. Farnham Royal, Bucks, UK: Commonwealth Agricultural Bureaux.
ARREDONDO NJ & GIL DE PERTIERRA AA. 2009. Pseudoacanthocephalus lutzi (Hamann, 1891) comb. n. (Acanthocephala: Echinorhynchidae) for Acanthocephalus lutzi (Hamann, 1891), parasite of South American amphibians. Folia Parasit 56(4): 295-304.
ARYA SN. 1991. Two new species of the genus Cosmocercoides Wilkie, 1930 from a frog Rana cyanophlyctis from Nainital. Indian J Helminthol 43: 139-143.
ÁVILA RW, STRUSSMANN C & DA SILVA RJ. 2010. A new species of Cosmocercoides (Nematoda: Cosmocercidae) from a gymnophthalmid lizard of western Brazil. J Parasitol 96: 558-560.
BAKER MR. 1980. Revision of Old World species species of the genus Aplectana Raillet and Henry, 1916 (Nematoda, Cosmocercidae). Bull Mus Natl Hist Nat Sect A 2: 955-998.
BAKER MR & VAUCHER C. 1984. Parasitic Helminths from Paraguay VI: Cosmocerca Diesing, 1861 (Nematoda: Cosmocercoida) from Frogs. Rev Suisse Zool 1(4): 925-934.
BAKER MR & VAUCHER C. 1986. Parasitic helminths from Paraguay XII: Aplectana Raillet and Henry, 1916 (Nematoda: Cosmocercoida) from frogs. Rev Suisse Zool 93: 607-616.
BAKER MR & VAUCHER C. 1988. Parasitic helminths from Paraguay XV: Atractidae (Nematoda; Cosmocercoida) from frogs. Rev Suisse Zool 95: 325-334.
BRAY RA, GIBSON DI & JONES. 2008. Keys to the Trematoda. London: CABI Publishing and The Natural History Museum, 824 p.
BURSEY CR, GOLDBERG SR & KRAUS F. 2011. New species of Aplectana (Nematoda: Cosmocercidae) in Sphenomorphus pratti from Papua New Guinea. J Parasitol 97(4): 654-660.
BURSEY CR, GOLDBERG SR, SILER CD & BROWN RM. 2015. A new species of Cosmocerca (Nematoda: Cosmocercidae) and other helminths in Cyrtodactylus gubaot (Squamata: Gekkonidae) from the Philippines. Acta Parasitol 60(4): 675-81.
BUSH AO, LAFFERTY KD, LOTZ JM & SHOSTAK AW. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. J Parasitol 83: 575-583.
CAMPÍÃO KM, DA SILVA IC, DALAZEN GT, PAIVA F & TAVARES LER. 2016. Helminth Parasites of 11 Anuran Species from the Pantanal Wetland, Brazil. Comp Parasitol 83(1): 92-100.
CAMPÍÃO KM, MORAIS DH, DIAS OT, AGUIAR A, TOLEDO G, TAVARES LER & DA SILVA RJ. 2014. Checklist of Helminth parasites of Amphibians from South America. Zootaxa 3843: 1-93.
CHEN HX, ZHANG LP, NAKAO M & LI L. 2018. Morphological and molecular evidence for a new species of the genus Cosmocercoides Wilkie, 1930 (Ascaridida: Cosmocercidae) from the Asiatic toad Bufo gargarizans Cantor (Amphibia: Anura). Parasitol Res 117: 1857-1864.
CHERO J, CRUCES C, IANNACONE J, SÁEZ G, ALVARIÑO L, LUQUE J & MORALES V. 2016. Comunidad de Helminths Parásitos del Sapo Espinoso Rhinella spinulosa (Wiegmann, 1834) (Anura: Bufonidae) de Perú. Rev Investig Vet Perú 27(1): 114-129.
CORDERO EH. 1933. Sur quelques acanthocéphales de l’Amérique Méridionale, I. Ann Parasitol 11: 271-279.
CRUMP ML & SCOTT NJ. 1994. Visual encounter surveys. In: Heyer W, Donnelley MA, McDirmid RA, Hayec LC & Foster
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MC (Eds), Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians, p. 84-92.

DRAGHI R, LUNASCHI LI & DRAGO FB. 2015. First report of helminth parasitizing Trachycephalus typhonius (Anura: Hylidae) from northeastern Argentina. Rev Mex Biodivers 86: 255-261.

DUELLMAN WE & TRUEB L. 1994. Biology of Amphibians. Baltimore and London: JHU Press, 670 p.

FERNANDES BMM & KHOHN A. 2014. South American trematodes of amphibians and reptiles. Rio de Janeiro: Instituto Oswaldo Cruz, 228 p.

GONZÁLEZ CE & HAMANN MI. 2015. Checklist of nematode parasites of amphibians from Argentina. Zootaxa 3980 (4): 451-476.

GONZÁLEZ CE & HAMANN MI. 2016. Nematode Parasites of Leptodactylus elenae and Leptodactylus podicipinus (Anura: Leptodactylidae) from Corrientes, Argentina. Comp Parasitol 83(1): 117-121.

GONZÁLEZ CE, HAMANN MI & SALGADO C. 2012. Study of helminth parasites of amphibians by Scanning Electron Microscopy. In: Kazmiruk V (Ed), The Scanning Electron Microscope, InTech Open Acces, p. 267-294.

GONZÁLEZ CE, QUIROGA LB, MORENO D & SANABRIA EA. 2013. Primer registro de Aplectana hylambatis para anfibios de la provincia de San Juan. Cuad Herp 27: 155-159.

GUTIÉRREZ C, ATTADÉMO A, GUERRERO S, PELTZER P & LAJMANOVICH R. 2005. Physalaemus biligonigerus (False-eyed Frog) endoparasites. Herpetol Rev 36: 161-162.

GUTIÉRREZ RO. 1945. Contribución al conocimiento de los nemádodos parásitos de anfibios argentinos. La Plata: Universidad Nacional de La Plata, 37 p.

HAMANN MI & GONZÁLEZ CE. 2015. Helminth parasites in the toad Rhinella major (Bufonidae) from Chaco region, Argentina. Acta Herpetol 10(2): 93-101.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2006a. Species affinity and infracommunity ordination of helminths of Leptodactylus chaquensis (Anura: Leptodactylidae) in two contrasting environments from Northeastern Argentina. J Parasitol 92: 1171-1179.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2006b. Helminth community structure of the oven frog Leptodactylus latinasus (Anura, Leptodactylidae) from Corrientes, Argentina. Acta Parasitol 51 (4): 294-299.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2012. Community structure of helminth parasites of Leptodactylus bufonius (Anura: Leptodactylidae) from Northeastern Argentina. J Helminthol 86(6): 1155-1162.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2013. Helminth communities in the burrowing toad, Rhinella fernandezae, from Northeastern Argentina. Biologia 68(6): 1155-1162.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2014. Helminth community structure in the argentinian bufonid Melanophryniscus klappenbachi: importance of habitat use and season. Parasitol Res 113: 3639-3649.

HAMANN MI, KEHR AI & GONZÁLEZ CE. 2010. Helminth community structure of Scinax nasicus (Anura: Hylidae)
from a South American subtropical area. Dis Aquat Organ 93: 71-82.

HEYER R, LANGONE J, LA MARCA E, AZEVEDO-RAMOS C, DI TADA I, BALDO D, LAVIDA E, SCOTT N, AQUINO L & HARDY J. 2010. *Leptodactylus latrans*. The IUCN Red List of Threatened Species. e.T57151A1592655. http://dx.doi.org/10.2305/IUCN.UK.2010-2.RLTS.T57151A1592655.en.

JONES A, BRAY RA & GIBSON DI. 2005. Keys to the Trematoda, vol. 2, Wallindford: CABI Publishing and The Natural History Museum, xvi + 745 p.

KUZMIN Y, TKACH VV & BROOKS DR. 2007. Two New Species of Rhabdias (Nematoda: Rhabdiasidae) from the Marine Toad, *Bufo marinus* (L.) (Lissamphibia: Anura: Bufonidae), in Central America. J Parasitol 93 (1): 159-165.

LAJMANOVICH RC & MARTÍNEZ DE FERRATO A. 1995. Acanthocephalus lutzi (Hamann, 1891) parásito de *Bufo arenarum* en el Río Paraná, Argentina. Rev Asoc Cienc Nat Litoral 26: 19-23.

LUNASCHI LI & DRAGO FB. 2002. Primer registro de *Catadiscus uruguayensis* Freitas y Lent, 1939 (Digenea: Diplodiscidae) como parásito de reptiles. Neotropica 48: 65-67.

LUNASCHI LI & DRAGO FB. 2010. Platyhelminthes, Trematoda, Cestoda y trematodes. Buenos Aires: Escuela de Farmacia de la Universidad del Litoral, 43 p.

MORDEGLIA C & DIGIANI MC. 1998. *Cosmocerca parva* Travassos, 1925 (Nematoda: Cosmocercidae) in Toads from Argentina. Mem Inst Oswaldo Cruz 93: 737-738.

OSTROWSKI DE NÚÑEZ M. 1978. Fauna de agua dulce de la república Argentina. IX. Sobre representantes de la familia Paramphistomatidae (Trematoda). Phys B 38(95): 55-62.

PETROCHENKO VI. 1971a. Acanthocephala of domestic and wild animals. Jerusalem: Keter Press, Vol. 1, 465 p.

PETROCHENKO VI. 1971b. Acanthocephala of domestic and wild animals. Jerusalem: Keter Press, Vol. 2, 465 p.

PINOYER GOMEZ MD, GONZÁLEZ CE & SANABRIA EA. 2017. New species of Aplectana (Nematoda: Cosmocercidae) parasite of Pleurodema nebulosum (Anura: Leptodactylidae) from the Monte desert, Argentina, with a key to Neotropical species of the genus Aplectana. Zootaxa 4247(2): 121-130.

RAMALLO G, BURSEY CR & GOLDBERG SR. 2007. Two new species of cosmocercids (Ascaridida) in the toad *Chaunus arenarum* (Anura: Bufonidae) from Argentina. J Parasitol 93: 910-916.

SANTOS JN, MELO FT, NASCIMENTO LCS, NASCIMENTO DEB, GIESE EG & FURTADO AP. 2011. *Rhabdias parasaensis* sp. nov.: A parasite of the lung of *Rhinella marina* (Amphibia: Bufonidae) from Brazilian Amazonia. Mem Inst Oswaldo Cruz 106: 433-440.

SANTOS VGT & AMATO SB. 2010. Helminth fauna of *Rhinella fernandezae* (Anura: Bufonidae) from the Rio Grande do Sul coastland, Brazil: Analysis of the parasite community. J Parasitol 96: 823-826.

SANTOS VGT & AMATO SB. 2013. Species of *Cosmocerca* (Nematoda, Cosmocercidae) in Anurans from Southern Santa Catarina State, Brazil. Comp Parasitol 80(1): 123-129.

SAVAZZINI LA. 1930. Contribución al estudio de parásitos de los aparatos circulatorio y digestivo de nuestro *Leptodactylus ocellatus*. Nuevas especie de nematodes, cestodes y trematodes. Buenos Aires: Escuela de Farmacia de la Universidad del Litoral, 43 p.

SCHAEFER EF, HAMANN MI, KEHR A & DURÉ MI. 2006. Trophic, reproductive and parasitological aspects of the ecology of *Leptodactylus chaquensis* (Anura: Leptodactylidae) in Argentina. Herpetol J 16(4): 387-394.

SMALES LR. 2007. Acanthocephala in amphibians (Anura) and reptiles (Squamata) from Brazil and Paraguay with description of a new species. J Parasitol 93: 392-398.

SUELDO C & RAMÍREZ VG. 1976. Aportes sobre parásitos de *Bufo arenarum* en la provincia de Salta (Nematoda). Neotropica 22: 105-106.

SULLIVAN JJ. 1977. Revision of the genus *Rauschiella* Babero, 1951 (Digenea: Plagiorchiidae) with a redescription of *R. palmipes* (Lutz, 1928) n. comb. from venezuelan frogs. Proc Helminthol Soc Wash 44: 82-86.

TANTALEÁN M, SÁNCHEZ L, GÓMEZ L & HUIZA A. 2005. *Tantalaenium* (Nematoda, Cosmocercidae) in Amphibians and Reptiles (Squamata) from Paraguay. Mem Inst Oswaldo Cruz 106: 433-440.

TRAVASSOS LT, SATO H & LUC PV. 2015. A new *Cosmocercoides* species (Nematoda: Cosmocercidae), *C. tonkinensis* n. sp., in the scale-bellied tree lizard (*Acanthosaura lepidogaster*) from Vietnam. Acta Parasitol 60: 407-416.

TRAVASSOS L & FREITAS JFT. 1964. Pesquisas helminthológicas realizadas em Maicuru, Estado do Pará. Bol Mus Para Emílio Goeldi, Publicações avulsas 2: 1-16.
VICENTE JJ, RODRIGUEZ HO, GOMEZ DC & PINTO RM. 1991. Nematóides do Brasil. Parte II: Nematóides de Anfíbios. Rev Bras Zool 7: 549-626.

WANG PQ, ZHAO Y & CHEN C. 1978. On some nematodes from vertebrates in south China. Fujian Shida Xuebao 2: 75-90.

YAMAGUTI S. 1961. Systema Heminthum. Vol. 3. The nematodes of vertebrate. New York: Interscience Publishers Inc., 679 p.

YAMAGUTI S. 1963. Systema Helminthum. Vol. 5. Acanthocephala. New York: Interscience Publishers Inc., 423 p.

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