

Nematode parasites of two anuran species *Rhinella schneideri* (Bufonidae) and *Scinax acuminatus* (Hylidae) from Corrientes, Argentina

Cynthia Elizabeth González¹ & Monika Inés Hamann²

1, 2. Centro de Ecología aplicada del Litoral (CECOAL), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), C.C. 291, C.P. 3400, Corrientes, Argentina;

1. cynthyaelizabethg@hotmail.com;

2. monika_hamann@yahoo.com

Received 10-I-2008. Corrected 30-VI-2008. Accepted 31-VII-2008.

Abstract: The nematological fauna of most anuran species from Corrientes province, north of Argentina; has not been studied. We report for the first time the nematode species found in *Rhinella schneideri* and *Scinax acuminatus*. Forty four amphibians representing two species (*R. schneideri* -six males, three females and two juveniles- and *S. acuminatus* -fifteen males and eighteen females) were collected near the city of Corrientes, between January 2002 and December 2003 and searched for nematodes. *R. schneideri* contained eight species of nematodes (adults: *Rhabdias füelleborni*, *R. elegans*, *Oswaldocruzia proencai*, *Cosmocerca podicipinus*, *C. parva* and *Falcaustra mascula*; larvae: *Porrocaecum* sp. and *Physaloptera* sp.), and *S. acuminatus* contained three (adults: *Cosmocerca parva* and *Oxyascaris caudacutus*; larvae: *Physaloptera* sp.). We present morphology (scanning electron microscope) and metric information, range extensions, and new host records for these nematode species. Rev. Biol. Trop. 56 (4): 2147-2161. Epub 2008 December 12.

Key words: Amphibians, *Rhinella schneideri*, *Scinax acuminatus*, Nematodes, Corrientes, Argentina.

Lavilla *et al.* (2000) referred to 52 species of anurans for Corrientes province in the north of Argentina; the nematological fauna of most to these species has not been studied. Mordeglia and Digiani (1998) and González and Hamann (2004, 2006a, b, 2007a,b,c) have analyzed nematode parasites of the following species: *Chaunus granulatus major* (Müller & Hellmich, 1936), *C. fernandezae* (Gallardo, 1957), *C. bergi* (Céspedes, 2000) (Bufonidae), *Lysapsus limellum* Cope, 1862 (Hylidae), *Pseudopaludicola falcipes* (Hensel, 1867) (Leiuperidae), and, *Leptodactylus bufonius* Boulenger, 1894 (Leptodactylidae). Nematodes of larval amphibians have been reported by González and Hamann (2005) who found one pharyngodonid species, *Gyrinocola chabaudi* Araujo & Artigas, 1982 in tadpoles of the hylid *Scinax nasicus* (Cope, 1862).

Continuing the study of Argentinean amphibians, we analyzed the parasite fauna of one bufonid species, *Rhinella schneideri* (Werner, 1894), and one hylid species, *Scinax acuminatus* (Cope, 1862).

Rhinella schneideri is distributed from the Atlantic coast of Brazil inland through Paraguay to central Bolivia; and southwest to northern and central Argentina and Uruguay, whereas to *S. acuminatus* is distributed in southern Mato Grosso and Mato Grosso do Sul (Brazil), Paraguay, Bolivia and northern Argentina (Frost 2007). *Rhinella schneideri*, like the majority species of *Rhinella*, is highly terrestrial and is an active predator with a generalist diet. On the other hand, *S. acuminatus* occurs in forests, shrublands, and grasslands, and is very well adapted to anthropogenic areas; it has a generalist diet that it can be

considered intermediate between a sit-and-wait and an actively foraging predator (Duré 2004).

The purpose of this study is to report for the first time nematodes harboured by *R. schneideri* and *S. acuminatus*. We describe the nematodes found in both species and present new morphological and metric data.

MATERIAL AND METHODS

Samples of *R. schneideri* (N = 11) and *S. acuminatus* (N = 33) were collected near the city of Corrientes, Province of Corrientes in Argentina (27°28'S - 58°50'W), between January 2002 and December 2003. Six males (snout-vent length - SVL) = 42.58 mm ±31.82 SD; min.-max. = 10.1-86.6 and 26.0 g ±37.0 SD; min.-max. = 0.19-86.6 of weight), three females (SVL = 81.8 mm ±77.8 SD; min.-max. = 23.0-170.0, and 23.4 g ±24.5 SD; min.-max. = 1.8-50.0 of weight), and two juvenile (SVL = 15.75 mm ±1.06 SD; min.-max. = 15.0-16.5 and 0.39 g ±0.007 SD; min.-max. = 0.39-0.4 of weight), of *R. schneideri* were collected. Fifteen males (snout-vent length - SVL) = 33.64 mm ±5.42 SD; min.-max. = 25.5-43.0 and 3.87 g ±1.48 SD; min.-max. = 1.24-6.29 of weight) and eighteen females (snout-vent length - SVL) = 29.44 mm ±4.65 SD; min.-max. = 21.0-41.0 and 3.06 g ±1.99 SD; min.-max. = 0.74-9.19 of weight) of *S. acuminatus* were collected in same area.

Amphibians were transported live to the laboratory, killed in a chloroform (CHCl₃) solution; and their snout-vent length (SVL) and body weight were recorded. At necropsy, hosts were sexed and the alimentary canal, lungs, liver, kidneys, urinary bladder, musculature and integument examined for parasites by dissection. Nematodes were observed in vivo, counted and killed in hot distilled water and preserved in 70% ethyl alcohol, cleared in glycerine or lactophenol and examined as temporary mounts. Some specimens were studied by scanning electron microscopy (SEM); these specimens were dehydrated in ethanol series, dried using the critical point technique, coated with gold, and examined with a JSM-5800

scanning electron microscope. Measurements are given in micrometers (µm) unless otherwise stated, as the mean ± SD followed by range in parentheses. Prevalence, mean intensity and mean abundance were calculated according to Bush *et al.* (1997). Voucher specimens of all nematode species were deposited in the Helminthological Collection of the Centro de Ecología Aplicada del Litoral (CECOAL), Corrientes, Argentina. Amphibians were deposited in the Herpetological Collection of CECOAL (*S. acuminatus*: Cecoal 2405; *R. schneideri*: Cecoal 2663)

RESULTS

A total of 153 nematodes was collected from 44 anurans examined. In *R. schneideri*, we found eight species of nematodes from six families: Rhabdiasidae: *Rhabdias füelleborni* Travassos, 1926 and *Rhabdias elegans* Gutierrez, 1945; Molineidae: *Oswaldocruzia proencai* Ben Slimane & Durette-Desset, 1995; Cosmocercidae: *Cosmocerca podicipinus* Baker & Vaucher, 1984 and *Cosmocerca parva* Travassos, 1925; Kathlaniidae: *Falcaustra mascula* (Rudolphi, 1819) Freitas & Lent, 1941; Ascarididae: *Porrocaecum* sp. (Larvae) and Physalopteridae: *Physaloptera* sp. (Larvae). In *S. acuminatus*, we found three species of nematodes from two families: Cosmocercidae: *Cosmocerca parva* and *Oxyascaris caudacutus* (Freitas, 1958) Baker & Vaucher, 1984, and, Physalopteridae: *Physaloptera* sp. (Larvae). Prevalence, number of parasites, mean intensity, mean abundance and site of infection for each one of these nematodes in each host appear in Table 1.

Family Rhabdiasidae Railliet, 1915
Genus *Rhabdias* Stiles & Hassall, 1905
Rhabdias füelleborni Travassos, 1926
(Fig. 1A)

Description: Based on 14 gravid specimens. Body of parthenogenetic female 10.18±1.12 mm (8.55-12.0 mm) x 408.2±33.7 (350-450). Outer layers of body cuticle inflated.

TABLE 1

Percentage occurrence, quantity, mean intensity (\pm SD), mean abundance (\pm SD), and site of infection with nematode parasites in *Rhinella schneideri* and *Scinax acuminatus* in Corrientes, Argentina

Nematodes	%	#	Mean intensity	Mean abundance	Site of infection
<i>Rhinella schneideri</i>					
<i>R. füelleborni</i> Cecoal 03091901	9	76	38.5 \pm 53.0	7.0 \pm 22.9	Lungs
<i>R. elegans</i> Cecoal 02111301	9	1	-	0.09 \pm 0.3	Lungs
<i>O. proencai</i> Cecoal 03091901	9	1	-	0.09 \pm 0.3	Small intestine
<i>C. parva</i> Cecoal 02042627	18	42	21.0 \pm 28.28	3.8 \pm 12.3	Large intestine
<i>C. podicipinus</i> Cecoal 02123280	18	5	2.5 \pm 0.70	0.45 \pm 1.03	Lungs and large intestine
<i>F. mascula</i> Cecoal 02052663	9	2	-	0.18 \pm 0.6	Large intestine
<i>Porrocaecum</i> sp. Cecoal 03091901	9	1	-	0.09 \pm 0.3	Liver
<i>Physaloptera</i> sp. Cecoal 03013425	9	1	-	0.09 \pm 0.3	Gastric mucosa
<i>Scinax acuminatus</i>					
<i>C. parva</i> Cecoal 04050462	12	5	1.25 \pm 0.5	0.15 \pm 0.44	Large intestine
<i>O. caudacutus</i> Cecoal 03061205	12	10	2.5 \pm 1.29	0.3 \pm 0.91	Large intestine and small intestine
<i>Physaloptera</i> sp. Cecoal 05040701	3	9	-	0.03 \pm 0.17	Gastric mucosa

Oral opening small, almost circular, surrounded by six small lips. Intestine filled with brown or black contents. Clavicular esophagus 560.7 \pm 66.5 (460-650) x 63.1 \pm 7.5 (50-75). Nerve ring 237.4 \pm 46.1 (186-350) from anterior extremity. Vulva 4.88 \pm 0.32 mm (4.42-5.46 mm) from anterior end of body; ovaries straight, lying along intestine. Uteri wide, filled with numerous eggs; egg shell thin, smooth, hyaline; larvate eggs placed near to the vagina 114.6 \pm 19.6 (97-160) x 58.0 \pm 9.3 (48-80) wide. Tail conical, 358.3 \pm 69.7 (250-450) in length.

Remarks: *Rhabdias* Stiles and Hassall, 1905 is a genus of nematode parasites widely distributed in ranids and bufonids but is infrequently found in salamanders, snakes and lizards (Baker 1987, Bursey *et al.* 2003, Martínez-Salazar and León-Règagnon 2006). In South American *Rhabdias füelleborni* was found in Brazil, Uruguay and Paraguay in the following hosts: *Bufo marinus*, *B. arenarum*, *B. ictericus*, *B. paracnemis* (Bufonidae) and *Leptodactylus pentadactylus* and *Eleutherodactylus guentheri*

(Leptodactylidae) (Travassos 1926, Fahel 1952, Kloss 1971, 1974, Masi Pallares and Maciel 1974, Rodrigues *et al.* 1982, Vicente *et al.* 1990, Luque *et al.* 2005, Martins and Fabio 2005). This is the first report of *R. füelleborni* in an amphibian from Argentina. The metric and morphologic data of specimens studied here agree with those of Travassos (1926).

Rhabdias elegans Gutierrez, 1945

Description: Based on 1 gravid specimen. Body of parthenogenetic female 6.2 mm x 400 μ m. Cuticle swollen, with irregular folds. Head end rounded. Simple mouth, not surrounded by distinguishable lips. Esophagus, 390 x 50. Vulva 3.5 mm from anterior end of body. Uteri with numerous eggs; larvated eggs 88 x 53 wide. Tail conical 220 in length.

Remarks: In Argentina, this species was found in *B. arenarum* (Bufonidae) from the province of Buenos Aires (Gutierrez 1945) and from the province of Salta (Sueldo and Ramírez 1976),

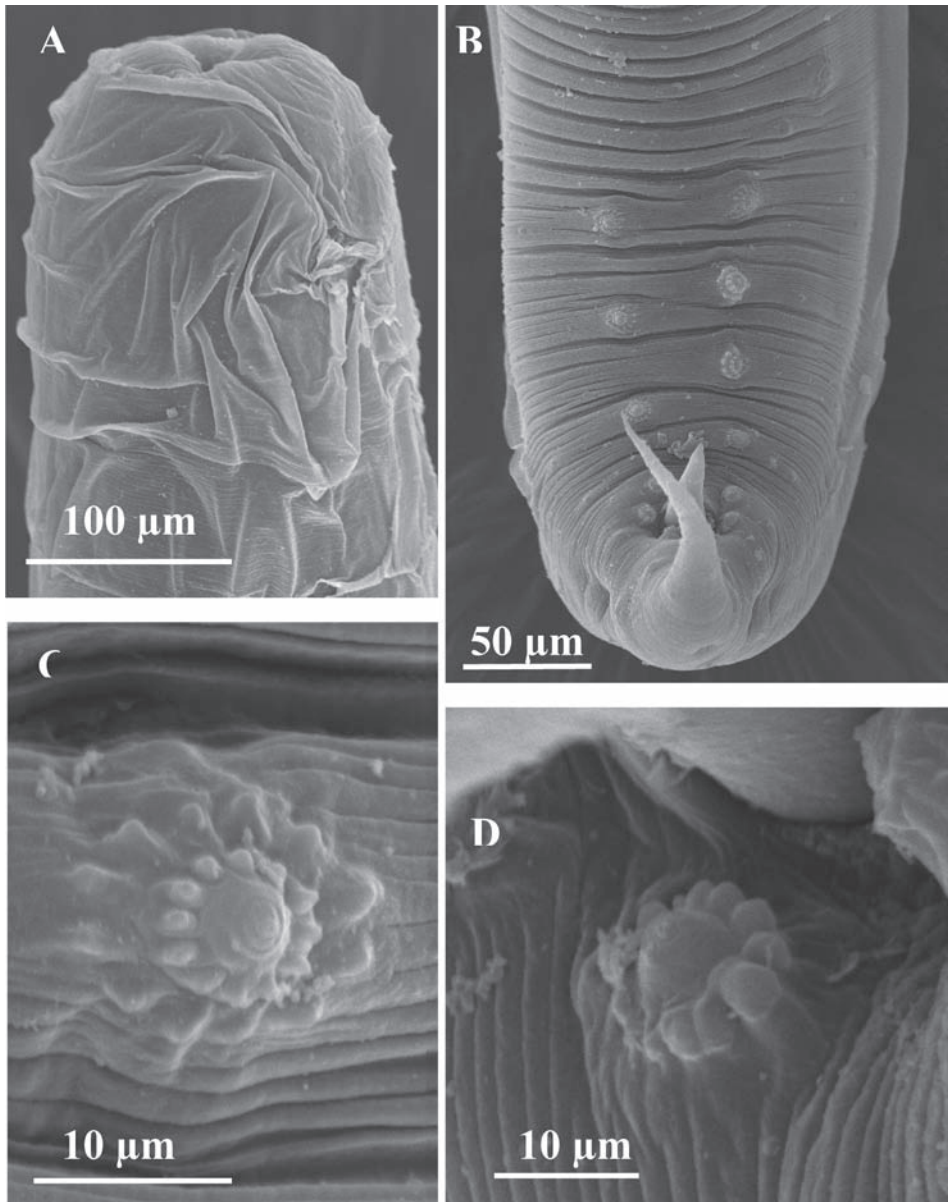


Fig. 1. Nematode parasites of *Rhinella schneideri* and *Scinax acuminatus* from Corrientes, Argentina. A. *Rhabdias fülleborni*, body anterior end. B. *Cosmocerca parva*, male, body posterior end, ventral view. C. detail of plectane. D. detail of adanal papillae, ventro-lateral view. (A-D collected from *R. schneideri*).

in *Leptodactylus bufonius* (Leptodactylidae) from the province of Corrientes (González and Hamann 2006b), in *Bufo rufus* from Brazil, in *B. ictericus* from Paraguay and Brazil, and in *B. arenarum* (Bufonidae) from Uruguay (Kloss 1971, 1974, Baker 1987, Vicente *et al.* 1990, Luque *et al.* 2005).

Compared with specimens studied by Gutiérrez (1945) the female found in *R. schneideri* has eggs with a smaller length (Gutiérrez 1945: 91-112 µm); other characters (e.g., body size and esophagus length) are similar.

Family Molineidae

Durette-Desset & Chabaud, 1977

Genus *Oswaldocruzia* Travassos, 1917

Oswaldocruzia proencai

Ben Slimane & Durette-Desset, 1995

Description: Based on 1 male specimen. Body 10.5 mm x 127.5, with maximum width at level of midbody. Claviform esophagus 540 length. Nerve ring 184 from anterior extremity. Excretory pore 282 from anterior extremity. Caudal bursa: rays 8 arising on root of the dorsal ray, and overlapped with rays 6 in half of its length only. Dorsal ray conical, rising from common base with ribs 8, tapering to pointed tip. Spicules 165.6 in length, distal third divided into 3 branches: blade, shoe and fork. Ribs 4 more short than ribs 5. Branches of the spicule with equivalent length.

Remarks: Ben Slimane *et al.* (1996) analyzed the morphology of the caudal bursa and identified 72 species of *Oswaldocruzia*. The species *O. proencai* is included within the groupe possessing type II bursa. The neotropical *Oswaldocruzia* have spicula divided in three main branches: blade, shoe and fork and the division of the fork always occurs before the distal third of its length (in holartic species occurs beyond the distal third). Gubernaculum is absent. On the other hand, Ben Slimane and Durette-Desset (1995) proposed the species *O. proencai* for the specimens collected in the amphibians *Bufo paracnemis*, *Leptodactylus ocellatus* and *L. bufonius* from Paraguay and

that was described by Lent *et al.* (1946) like *O. mazzai* Travassos, 1935. This is the first report of *O. proencai* in an amphibian from Argentina.

Family Cosmocercidae Travassos, 1925

Genus *Cosmocerca* Diesing, 1861

Cosmocerca podicipinus

Baker & Vaucher, 1984

The caudal portion of the males of this species was extensively detailed for González and Hamann (2004), those that provided new morphologic information related to the structure of the plectanas and the adanal papillae. This species is readily distinguished from other species by the fusion of the underlying sclerotized plectane supports between the plectanes (Baker and Vaucher 1984). The Table 2 shows the metric characters of the males and females of *C. podicipinus* found in *R. schneideri*.

Cosmocerca parva

Travassos, 1925 (Fig. 1B, C, D)

This species is distinguished from the *Cosmocerca podicipinus* in the morphology of the plectanes; in *C. parva* union between the plectanas of each row does not exist, whereas in *C. podicipinus* the plectanes on each side of body are fused by underlying sclerotized supports; in addition, the lateral alae in this species are very marked.

The metric characters of the males and females of these nematodes found in *R. schneideri* and *S. acuminatus* are present in Table 2.

Remarks: In South America, the genus *Cosmocerca* is widely distributed in amphibians and reptiles (Baker 1987).

In Paraguay, *C. podicipinus* was found in *Leptodactylus podicipinus*, *L. fuscus*, *L. elenae* and *L. chaquensis* (Leptodactylidae) (Baker and Vaucher 1984); in Colombia was found by Goldberg and Bursey (2003) in *Atelopus spurrelli* (Bufonidae) and *Dendrobates histrionicus* (Dendrobatidae); in Peru was found in *Bufo typhonius* (Bufonidae), *Colostethus*

TABLE 2
Morphology characteristics of males and females of Cosmocerca parva and C. podicipinus in Rhinella schneideri and Scinax acuminatus in Corrientes, Argentina

	<i>R. schneideri</i> <i>C. podicipinus</i>		<i>R. schneideri</i> <i>C. parva</i>		<i>S. acuminatus</i> <i>C. parva</i>	
	Males n= 2	Females n= 3	Males n= 5	Females n= 10	Males n= 1	Females n= 4
Total length	2.33 ± 0.01mm (2.32 – 2.34)	4.80 ± 0.22 mm (3.29 – 7.35)	2.02 ± 0.35mm (1.7 – 2.53)	5.11 ± 1.0mm (4.27 – 8.08)	2.37mm	5.12 ± 0.15mm (3.22 – 6.66)
Width	235.0 ± 7.0 (230 – 240)	240.0 ± 55.6 (190 – 300)	235.0 ± 27.9 (200 – 260)	317.4 ± 46.4 (270 – 440)	190.0	282.0 ± 33.6 (240 – 312)
Length of pharynx	26.3 ± 1.8 (25 – 27)	34.5 ± 4.5 (30 – 39)	27.9 ± 2.9 (23 – 30)	41.0 ± 6.1 (34 – 49)	29.9	37.1 ± 3.8 (32 – 41)
Width of pharynx	20.3 ± 0.5 (20 – 21)	37.6 ± 6.9 (30 – 44)	20.2 ± 1.6 (19 – 23)	42.2 ± 5.3 (37 – 55)	18.4	38.6 ± 5.1 (34 – 46)
Length of muscular esophagus	205.2 ± 13.7 (195 – 215)	328.6 ± 71.0 (282 – 410)	227.1 ± 17.4 (207 – 250)	307.9 ± 11.8 (291 – 324)	218.5	319.5 ± 42.0 (270 – 360)
Width of muscular esophagus	22.9 ± 3.0 (21 – 25)	40.2 ± 10.3 (30 – 51)	27.7 ± 2.7 (25 – 31)	41.3 ± 4.41 (36 – 48)	23	41.6 ± 1.9 (39 – 44)
Length of bulb	50.3 ± 0.4 (50 – 51)	82.5 ± 8.6 (75 – 92)	70.6 ± 5.4 (67 – 80)	98.8 ± 7.0 (87 – 113)	57.5	91.5 ± 9.4 (80 – 103)
Width of bulb	61.5 ± 5.6 (57 – 65)	108.2 ± 10.2 (101 – 120)	68.7 ± 6.5 (60 – 78)	104.2 ± 7.6 (97 – 122)	55.2	104.3 ± 11.1 (93 – 120)
Nerve ring from anterior end	162.5 ± 67.1 (115 – 210)	180.6 ± 25.7 (162 – 210)	147.0 ± 10.6 (138 – 158)	211.9 ± 18.6 (192 – 252)	160	269.0 ± 66.7 (210 – 360)
Excretory pore from anterior end	265.1 ± 119.0 (182 – 350)	251.6 ± 42.5 (210 – 295)	217.6 ± 20.8 (200 – 252)	343.1 ± 54.7 (276 – 420)	240	394.5 ± 78.4 (300 – 480)
Anus from posterior end	127.5 ± 17.7 (115 – 140)	480.0 ± 191.6 (350 – 700)	145.9 ± 8.0 (135 – 155)	524.5 ± 139.4 (350 – 800)	151.8	453.5 ± 141.9 (312 – 650)
Gubernaculum	112.0 ± 14.1 (102 – 122)	-	73.8 ± 9.7 (60 – 85)	-	85	-
Spicules	111.5 ± 4.9 (108 – 115)	-	72.6 ± 4.4 (70 – 80)	-	110	-
Number of plectanes	5 pairs	-	4 – 5 pairs	-	6 pairs	-
Adanal papillae	3 pairs + 1	-	2 - 4 pairs + 1	-	3 pairs + 1	-
Vulva from anterior end	-	2.56 ± 0.96mm (1.7 – 3.6)	-	2.5 ± 0.51mm (1.95 – 3.82)	-	2.70 ± 0.34mm (2.29 – 3.15)
Length of eggs	-	100.4 ± 8.1 (92 – 108)	-	110.0 ± 3.7 (103 – 116)	-	96.6 ± 6.1 (91 – 103)
Width of eggs	-	62.9 ± 11.3 (55 – 76)	-	71.0 ± 4.0 (66 – 78)	-	65.7 ± 6.0 (57 – 71)

marchesianus, *Epipedobates femoralis* (Dendrobatidae), *Eleutherodactylus imitatrix* and *Leptodactylus leptodactyloides* (Leptodactylidae) by Bursey *et al.* (2001), in Brazil in *Scinax fuscomarginatus* (Goldberg *et al.* 2007), and, in Argentina, in *Pseudopaludicola falcipes* (Leiuperidae), *Leptodactylus bufonius*, *L. latinus*, *L. chaquensis* (Leptodactylidae) and *Chaunus granulatus major*, *C. bergi* and *C. fernandezae* (Bufonidae) (González and Hamann 2004, 2006a,b, 2007a, b, Hamann *et al.* 2006a, b).

Cosmocerca parva was found in *Leptodactylus mystaceus*, *L. caliginosus*, *L. fuscus*, *L. ocellatus*, *Adenomera marmorata*, *Physalaemus signiferus* and *P. soaresi* (Leptodactylidae) and *Olylogon fuscovaria* (Hylidae) from Brazil (Silva 1954, Fabio 1982); in *Leptodactylus* sp., *L. chaquensis*, *L. elenae* (Leptodactylidae) and *Olylogon fuscovaria* (Hylidae) from Paraguay (Masi Pallares and Maciel 1974, Baker and Vaucher 1984); in *Bufo glaberrimus*, *B. marinus* and *B. typhonius* (Bufonidae), *Epipedobates pictus* (Dendrobatidae), *Hyla fasciata*, *Phyllomedusa atelopoides*, *Scarthyla ostinodactyla*, *Scinax garbei*, *S. icterica* (Hylidae), *Edalorhina perezii*, *Eleutherodactylus fenestratus*, *E. peruvianus*, *E. toftae*, *Leptodactylus leptodactyloides*, *L. mystaceus* (Leptodactylidae), *Elachistocleis ovalis* and *Hamptophryne boliviana* (Microhylidae) from Peru (Bursey *et al.* 2001). Finally, in Argentina, it was found in bufonids *Chaunus granulatus major*, *C. fernandezae* and *C. bergi* and, in leptodactylids *Leptodactylus bufonius*, *L. chaquensis* and *L. latinus* (Mordeglia and Digiani 1998, González and Hamann 2006a,b, González and Hamann 2007a, b, Hamann *et al.* 2006a, b).

The general metric characteristics of the specimens of *Cosmocerca podicipinus* corresponds to others nematodes of the same species analyzed from others hosts of Corrientes, Argentina. Nevertheless, the body size of the females of this study is greater (3.0-7.0 mm) than the found ones in other hosts; for example, the

maximum body size of females of *C. podicipinus* from *P. falcipes*: 6.0 mm (González and Hamann, 2004); from *C. fernandezae*: 4.3 mm; from *C. bergi*: 6.9 mm (González and Hamann, 2007a). The other metric characters, in both males and females, are similar to those found by the authors mentioned for this geographic region. The length of spicule of male collected from *S. acuminatus* is longer than found in *R. schneideri*.

With respect to *Cosmocerca parva*, we found that the female specimens collected from *R. schneideri* are longer than found in *S. acuminatus* and the other specimens collected from bufonids of the same area, i.e., from *Chaunus granulatus major*: 5.1 mm (González and Hamann 2006a); *C. fernandezae*: 6.7 mm and *C. bergi*: 5.6 mm (González and Hamann 2007a).

The males of *C. parva* can have from 5 to 7 pairs of plectanes (Baker and Vaucher 1984). In the present study, the most males of *C. parva* analyzed from *R. schneideri* had 5 pairs of plectanes, although some of them had 4 pairs. Each plectane was formed by one interior complete rosette of 12-15 punctations and one exterior complete rosette of 12-15 punctations, and, a relatively inconspicuous underlying sclerotized support which is not fused to other plectanes. Previously reports of plectanes with scanning electron microscopy realized by Mordeglia and Digiani (1998) showed 12-16 punctations in each rosette of these structures. The only male of *C. parva* found in *S. acuminatus* presented 6 pairs of plectanes.

The numbers of pairs of adanal papillae varied between 2 and 4 pairs in specimens from *R. schneideri* but were 3 pairs only in male collected from *S. acuminatus*. González and Hamann (2006a, 2007a) found 2-4 pairs of adanal papillae in males of *C. parva* from *C. granulatus major* and *C. fernandezae*; and 3 pairs only in males from *C. bergi*. We observed the unpaired little papilla on the anterior lip of anus in males of *C. parva* in both hosts of this study.

Both, *R. schneideri* and *S. acuminata*, represent new host records for *C. podicipinus* and *C. parva*.

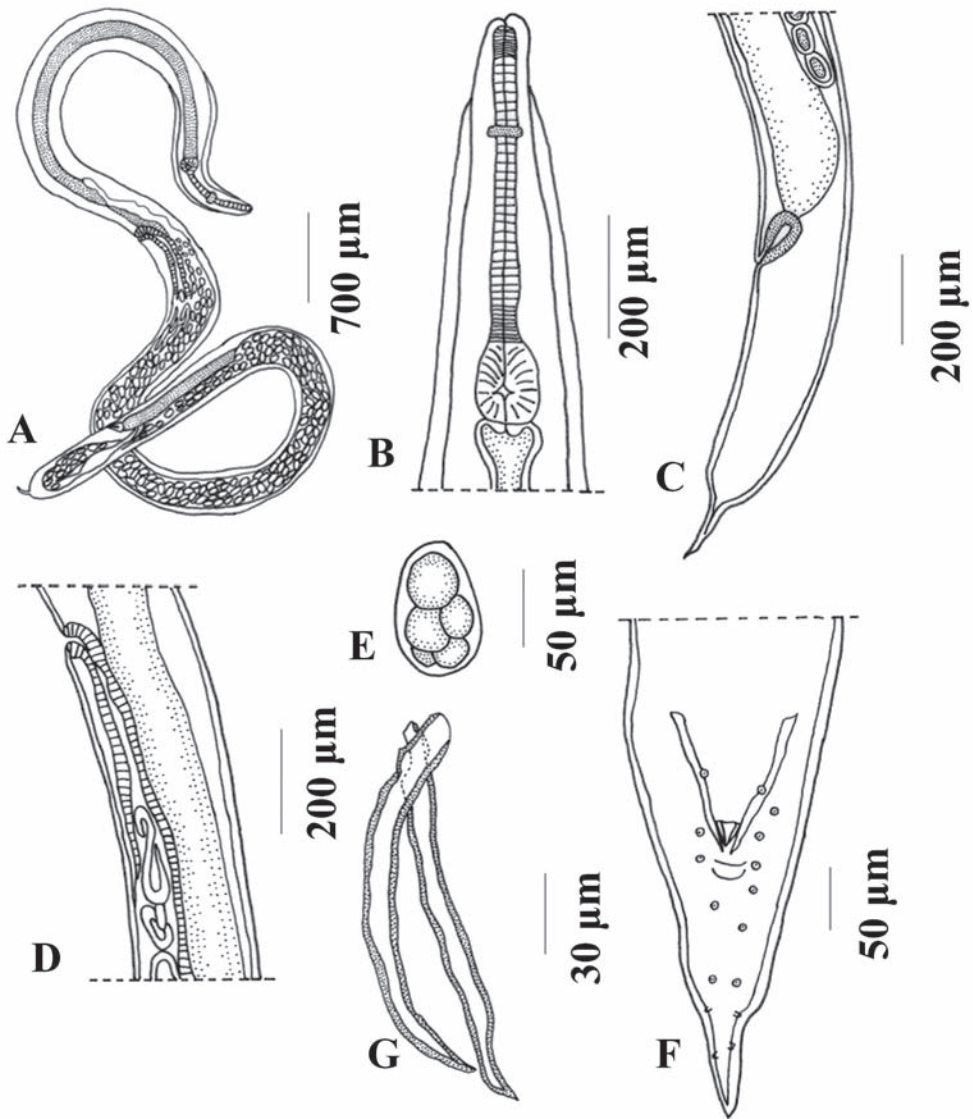


Fig. 2. Nematode parasites of *Rhinella schneideri* and *Scinax acuminatus* from Corrientes, Argentina. A. *Oxyascaris caudacutus*, female, general view. B. body anterior, ventral view. C. body posterior, lateral view. D. detail of vulva, lateral view. E. egg. F. *Oxyascaris caudacutus*, male, body posterior, ventral view. G. detail of spicules.

Genus *Oxyascaris* Travassos, 1920
Oxyascaris caudacutus (Freitas, 1958)
 Baker & Vaucher, 1984 (Fig. 2 A-G)

Description: Nematodes with marked dimorphism in size; mature females more than

twice as large as male. Oral opening triangular, three small lips present. Four large outer papillae and six minute inner labial papillae in the cephalic extremity. Lateral alae extending from just anterior to nerve ring in both sexes to the preanal region in males and to near midbody in

females. Markedly wide and thick at anterior end and tapering rapidly posteriorly. Somatic papillae present, in two subventral and two subdorsal rows.

Males: based on 3 specimens. Body 3.4±0.65 mm (2.65-3.9 mm) x 173.33±32.14 (150-210). Pharynx 31.5±7.46 (23-37) x 22.56±1.69 (20.7-24). Esophagus divided in two portions: corpus 290±28.28 (270-310) x 29.93±4.60 (25.3-34.5), and bulb 72.0±4.24 (69-75) x 68.26±9.61 (57.5-76). Nerve ring 200.0±70.71 (150-250) from anterior extremity. Excretory pore 370.6±25.32 (342-390) from anterior extremity. Tail conical, 208.0±9.16 (198-216) long, with four pairs of subventral and two pairs of subdorsal papillae; one unpaired papilla on anterior lip of cloaca, and three pairs of subventral papillae variable in position. Spicules sharply pointed distally, 144.0±29.4 (110-161) long. Gubernaculum weakly sclerotized, 37.25±3.88 (34.5-40) long.

Females: based on 7 gravid specimens. Body 12.0±2.07 mm (9.0-16.0 mm) x 272.0±58.93 (165-375) with maximum width at level of vulva. Pharynx 45.91±6.71 (34.5-57.5) x 42.04±5.83 (34.5-52.9). Esophagus divided in two portions: corpus 439.0±34.47 (384-498) x 46.84±7.91 (34.5-57.5), and bulb 91.15±9.78 (78.2-110) x 89.03 ±8.91 (75.9-100). Nerve ring 415.5±50.04 (342-450) from anterior extremity. Excretory pore 434.8±62.91 (354-534) from anterior end of body. Vulva 4.0±0.59 (3.15-4.8) from anterior extremity. Tail robust, tapering abruptly to distal spike, 0.90±0.11 mm (0.67-1.05 mm) long. Uteri in mature females containing many eggs and free larvae. Eggs oval, thin-walled, 84.48±10.91 (69-103.5) x 52.28±5.75 (46-62.140), often contains fully developed larvae.

Remarks: This species was originally described from *Hyla nasica* (identification of host not definitive according to Freitas 1958), of Sao Paulo, Brazil. Then, it was found in *Leptodactylus fuscus* and *L. mystacinus* (Leptodactylidae) from Brazil, too (Fabio 1982) and, in *Ololygon fuscovaria* (Hylidae) from Paraguay (Baker and Vaucher 1985). This

is the first report of this species for Argentinean amphibians.

The general morphology of this specimens correspond with others descriptions (Freitas 1958, Baker and Vaucher 1985) but we added with this study some metric characters, e.i., the range of body size of male specimens: of these study are greater than of those of the original description, and of the other host (Freitas 1958: 2.78-3.62 mm; Baker and Vaucher 1985: 3.50-3.70 mm; present study: 2.65-3.90 mm); in these specimens they have been spicules of greater length than in the specimens of previous studies (Freitas 1958: 122-134 µm; Baker and Vaucher 1985: 148-155 µm; present study: 110-161 µm); finally, with respect to gubernaculum, Freitas (1958) does not provide any measurement of this masculine genital structure; on the other hand, Baker and Vaucher (1985) found in this structure a length between 36 and 40 µm. The lateral alae got to measure 35 µm in specimens studied by Baker and Vaucher (1985), whereas in the present study they reached 39 µm.

Family Kathlaniidae Lane, 1914

Genus *Falcaustra* Lane, 1915

Falcaustra mascula (Rudolphi, 1819)

Freitas & Lent, 1941 (Fig. 3 A-C)

Description: Based on 2 females specimens. Body 10.75±1.9mm (9.37-12.12 mm) x 405±7.07 (400-410). Cuticle with fine longitudinal striations. Pharynx 75.0±7.07 (70-80) x 71.0±1.41 (70-72). Esophagus (with isthmus) 1.38±0.017 mm (1.37-1.4 mm) x 70.8±5.86 (66.7-75); isthmus 135.0±21.21 (120-150) x 105.0±7.07 (100-110); bulb 163.5±2.12 (162-165) x 193.0±9.89 (186-200). Nerve ring 345.0±7.07 (340-350) from anterior end of body. Excretory pore 1.09±0.22 mm (0.93-1.25 mm) from anterior extremity. Vulva 7.70±1.73 mm (6.47-8.92) from anterior end of body. Tail 355.0±7.07 (350-360) in length. The studied females did not have eggs.

Remarks: In South America, *Falcaustra mascula* was found in *Leptodactylus ocellatus*, *L. pentadactylus*, *L. caliginosus*, *L.*

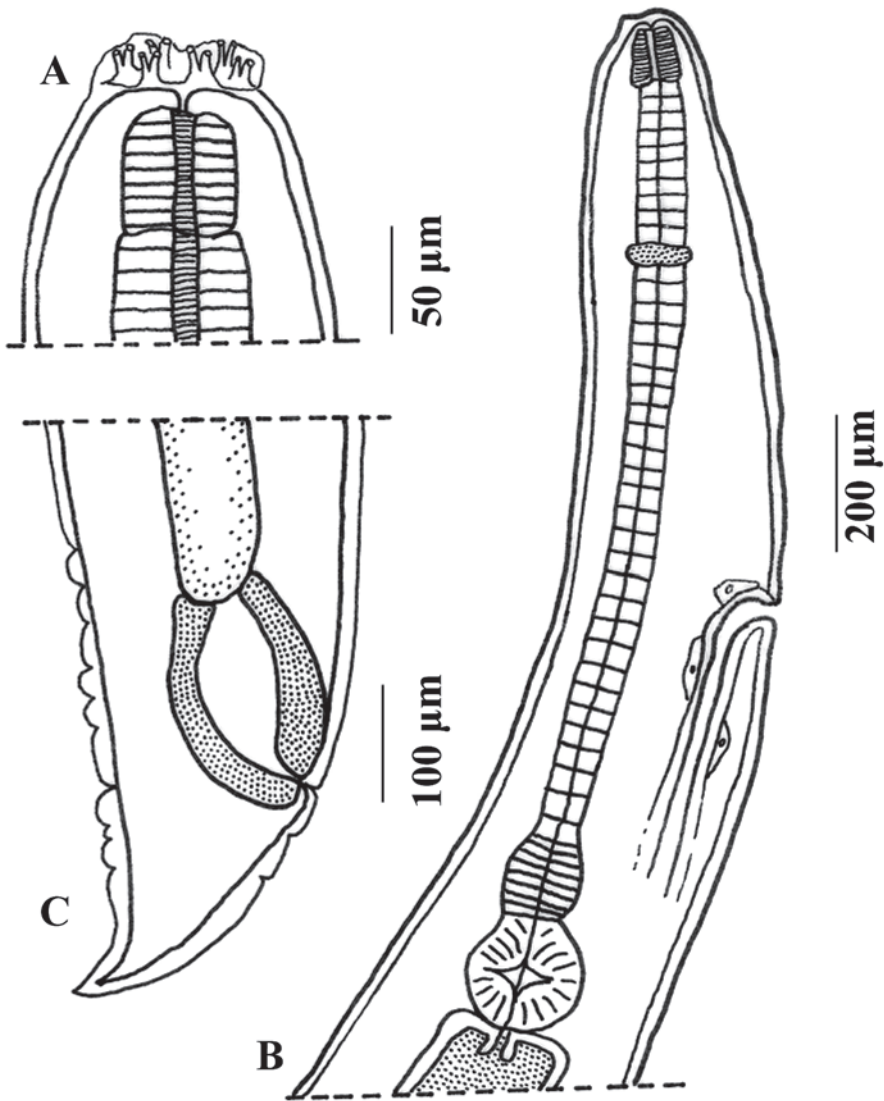


Fig. 3. Nematodes parasites of *Rhinella schneideri* and *Scinax acuminatus* from Corrientes, Argentina. A. *Falcaustra mascula*, female, detail of cephalic end. B. body anterior end, lateral view. C. body posterior end.

rhodomystax, *Crossodactylus gaudichaudii*, *Eleutherodactylus parvus*, *E. guentheri* and *Elosia nasus* (Leptodactylidae), *Bufo paracnemis* and *B. ictericus* (Bufonidae), *Hyla faber* (Hylidae) from Brazil and Paraguay (Freitas and Lent 1941, Lent *et al.* 1946, Gomes and Vicente 1966, Vicente and dos Santos 1976, Guimaraes *et al.* 1976, Fabio 1982, Rodrigues

et al. 1982, Baker 1987, Vicente *et al.* 1990, Luque *et al.* 2005, Martins and Fabio 2005, Goldberg *et al.* 2007).

The measurements of these specimens are something greater than those found by Freitas and Lent (1941) and by Vicente and dos Santos (1976); for example, the total length of body (Freitas and Lent 1941: 8.66-9.78 mm; Vicente

and dos Santos 1976: 7.23 mm; present study: 9.37-12.12 mm), the length of excretory pore to anterior end (Freitas and Lent 1941: 1.07-1.20 mm; Vicente and dos Santos 1976: 1.07 mm; present study: 0.93-1.25 mm) and the distance of vulva to the anterior end (Vicente and dos Santos 1976: 5.67 mm; present study: 6.47-8.92 mm).

This is the first record of *F. mascula* in an amphibian from Argentina.

Family Ascarididae Baird, 1853

Genus *Porrocaecum* Railliet & Henry, 1912

Porrocaecum sp. (Larvae)

Description: Based on 1 specimen. Body whitish, 9.3 mm x 195.0. Cuticle almost smooth or with very fine transverse striations. Cephalic end rounded, bearing small ventral larval tooth. Lips with dentigerous ridges. Esophagus narrow, 875.0 long. Nerve ring encircling esophagus, 186.3 from anterior extremity. Excretory pore 222.0 from anterior end of body. Ventriculus elongate 130 x 90; caecum 550 x 37.5. Rectum a short hyaline tube; small rectal glands present. Anus 126.5 from posterior extremity.

Remarks: In South America, *Porrocaecum* larvae were recorded in *Pipa pipa* (Pipidae) from Peru (Bursey *et al.* 2001) and in *L. chaquensis* (Leptodactylidae) from Argentina (Hamann *et al.* 2006b). These larvae undoubtedly belong to a *Porrocaecum* species parasitizing predatory birds, with amphibians and reptiles serving as paratenic hosts.

Family Physalopteridae Leiper, 1908

Genus *Physaloptera* Rudolphi, 1819

Physaloptera sp. (Larvae)

Description: (corresponding measurements of larvae obtained in *R. schneideri* are given within brackets). Larval body whitish, with transversely annulated cuticle. Terminus of head with two lateral lips and cephalic collar formed by inflated cuticle. On either lip a sclerotized

support and one terminal tooth present at upper margin. Each lip bearing two cephalic papillae and one amphid. Total length 3.59±0.65 mm (2.3-4.4) [5.9mm] x 163.3±22.7. (120-200) [280.0]. Muscular esophagus 176.0±18.4 (138-205) [275.0] x 32.7±3.5 (28-38) [45.0] and glandular esophagus 1.1±0.13mm (0.8-1.2) [1.75mm] x 59.3±7.0(51-70) [69.0]. Nerve ring and excretory pore from anterior end 149.0±17.8 (122-175) [275.0] and 161.1±12.0 (138-174) [360.0], respectively. Tail conical. Anus from posterior end 120.7±9.4 (110-135) [120.0].

Remarks: Larvae of this genus were found in the following South American amphibians: *Hyla faber* (Hylidae), *Bufo marinus* (Bufonidae), *Adenomera marmorata*, *Leptodactylus caliginosus*, *L. mystaceus*, *Physalaemus signiferus*, *P. soaresi* and *Proceratophrys appendiculata* (Leptodactylidae), from Brazil (Boquimpani-Freitas *et al.* 2001, Vicente *et al.* 1990); in *Bufo marinus* and *B. typhonius* (Bufonidae), in *Colostethus marchesianus* (Dendrobatidae), in *Hyla boans*, *H. fasciata*, *H. granosa*, *H. leali*, *H. leucophyllata*, *H. marmorata*, *Osteocephalus taurinus*, *Phrynohyas coriacea*, *P. venulosa*, *Phyllomedusa tomopterna*, *Scinax ictericus* and *S. ruba* (Hylidae), in *Edalorhina perezii*, *Eleutherodactylus cruralis*, *E. fenestratus*, *Leptodactylus bolivianus*, *L. leptodactyloides*, *L. mystaceus*, *L. pentadactylus*, *L. rhodonotus* and *Lithodytes lineatus* (Leptodactylidae), in *Ctenophryne geayi* and *Hamptophryne boliviana* (Microhylidae) and *Pseudis paradoxa* (Pseudidae) from Peru (Bursey *et al.* 2001). In Argentina, it was found by Gutiérrez *et al.* (2005) in *Physalaemus biligonigerus* and by González and Hamann (2006a, b, 2007a) in *Leptodactylus bufonius* (Leptodactylidae) and in *Chaunus granulatus major* and in *C. fernandezae* (Bufonidae). *Rhinella schneideri* and *Scinax acuminatus* represent two new records for this nematode.

The measures of the larvae found in the bufonid were, in general, greater than the found ones in the hylids. These measurements

correspond to the larvae found in other bufonids studied in the same area (González and Hamann 2006a).

DISCUSSION

Four of nine species of nematodes found in amphibians of this study were new records for Argentina: *Rhabdias füelleborni*, *Oswaldocruzia proencai*, *Falcaustra mascula* and *Oxyascaris caudacutus*, whereas *Rhabdias elegans*, *Cosmocerca parva*, *C. podicipinus*, *Porrocaecum* sp. and *Physaloptera* sp. have previously been reported from Argentinean amphibians. All these nematodes have been found in hylids and bufonids of South America, except *Porrocaecum* sp. that until now had been found in leptodactylids and pipids amphibians only from Argentina (Hamann *et al.* 2006b) and Peru (Burseley *et al.* 2001). In the present study no rhabditids were found in *S. acuminatus*. Besides, this host has less than half species of nematodes that *R. schneideri*.

All nematode species found in this study were classified as generalist because they were not restricted to a single host species.

In general, the bufonids present high predominance of nematodes in their parasitofauna; the highest species richness of nematodes in South America was reported by Luque *et al.* (2005) in *Bufo ictericus* from Brazil with thirteen nematodes species. For other bufonids the reports were the following: six species for *B. typhoni*, four species for *B. marinus* and *Atelopus bomolochus*, and two species for *B. glaberrimus* from Peru (Burseley *et al.* 2001, Iannaccone 2003), three species for *Atelopus spurelli* from Colombia (Goldberg and Bursey 2003), and four species for *Chaunus granulatus major* and *C. fernandezae* from Argentina (González and Hamann 2006a, 2007); lowest species richness of nematodes in Argentinean bufonids were two species for *C. bergi* (González and Hamann 2007a,b).

In the genus *Scinax* nematode species richness is, in general, low. In Peruvian anurans only one species was found in *S. pedromedinae*, two in *S. garbei* and *S. ruba*, and three

species in *S. icterica* (Burseley *et al.* 2001); in Brazil, Azevedo-Ramos *et al.* (1998) found two species of nematodes in *S. trilineata* and in *S. nebulosa*, and, and Goldberg *et al.* (2007) found two species in *S. fuscomarginatus*.

In agreement with Bursey *et al.* (2001), we found different nematode species between *R. schneideri* (terrestrial habitat), and *S. acuminatus* (mostly arboreal habitat), suggesting host behaviour and parasites biology are an important factor in the infection of parasites, but, in contraposition of these authors we found the most important intestinal nematodes in terrestrial amphibia were those that infect host by skin penetration (i.e., *Rhabdias* spp. and *Cosmocerca* spp.) this result could be explained by the type of habitat in our studies.

ACKNOWLEDGMENTS

This work was partially supported by Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) from Argentina, through grant PIP 2945 to M. I. Hamann. The suggestions made by referees have greatly improved the manuscript.

RESUMEN

Cuarenta y cuatro anfibios pertenecientes a dos especies (*Rhinella schneideri* –seis machos, tres hembras y dos juveniles- y *Scinax acuminatus* –quince machos y dieciocho hembras) fueron recolectados para extraer nemátodos en las proximidades de la ciudad de Corrientes, provincia de Corrientes en Argentina, entre enero 2002 y diciembre 2003. *Rhinella schneideri* estuvo parasitada por ocho especies de nemátodos (adultos: *Rhabdias füelleborni*, *R. elegans*, *Oswaldocruzia proencai*, *Cosmocerca podicipinus*, *C. parva* y *Falcaustra mascula*; larvas: *Porrocaecum* sp. y *Physaloptera* sp.), y *S. acuminatus* presentó tres especies de nemátodos (adultos: *Cosmocerca parva* y *Oxyascaris caudacutus*; larva: *Physaloptera* sp.). Para todas estas especies de nemátodos se presentan datos morfológicos y métricos, y para algunas sus nuevos ámbitos y caracteres, así como también los detalles obtenidos mediante el microscopio electrónico de barrido. Éste es el primer informe de nemátodos parásitos para los citados anfibios de Corrientes, Argentina.

Palabras clave: anfibios, *Rhinella schneideri*, *Scinax acuminatus*, nemátodos parásitos, Corrientes, Argentina.

REFERENCES

- Azevedo-Ramos, C., M.M.Q. Santos & V.R.L. Oliveira. 1998. Helminths of Three Amazonian Treefrogs: Interspecific Differences in Prevalence and Infection Intensity of Parasites. *Cien. Cult.* 50: 361-363.
- Baker, M.R. 1987. Synopsis of the nematoda parasitic in amphibians and reptiles. Occasional Papers in Biology. No 11. Memorial University of Newfoundland. Guelph, Ontario, Canada.
- Baker, M.R. & C. Vaucher. 1984. Parasitic Helminths from Paraguay VI: *Cosmocerca* Diesing, 1861 (Nematoda: Cosmocercidae) from frogs. *Rev. suisse Zool.* 91, 925-934.
- Baker, M.R. & C. Vaucher. 1985. Parasitic Helminths from Paraguay VII: Systematic Position of *Oxyascaris* Travassos, 1920 (Nematoda: Cosmocercidae). *Rev. suisse Zool.* 92: 303-310.
- Ben Slimane, B. & M-C. Durette-Desset. 1995. *Oswaldocruzia* (Nematoda, Trichostrongylina, Molineoidea) parasites d'Amphibiens du Brésil et de l'Équateur, avec redéfinition de l'espèce-type *O. subauricularis* (Rudolphi, 1819) et d'*O. mazzai* Travassos, 1935. *Rev. suisse Zool.* 102: 635-653.
- Ben Slimane, B., A.G. Chabaud & M-C. Durette-Desset. 1996. Les nématodes Trichostrongylinae parasites d'amphibiens et de reptiles: Problèmes taxonomiques, phylétiques et biogéographiques. *Syst. Parasitol.* 35: 179-206.
- Bolek, M.G. & J.R. Coggins. 2000. Seasonal occurrence and community structure of helminth parasites from the eastern American toad, *Bufo americanus americanus* from southeastern Wisconsin, U.S.A. *Comp. Parasitol.* 67: 202-209.
- Bolek, M.G. & J.R. Coggins. 2003. Helminth community structure of sympatric eastern american toad, *Bufo americanus americanus*, northern leopard frog, *Rana pipiens*, and blue-spotted salamander, *Ambystoma laterale*, from southeastern Wisconsin. *J. Parasitol.* 89: 673-680.
- Boquimpani-Freitas, L., D. Vrcibradic, J.J. Vicente, C.R. Bursey, C.F.D. Rocha & M. Van Sluys. 2001. Helminths of the horned leaf frog, *Proceratophrys appendiculata*, from southeastern Brazil. *J. Helminthol.* 75: 233-236.
- Bursey, C.R., S.R. Goldberg & J.R. Pamarlee. 2001. Gastrointestinal helminths of 51 species of anurans from Reserva Cuzco Amazónico, Peru. *Comp. Parasitol.* 68: 21-35.
- Bursey, C.R., S.R. Goldberg & S.R. Telford, Jr. 2003. *Rhabdias anolis* n. sp. (Nematoda: Rhabdiasidae) from the lizard, *Anolis frenatus* (Sauria: Polychrotidae), from Panama. *J. Parasitol.* 89: 113-117.
- Bush, A.O., K.D. Lafferty, J.M. Lotz & A.W. Shostak. 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *J. Parasitol.* 83: 575-583.
- Duré, M.I. 2004. Estructura trófica y aspectos ecológicos de los gremios de una comunidad de anfibios de la provincia de Corrientes. Tesis, Universidad Nacional de La Plata. Argentina.
- Fabio, S.P. 1982. Helminths de populações simpátricas de algumas espécies de anfíbios anuros da família Leptodactylidae. *Arq. Univ. Fed. Rur. Rio de Janeiro* 5: 69-83.
- Fahel, J. 1952. Fauna helminthologica das "guas" de Salvador (*Leptodactylus pentadactylus* (Lau.). *An. Acad. Brasil. Ci.* 24: 389-436.
- Freitas, J.F.T. 1958. Estudos sobre "Oxyascarididae" (Travassos, 1920) (Nematoda, Subuluroidea). *Mem. Inst. Oswaldo Cruz* 56: 489-515.
- Freitas J.F.T. & H. Lent. 1941. Contribuição ao estudo da sub-família Kathlaniinae Lane, 1914 (Nematoda, Subuluroidea). *Arq. Zool. S. Paulo* 3: 13-42.
- Gomes, D.C. & J.J. Vicente. 1966. Ocorrência de *Falcaustra mascula* (Rud., 1819) em *Crossodactylus gaudichaudii* Dum. & Bibr. (Nematoda, Kathlanidae). *Atas Soc. Biol. Rio de Janeiro* 10: 113-116.
- Goldberg, S.R. & C.R. Bursey. 2003. Helminths of two anuran species; *Atelopus spurrelli* (Bufonidae) and *Dendrobates histrionicus* (Dendrobatidae), from Colombia, South America. *Parasitol. Int.* 52: 251-253.
- Goldberg, S.R., C.R. Bursey, J.P. Caldwell, L.J. Vitt & G.C. Costa. 2007. Gastrointestinal helminths from six species of frogs and three species of lizards, sympatric in Pará State, Brazil. *Comp. Parasitol.* 74: 327-342.
- González, C.E. & M.I. Hamann. 2004. Primer registro de *Cosmocerca podicipinus* Baker y Vaucher, 1984 (Nematoda: Cosmocercidae) en *Pseudopaludicola falcipes* (Hensel, 1867) (Amphibia: Leptodactylidae) en Corrientes, Argentina. *Facena* 20: 65-72.
- González, C.E. & M.I. Hamann. 2005. *Gyrinicola chabaudi* Araujo & Artigas, 1982 (Nematoda:

- Pharyngodonidae) in tadpoles of *Scinax nasicus* (Cope, 1862) (Anura: Hylidae) from Corrientes, Argentina. *Facena* 21: 145-148.
- González, C.E. & M.I. Hamann. 2006a. Nematodes parásitos de *Chaunus granulatus major* (Müller & Hellmich, 1936) (Anura: Bufonidae) en Corrientes, Argentina. *Cuad. Herpetol.* 20: 43-49.
- González, C.E. & M.I. Hamann. 2006b. Helmintos parásitos de *Leptodactylus bufonius* Boulenger, 1894 (Anura: Leptodactylidae) de Corrientes, Argentina. *Rev. Esp. Herpetol.* 20: 39-46.
- González, C.E. & M.I. Hamann. 2007a. Nematode parasites of two species of *Chaunus* (Anura: Bufonidae) from Corrientes, Argentina. *Zootaxa* 1393: 27-34.
- González, C.E. & M.I. Hamann. 2007b. *Chaunus bergi* (NCN) Endoparasites. *Herpetol. Rev.* 38: 181.
- González, C.E. & M.I. Hamann. 2007c. The first record of amphibians as paratenic host of *Serpinema* larvae (Nematoda: Camallanidae). *Braz. J. Biol.* 67: 579-580.
- Guimaraes, J.F., R. Cristofaro & H.O. Rodrigues. 1976. Alguns nematódeos de anfíbios de Salvador, Bahia. *Atas Soc. Biol. Rio de Janeiro* 18: 71-74.
- Gutierrez, R.O. 1945. Contribución al conocimiento de los nematodos parásitos de anfíbios argentinos. Tesis. Universidad Nacional de La Plata. Argentina.
- Gutierrez, C., A. Attademo, S. Guerrero, P. Peltzer & R. Lajmanovich. 2005. *Physalaemus biligonigerus* (False-eyed Frog). *Endoparasites. Herpetol. Rev.* 36: 161-162.
- Hamann, M.I., C.E. González & A.I. Kehr. 2006a. Helminth community structure of the oven frog *Leptodactylus latinasus* (Anura, Leptodactylidae) from Corrientes, Argentina. *Acta Parasitol.* 51: 294-299.
- Hamann, M.I., A.I. Kehr & C.E. González. 2006b. Species affinity and infracommunity ordination of helminths of *Leptodactylus chaquensis* (Anura: Leptodactylidae) of two contrasting environments from northeastern Argentina. *J. Parasitol.* 92: 1171-1179.
- Ianaconne, J. 2003. Helmintos parásitos de *Atelopus bomolochus* Peters, 1973 (Anura: Bufonidae) from Piura, Peru. *Gayana* 67: 9-15.
- Kloss, G.R. 1971. Alguns *Rhabdias* (Nematoda) de *Bufo* no Brasil. *Pap. Avuls. Dep. Zool. S. Paulo* 24: 1-52.
- Kloss, G.R. 1974. *Rhabdias* (Nematoda, Rhabditoidea) from the *marinus* group of *Bufo*. A study of sibling species. *Arq. Zool.* 25: 61-120.
- Lavilla, E.O., E. Richard & G.J. Scrocchi. 2000. Categorización de los anfibios y reptiles de la República Argentina. Asociación Herpetológica Argentina. Tucumán, Tucumán. Argentina.
- Lent, H., J.F.T. Freitas & M.C. Proença. 1946. Alguns helmintos de batráquios coleccionados no Paraguai. *Mem. Inst. Oswaldo Cruz* 44: 195-214.
- Luque, J.L., A.N. Martins & L.E.R. Tavares. 2005. Community structure of metazoan parasites of the yellow Cururu toad, *Bufo ictericus* (Anura, Bufonidae) from Rio de Janeiro, Brazil. *Acta Parasitol.* 50: 215-220.
- Masi Pallares, R. & S. Maciel. 1974. Helminthes en batracios del Paraguay (Ira. Parte), con descripción de una nueva especie, *Aplectana pudenda* (Oxyuridae: Cosmocercinae). *Rev. Paraguaya Microbiol.* 9: 55-60.
- Martínez-Salazar, E.A. & V. León-Règagnon. 2006. *Rhabdias lamothei* n. sp. (Nematoda: Rhabdiasidae) from *Leptodeira maculata* (Colubridae) in Mexico, including new records of *R. fuscovenosa* (Railliet, 1899) Goodey, 1924. *Zootaxa* 1257: 27-48.
- Martins, A.N. & S.P. Fabio. 2005. Parasitismo por nematóides em populações simpátricas de *Eleutherodactylus parvus* (Girard, 1853) e *Eleutherodactylus guentheri* (Steindachner, 1864) - (Anura: Leptodactylidae). *Acta Biol Leopold.* 27: 47-50.
- Mordeglia, C. & M.C. Digiani. 1998. *Cosmocerca parva* Travassos, 1925 (Nematoda: Cosmocercidae) in Toads from Argentina. *Mem. Inst. Oswaldo Cruz* 93: 737-738.
- Rodrigues, H.O., S.S. Rodrigues & R. Cristofaro. 1982. Contribuição ao conhecimento da fauna helmintológica de Barra do Pirai, Estado do Rio de Janeiro. *Atas Soc. Biol. Rio de Janeiro* 23: 5-8.
- Sueldo, C. & V.G. Ramirez. 1976. Aportes sobre parásitos de *Bufo arenarum* en la provincia de Salta (Nematoda). *Neotropica* 22: 105-106.
- Travassos, L. 1926. Entwicklung des *Rhabdias fülleborni* n. sp. *Arch. f Schiffs Trop. Hyg.* 30: 594-602.
- Vicente, J.J. & E. dos Santos. 1976. Fauna helmintológica de *Leptodactylus ocellatus* (L., 1758) de Volta

Redonda, Estado do Rio de Janeiro. Atas Soc. Biol. Rio de Janeiro 18: 27-42.

Vicente, J.J., H.O. Rodrigues, D.C. Gomes & R.M. Pinto. 1990. Nematóides do Brasil. Parte II: Nematóides de anfíbios. Rev. Brasil. Zool. 7: 549-626.

Yoder, H.R. & J.R. Coggins. 1996. Helminth communities in the northern spring peeper, *Pseudacris c. crucifer* Wied., and the wood frog, *Rana sylvatica* Le Conte from southeastern Wisconsin. J. Helminthol. Soc. Wash. 63: 211-214.

Yoder, H.R. & J.R. Coggins. 2007. Helminth communities in five species of sympatric amphibians from three adjacent ephemeral ponds in Southeastern Wisconsin. J. Parasitol. 93: 755-760.

INTERNET REFERENCE

Frost, D.R. 2007. Amphibian species of the world: an online reference. Version 4.0. American Museum of Natural History, New York, USA. (Downloaded: 19 June 2008, <http://research.amnh.org/herpetology/amphibia/index.php>).