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Digenean fauna in raptors from northeastern Argentina, with the description of a new species of *Strigea* (Digenea: Strigeidae)

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Abstract

The digenean fauna of six species of falconiform birds from northeastern Argentina is reported and a new species and several new hosts and geographical records are presented. *Strigea proteolytica* **n. sp.** (Strigeidae) is described from *Buteogallus urubitinga* and distinguished from their congeners by the combination of the following characters: plump body, conspicuous proteolytic gland, forebody with scarce vitelline glands, copulatory bursa with a well developed muscular ring (*Ringnapf*), and absence of true neck region in hindbody. Six previously known species are breifly described: *Strigea falconis brasiliana* Szidat, 1929 (Strigeidae) from *Milvago chimachima* and *Caracara plancus*; *Neodiplostomum travassosi* Dubois, 1937 from *Buteogallus meridionalis*; *Tylodelphys brevis* Drago & Lunaschi, 2008 and *Posthodiplostomum macrocotyle* Dubois, 1937 (Diplostomidae) from *Busarellus nigricollis*; *Spaniometra variolaris* (Fuhrmann, 1904) (Cyclocoelidae) and *Megalophallus deblocki* Kostadinova, Vaucher & Gibson, 2006 (Microphallidae) from *Rostrhamus sociabilis*. Literature records and information on distribution and host-parasite relationships is presented.

Key words: Accipitridae, Falconidae, *Strigea proteolytica* **n. sp.**, Diplostomidae, Cyclocoelidae, Microphallidae

Introduction

Although 55 species of falconiform birds (39 Accipitridae, 15 Falconidae and 1 Pandionidae) inhabit Argentina, the information about their digeneans fauna is scarce. At present, 5 accipitrid species (the savanna hawk, *Buteogallus meridionalis* [Latham]; the great black-hawk, *Buteogallus urubitinga* [Gmelin]; the black–collared hawk, *Busarellus nigricollis* [Latham]; the snail kite, *Rostrhamus sociabilis* [Vieillot] and the roadside hawk, *Rupornis magnirostris* [Gmelin]) and three falconid species (the southern caracara, *Caracara plancus* [Miller]; the yellow–headed caracara, *Milvago chimachima* [Vieillot] and the chimango, *Milvago chimango* [Vieillot]) have been reported as hosts of digeneans. In these hosts primarily have been reported strigeids: *Strigea elliptica* (Brandes) Szidat, 1928, *Strigea falconis brasiliana* Szidat, 1929, *Strigea magniova* Dubois, 1988, *Strigea meridionalis* Lunaschi & Drago, 2009, *Strigea microbursa* Pearson & Dubois, 1985, *Ophiosoma microcephalum* Szidat, 1928 and *Parastrigea macrobursa* Drago & Lunaschi, 2011. Also, one species of Diplostomidae (*Neodiplostomum travassosi* Dubois, 1937), one of Dicrocoeliidae (*Athesmia heterolecithodes* [Braun, 1899]) and one of Stomylotrematidae (*Stomylotrema vicarium* Braun, 1901) have been recovered (Lunaschi *et al*. 2007; Lunaschi & Drago 2009a, b; Drago & Lunaschi 2011a).

The aim of this paper is to increase the knowledge of the diversity of digenean parasites from falconiform birds from northeastern Argentina.

Material and methods

Twenty-five birds were collected with a shotgun between 2003 and 2012 at La Marcela farm, Pirané, Formosa Province, Argentina (26°17'35"S; 59°06'38"W), with authorization of Ministerio de la Producción, Dirección de

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Fauna y Parques of Formosa Province. The bird species analyzed were *Caracara plancus* (n=3), *Milvago chimachima* (n=2), *Rostrhamus sociabilis* (n=7), *Busarellus nigricollis* (n=2), *Buteogallus meridionalis* (n=7) and *Buteogallus urubitinga* (Gmelin) (n=4). The birds were dissected in the field and their viscera were analysed immediately after capture. The digenean specimens were removed, fixed in 5% hot formalin, stained with a 1:6 dilution in 96% ethanol of hydrochloric carmine, dehydrated and mounted in Canada balsam between cover glasses in order to facilitate handling and observation. Measurements are given in micrometres (μm) unless otherwise stated, as the range followed by the mean in parentheses. Drawings were made with the aid of a drawing tube. In strigeids, the opening is defined as the anterior end of hollow forebody, this structure is classified as: large opening, when is similar (75%–100%) to maximum width of forebody, medium opening, when occupy 25–75 % maximum width of forebody, and narrow opening when is lesser to 25% of maximum width of forebody. The term true neck region or Halsteil is used according Dubois (1968) as the proximal and preovarian region of hindbody, when it is elongate and thinner than the gonadal region and occupy nearly 40–50% of this segment. The taxonomy of digeneans is given in accordance to Gibson *et al*. (2002) and Bray *et al*. (2008). The digeneans were deposited in the Helminthological Collection of the Museo de La Plata (MLP), and the hosts in the Ornithological Collection of the Museo de La Plata (MLP), La Plata, Argentina.

Results

Seven digenean species (3 diplostomids, 2 strigeids, one cyclocoelid, and one microphallid) were found (Table 1).

TABLE 1. Prevalence (P) and mean intensity (MI) of digeneans from raptors in Formosa Province.

	Parasite species	P (%)	MI
Busarellus nigricollis	*Posthodiplostomum macrocotyle**	100	132
	*Tylodelphys brevis**	50	3
Buteogallus meridionalis	*Megalophallus deblocki**	14	1
	*Neodiplostomum travassosi**	29	26
Buteogallus urubitinga	*Strigea proteolytica* **n. sp.**	75	8
Caracara plancus	*Strigea falconis brasiliana*	33.3	9
Milvago chimachima	*Strigea falconis brasiliana**	33.3	2
Rostrhamus sociabilis	*Megalophallus deblocki*	14	64
	Spaniometra variolaris	29	11.5

*New Host record.

Strigeidae

***Strigea proteolytica* n. sp.**
(Figs. 1–4; Tables 2, 3)

Type host: *Buteogallus urubitinga* (Gmelin), great black-hawk (Accipitridae)

Site of infection: small intestine.

Type locality: La Marcela farm (26°17'35"S; 59°06'38"W), Pirané, Formosa Province, Argentina.

Type material: Holotype MLP 6709; paratypes, MLP 6710 (6 specimens).

Voucher specimens: MLP 6711 (4 specimens).

Prevalence: 3 of 4 (75 %).

Mean intensity: 8.3 (1–13).

Etymology: The specific name refers to its large and conspicuous proteolytic gland.

Description: Based on 12 specimens. Body plump, distinctly bipartite, 1.789–2.305 (1.992) mm long. Forebody cup-shaped, with a large opening, 580–1000 (756) long by 725–861 (803) wide; dorsal wall armed with minute, densely arranged tegumental spines. Hindbody subcylindrical, strongly curved dorsally, without true neck

region, 1.064–1.518 (1.237) mm long by 561–667 (598) wide. Ratio of forebody length to hindbody length 1:1.2–2.6 (1.7). Oral sucker elliptical, well developed, terminal, usually projecting from opening, 83–143 (124) long by 106–145 (131) wide. Ventral sucker round to elliptical, well developed, always larger than oral sucker, located in second half of forebody, 207–266 (225) long by 190–275 (235) wide. Suckers width ratio 1:1.5–2.1 (1.8). Prepharynx short; pharynx elliptical, immediately posterior to oral sucker, 129–167 (143) long by 105–136 (122) wide; esophagus present; ceca not discernible. Ratio of oral sucker width to pharynx width 1:0.8–1.1 (1). Pseudosuckers absent. Holdfast organ lobes usually projected from opening. Proteolytic gland multilobed, large, conspicuous, situated at base of forebody, usually displaced toward the dorsal wall, with some lobes overlapping ventral sucker, 112–290 (228) long by 248–410 (320) wide. Testes tandem, entire, occupying middle third of hindbody; anterior testis 193–338 (267) long by 294–386 (341) wide; posterior testis 159–386 (281) long by 217–425 (340) wide. Seminal vesicle long, folded on itself, posterior to posterior testis. Copulatory bursa poorly delimited, 217–425 (303) long by 241–430 (309) wide; genital atrium, 143–242 (192) in depth; genital cone well delimited from body parenchyma, strongly muscular, obliquely oriented, 202–275 (244) long by 143–290 (224) wide; ejaculatory duct and uterus join at base of genital cone forming a broad hermaphroditic duct. Muscular ring (*Ringnapf*) well developed and conspicuous. Ratio of genital cone length to hindbody length 1:4–6 (5). Preovarian region occupying 12%–24% of hindbody. Ovary bilobed, 97–150 (124) long by 179–251 (215) wide, located at 130–314 (233) from junction of fore– and hindbody. Laurer's canal short, opening dorsally between ovary and anterior testis. Vitelline follicles similar in size in both parts of body; in forebody invading principally the ventral lobe of holdfast organ, while in body wall dispersed, with few follicles in area of intersegmental constriction and in equatorial region; in hindbody occupying almost entire width in pre–ovarian region, extending ventrally to testes, up to the genital cone region. Mehlis' gland and vitelline reservoir in intertesticular region. Uterus ventral, containing 1–40 large eggs, 81–112 (100) long by 45–62 (54) wide, some with eye–spotted miracidia. Ratio of egg length to body length 1:17–26 (20). Ratio of egg length to genital cone length 1: 1.9–5.7 (3.6). Excretory vesicle and pore, not observed.

Remarks: At present, in the Neotropical region 14 species of *Strigea* Abildgaard, 1790 have been reported parasitizing strigiform, ciconiiform, falconiform, caprimulgiform, passeriform, gruiform, trogoniform and anseriform birds (see Lunaschi & Drago 2013). Among these species, only 3 of them share with *S. proteolytica* **n. sp.** the body shape, the absence of true neck region in hindbody and the distribution of vitelline follicles in forebody, which are scarce and extend into the lobes of the holdfast organ. These species are *Strigea vaginata* (Brandes) Szidat, 1928 from Cathartidae, Falconidae, Accipitridae, Cariamidae, Threskiornithidae and Anatidae from Argentina, Brazil, Colombia, Cuba and Venezuela (Dubois 1968, Drago & Lunaschi 2011b), *Strigea falconis brasiliana* from Accipitridae, Falconidae Cathartidae and Phalacrocoracidae from Cuba, Brazil, Venezuela and Argentina (Dubois 1968, Lunaschi & Drago 2006, 2009a, Drago *et al*. 2011) and *Strigea inflecta* Lunaschi & Drago, 2012 from *Cariama cristata* (L.) (Cariamidae) from Argentina (Lunaschi & Drago 2012). *Strigea vaginata* (Table 2) can be easily distinguished from *S. proteolytica* **n. sp.** by being larger (up to 7000 vs. 1789–2305), by having a proteolytic gland with two flaps that penetrate in the hindbody, and an enormous genital cone, that can reach up to half the length of the hindbody (480–2000 x 300–900 vs. 202–275 x 143–290). *Strigea falconis brasiliana* (Table 2) differs mainly from the specimens here studied by having a slender hindbody, testes lobed, smaller proteolytic gland (105–130 x 120–190 vs. 112–290 x 248–410), forebody (319–590 x 314–700 vs. 580–1000 x 725–861) and pharynx (73–95 x 48–95 vs. 129–167 x 105–136). *Strigea inflecta* (Table 2) can be distinguished from *S. proteolytica* **n. sp.** by the absence of muscular ring (*Ringnapf*), by having a larger genital cone (372–459 x 203–319 vs. 202–275 x 143–290), smaller proteolytic gland (72–121 x 121–174 vs. 112–290 x 248–410) and ratio Hi/Gc (2.4–3.1 vs. 4–6).

Three species of the genus reported parasitizing accipitrid birds from others zoogeographical regions are similar to the new species by having scarce vitelline glands in forebody: *Strigea sarcogyponis* (Vidyarthi, 1937) Dubois, 1966 reported in *Sarcogyps calvus* (Scopoli) by Vidyarthi (1937) and *Accipiter badius* (Gmelin) by Gupta & Mishra (1976) from India; *Strigea macroconophora* Dubois & Rausch, 1950 reported in *Buteo jamaicensis borealis* (Gmelin) and *Buteo platypterus* (Vieillot) by Dubois & Rausch (1950) from USA and *Strigea subglandulosa* Dubois & Beverley-Burton, 1971 described parasitizing *Circus ranivorus* (Daudin) by Dubois & Beverley-Burton (1971) from Zambia. *Strigea sarcogyponis* (Table 3) differs from the new species mainly by being larger (up to 5000 vs. 1789–2305), by having a medium opening, a true neck region (37%–50% of hindbody), a proteolytic gland situated in intersegmental region and multilobed testes. *Strigea macroconophora* (Table 3) can be

TABLE 2. Comparative data for *Strigea proteolytica* **n. sp.** and related species of the Neotropical Region.

Species	*Strigea proteolytica* **n. sp.**	*Strigea vaginata*		*Strigea falconis brasiliana*		*Strigea inflecta*
Country	Argentina	Brazil, Venezuela	Cuba	Brazil, Cuba	Argentina	Argentina
Source	Present study	Dubois (1968)	Dubois & Macko (1972)	Dubois (1968)	Lunaschi & Drago (2006)	Lunaschi & Drago (2012)
B	1789–2305	up to 7000	up to 5600	up to 2500	1305–1392	1605–1982
Fo	580–1000 x 725–861	680–1280 x 540–1070	740–1360 x 700–1300	380–590 x 420–700	319–415 x 314–367	561–754 x 783–1006
Hi	1064–1518 x 561–667	1160–1940 x 580–1290	1170–4240 x 580–1120	1110–1830 x 340–580	890–1073 x 362–435	967–1257 x 532–841
Os	83–143 x 106–145	115–210 x 100–210	110–170 x 100–150	100–125 x 85–115	76 x 55	183–241 x 126–155
Vs	207–266 x 190–275	165–296 x 133–285	185–280 x 160–240	160–235 x 140–200	152–162 x 71–105	179–290 x 174–256
Ph	129–167 x 105–136	96–165 x 100–165	105–150 x 90–145	73–95 x 70–95	74 x 48	140–169 x 109–126
Pg	112–290 x 248–410	——	190-270 x 210-370	105–130 x 120–190	——	72–121 x 121–174
O	97–150 x 179–251	100–350 x 140–360	100–230 x 200–380	110–200 x 175–300	59–68 x 101–107	111–237 x 155–222
At	193–338 x 294–386	180–620 x 320–630	210–500 x 290–750	235–360 x 235–410	169–227 x 174–190	135–232 x 401–483
Pt	159–386 x 217–425	230–600 x 340–660	220–500 x 350–710	275–370 x 235–420	197–217 x 179–241	150–193 x 338–483
Cb	217–425 x 241–430	——	——	——	183–241 x 215–226	314–435 x 483–652
Gc	202–275 x 143–290	580–2000 x 300–900	480–1500 x 350–875	240–350 x 220–310	128–167 x 129–143	372–459 x 203–319
Ga	143–242	——	——	——	——	232–290
E	81–112 x 45–62	80–106 x 46–65	99–104 x 57–70	67–91 x 42–55	82–88 x 48–52	86–111 x 50–58
Hi/Fo	1.2–2.6	1.5–2.5	1.5–3.1	1.9–3.6	2.1–3.4	1.5–1.7
Vs/Os	1.5–2.1	1.3–1.4*	1.6*	1.6–1.7*	1.9	1.4–2.1
Ph/Os	0.8–1.1	0.8–1*	0.9–1*	0.8*	0.9*	0.8–0.9*
B/E	17–26	66–88*	54–57*	27–37*	15–17*	16–19
Hi/Gc	4–6	——	2.4–2.8*	4.6–5.2*	6.4–7*	2.4–3.1
Gc/E	1.9–5.7	7-19*	5–15*	3–5*	1.5–2*	3.5–4.8
Hosts	*Buteogallus urubitinga*	*Cathartes aura aura* (L.)	*Cathartes aura aura*	Accipitridae** Falconidae***	*Rupornis magnirostris*	*Cariama cristata*

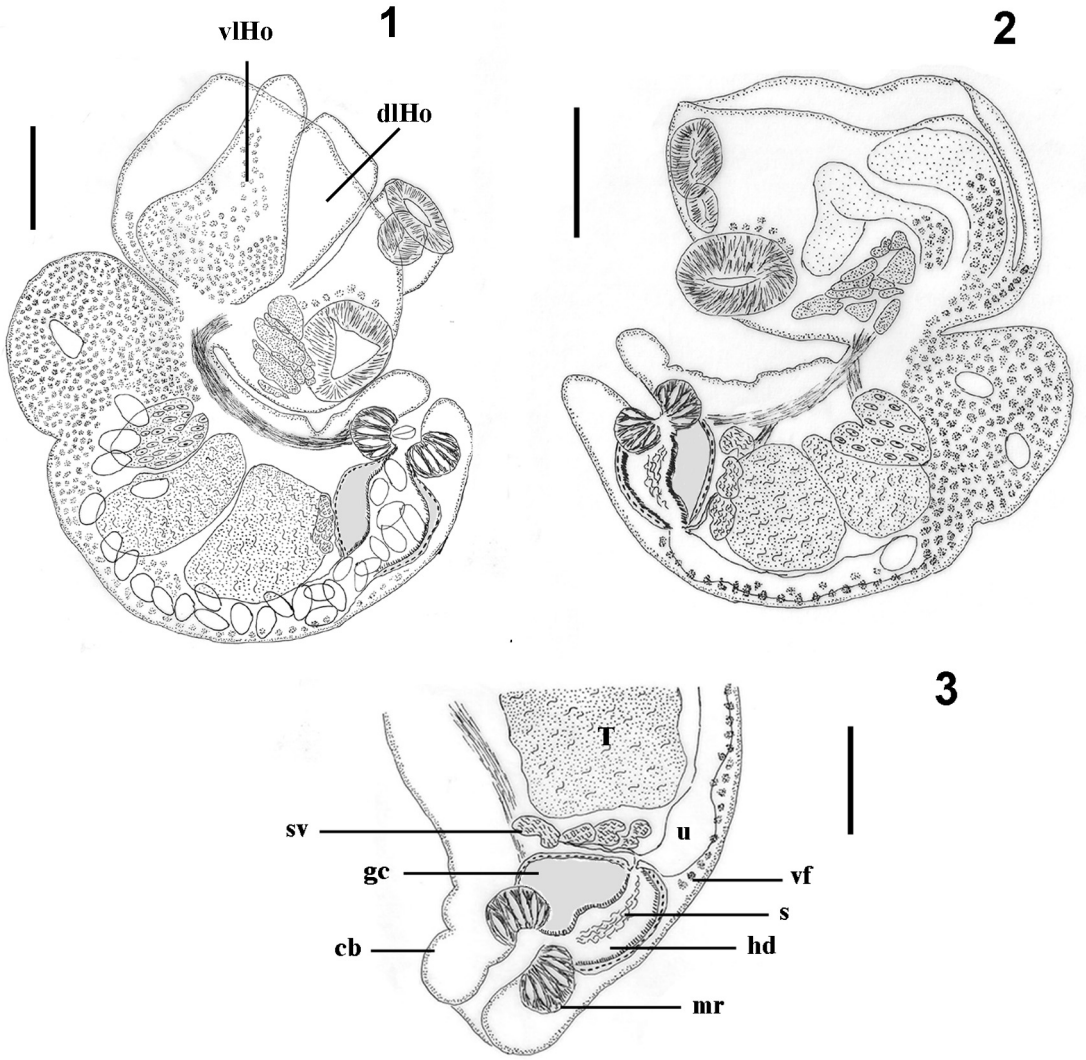
* Calculated from original descriptions; ** *Buteo albicaudatus* Vieillot, *Buteo jamaicensis umbrinus* Bangs, *R. magnirostris, Spizaetus ornatus* (Daudin); *** *Caracara plancus* (Miller), *Herpetotheres cachinnans* (L.). Abbreviations (used also in Table 3): At—anterior testis; B—body length; Cb—copulatory bursa; E—eggs; Fo—forebody; Ga—genital atrium; Gc—genital cone; Hi—hindbody; O—ovary; Os—oral sucker; Pg—proteolytic gland; Ph—pharynx; Pt—posterior testis; Vs—ventral sucker; B/E—body length/egg length; Gc/E—genital cone length/egg length; Hi/Fo—hindbody length/forebody length; Hi/Gc—hindbody length/genital cone length; Ph/Os—pharynx width /oral sucker width; Vs/Os—suckers width ratio.

TABLE 3. Comparative data for *Strigea proteolytica* **n. sp.** and related species of the Oriental, Holarctic and Ethiopian Regions.

Species	*Strigea proteolytica* **n. sp.**	*Strigea sarcogyponis*		*Strigea macroconophora*	*S. subglandulosa*
Country	Argentina	India		USA	Zambia
Source	Present study	Dubois (1968)	Gupta & Mishra (1976)**	Dubois (1968)	Dubois & Beverley-Burton (1971)
B	1789–2305	up to 5000	3190 (2900–3470)	up to 3100	1040–1340
Fo	580–1000 x 725–861	1400–1580 x 1260–1390	1010 x 830 (660–810 x 680–790)	600–810 x 730–1050	400–470 x 450–580
Hi	1064–1518 x 561–667	3420–3640 x 1020–1190	2180 x 580 (2120–2710 x 510–580)	1410–2340 x 750–900	640–960 x 360–560
Os	83–143 x 106–145	180–190 x 190–205	100 x 140 (75–85 x 100–125)	100–153 x 85–120	105–130 x 80–105
Vs	207–266 x 190–275	250–285 in diam.	225 x 240 (180–225 x 190–235)	190–200 x 140–160	135–185 x 90–160
Ph	129–167 x 105–136	128–133 x 92–96	105 x 127 (100–125 x 100–130)	100–119 in diam.	60–84 x 68–86
Pg	112–290 x 248–410	320 x 480	325 x 410 (175–185 x 220–300)	——	100–155 x 180–245
O	97–150 x 179–251	260 x 340	150 x 240 (190–235 x 150–250)	130–190 x 250–270	60–120 x 125–220
At	193–338 x 294–386	460 x 770	290 x 532 (325–425 x 340–425)	370–600 x 430–600	100–200 x 210–330
Pt	159–386 x 217–425	460–595 x 790	390 x 570 (360–490 x 400–490)	360–510 x 440–595	130–270 x 205–330
Cb	217–425 x 241–430	——	——	——	——
Gc	202–275 x 143–290	——	——	340–660 x 405–510	120–160 x 100–120
Ga	143–242	——	——	225–405	140–220
E	81–112 x 45–62	115–120 x 68–70	(87–90 x 70–80)	90–99 x 63–70	85–94 x 52–63
Hi/Fo	1.2–2.6	2.6–2.7	2.16 (2.7–3.9)	2.9–3.1 (2.3–2.6, in contracted specimens)	1.5–2.3
Vs/Os	1.5–2.1	1.3–1.4*	1.7 (1.9)*	1.3–1.6*	1.1–1.5*
Ph/Os	0.8–1.1	0.5*	0.9 (0.96–1)*	0.99–1.4*	0.8–0.9*
B/E	17–26	42–43*	(32–40)*	31–34*	11–16*
Hi/Gc	4–6	——	——	3.5–4.1*	5.3–6*
Gc/E	1.9–5.7	——	——	3–7*	1.3–1.9*
Hosts	*Buteogallus urubitinga*	*Sarcogyps calvus*	*Accipiter badius*	*Buteo jamaicensis borealis* *Buteo platypterus*	*Circus ranivorus*

* Calculated from original descriptions; ** In parentheses measurements of specimens from *A. badius* originally described as *Srigea thapari* Gupta & Mishra, 1976, and synonymized with *S. sarcogyponis* by Dubois (1982). See Table 2 for abbreviations.

distinguished from *S. proteolytica* **n. sp.** by having a forebody with a narrow opening, a proteolytic gland situated in the intersegmental region and deeply lobed testes, smaller ventral sucker (190–200 x 140–160 vs. 207–266 x 190–275) and pharynx (100–119 in diam vs. 129–167 x 105–136), and larger anterior testis (370–600 x 430–600 vs. 193–338 x 294–386), posterior testis (360–510 x 440–595 vs. 159–386 x 217–425) and genital cone (340–660 x 405–510 vs. 202–275 x 143–290). Finally, *Strigea subglandulosa* differs from the new species in most of the metrical characters (Table 3), and by possessing deeply lobed testes.



FIGURES 1–3. *Strigea proteolytica* **n. sp.** from *Buteogallus urubitinga*. **1.** Holotype, entire worm, scale bar = 250 µm. **2.** Paratype, entire worm, scale bar = 300 µm. **3.** Paratype, enlarged view of terminal genitalia, scale bar = 200 µm. Abbreviations: cb, copulatory bursa; dlHo, dorsal lobe of holdfast organ; gc, genital cone; hd, hermaphroditic duct; mr, muscular ring; s, spermatozoids; sv, seminal vesicle; T, testis; u, uterus; vf, vitelline follicles; vlHo, ventral lobe of holdfast organ.

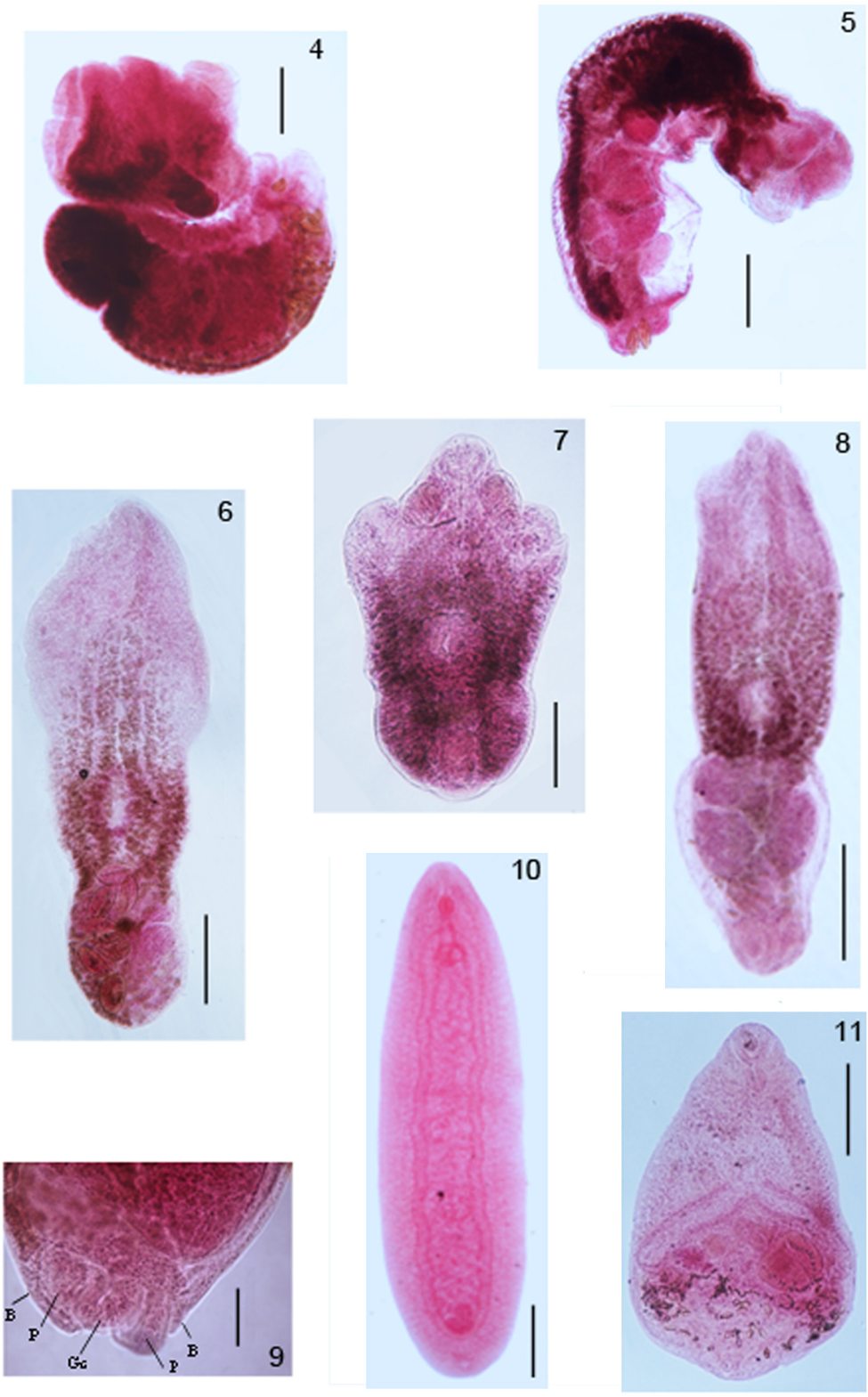
***Strigea falconis brasiliana* Szidat, 1929**
(Fig. 5)

Hosts: *Milvago chimachima* (Vieillot), yellow–headed caracara (Falconidae); *Caracara plancus* (Miller), southern caracara (Falconidae).

Site of infection: small intestine

Voucher specimens: *M. chimachima* MLP 6712, *C. plancus* MLP 6713.

Distribution and hosts: This strigeid is considered euryxenous, because it has a broad spectrum of definitive hosts, including 12 species of raptors, scavenging and aquatic birds (see Lunaschi and Drago 2013).



FIGURES 4–11. Digeneans from raptors. **4.** *Strigea proteolytica* **n. sp.** from *Buteogallus urubitinga*, scale bar = 250 µm. **5.** *Strigea falconis brasiliana* Szidat, 1929 from *Caracara plancus*, scale bar = 250 µm. **6.** *Neodiplostomum travassosi* Dubois, 1937 from *Buteogallus meridionalis*, scale bar = 200 µm. **7.** *Tylodelphys brevis* Drago & Lunaschi, 2008 from *Busarellus nigricollis*, scale bar = 100 µm. **8.** *Posthodiplostomum macrocotyle* Dubois, 1937 from *B. nigricollis*, scale bar 200 µm. **9.** Enlarged view of copulatory bursa of *P. macrocotyle*, scale bar 50 µm. **10.** *Spaniometra variolaris* (Fuhrmann, 1904) from *R. sociabilis*, scale bar 500 µm. **11.** *Megalophallus deblocki* Kostadinova, Vaucher & Gibson, 2006 from *R. sociabilis*, scale bar 100 µm. Abbreviations: B, body wall; Gc, genital cone; P, prepuce.

Measurements: Based on 5 specimens. Body distinctly bipartite; 1.949–2.881 mm (2.432 mm) long. Forebody cup shaped, 469–609 (543) long by 435–609 (548) wide. Hindbody subcylindrical, without true neck region, 1.480–2.272 (1.889) mm long by 532–706 (0.645) wide. Ratio of forebody length to hindbody length 1:3.2–3.7 (3.5). Oral sucker ovoid, slightly subterminal, 95–119 (107) long by 79–107 (93) wide. Ventral sucker round, 131–233 (181) long by 98–200 (139) wide. Suckers width ratio 1:1.1–2.5 (1.8). Pharynx elliptical, immediately posterior to oral sucker, 119–125 (121) long by 140–145 (142) wide. Testes tandem, lobated, in the posterior middle hindbody; anterior testis 237–507 (345) long by 290–440 (375) wide; posterior testis 327–362 (350) long by 314430 (388) wide. Copulatory bursa 450–464 (460) long by 465–474 (468) wide; genital cone 143–314 (229) long by 136–391 (264) wide. Muscular ring (*Ringnapf*) well developed. Ovary elliptical to reniform, 93–167 (132) long by 174–266 (207) wide, located at 435–783 (599) from junction of fore- and hindbody. Vitellarium follicular, densely distributed in hindbody; in forebody reaching to ventral sucker; in hindbody occupying its whole width in preovarian region and extending dorsally to copulatory bursa. Vitelline reservoir intertesticular. Uterus with 32–50 (41) eggs, 83–117 (99) long by 50–60 (54) wide.

Remarks: The finding of this strigeid species in *M. chimachima* represents a new host record.

Family Diplostomidae

***Neodiplostomum travassosi* Dubois, 1937**
(Fig. 6)

Host: *Buteogallus meridionalis* (Latham), savanna hawk (Accipitidae).

Site of infection: intestine.

Voucher specimens: MLP 6714.

Distribution and hosts: The adult specimens of *N. travassosi* parasitize a wide spectrum of phylogenetically unrelated birds: *Pulsatrix perspicillata* (Latham), *Lophostrix cristata* (Daudin), *Strix* sp. (Strigidae), *Ramphastos tucanus* Linnaeus (Ramphastidae) from Brazil (Dubois, 1970), *Caracara plancus* (Miller) (Falconidae) and *Phalacrocorax brasilianus* (Phalacrocoracidae) from Argentina (Lunaschi & Drago 2005).

Measurements: Based on 5 specimens. Body distinctly bipartite, 1.08–1.26 mm (1.17 mm) long. Forebody 769–874 (815) long by 349–532 (447) wide. Hindbody 314–369 (350) long by 275–290 (285) wide. Ratio of forebody length to hindbody length 1:0.41–0.46 (0.43). Oral sucker subterminal, round, 55–60 (58) long by 48–60 (52) wide. Ventral sucker spherical, 45–62 (55) long by 50–55 (52) wide, located at 435–493 (460) from anterior end. Suckers width ratio 1:1.0–1.2 (1.1). Pharynx well developed, immediately posterior to oral sucker, 59–60 (59) long by 43–52 (47) wide, esophagus 47–48 (47.5) long. Ratio of oral sucker width to pharynx width 1:0.8–1.1 (0.9). Pseudosuckers absent. Holdfast organ 169–193 (181) long by 126–159 wide (143), situated at 119–121 (120) from ventral sucker. Ratio of holdfast organ length to body length 1:6.3–7.4 (6.9). Ratio of organ holdfast length to forebody length 1:4.2–5.2 (4.7). Testes tandem; anterior testis asymmetrical, cuneiform, 95–119 (107) long by 260–268 (264) wide; posterior testis symmetrical, 86–119 (98) long by 238–243 (241) wide. Ovary elliptical, median, immediately posterior to junction of fore– and hindbody, 69–71 (70) long by 117–130 (124) wide. Previtelline region in forebody 304–377 (340). Vitellarium in fore– and hindbody, extending from nearly midway between intestinal bifurcation and ventral sucker to posterior extremity of hindbody. Eggs 91–100 (96) long by 48–67 (56) wide.

Remarks: The specimens obtained from *B. meridionalis* possess morphological and morphometric characters similar to those described by Dubois (1970) and Lunaschi & Drago (2005).

The life cycle of *N. travassosi* is unknown; however, considering the life cycle pattern of *Neodiplostomum* spp., the savanna hawk can be infected by ingesting amphibians, reptilians or mammals infected with neodiplostomulum–type metacercariae. Szidat (1969) briefly described *Neodiplostomulum gymnoti* Szidat 1969 in *Gymnotus carapo* L. (Pisces, Gymnotidae) from northeastern Argentina. However, Niewiadomska (2002) considers that these metacercariae belong to the genus *Diplostomum* von Nordmann, due to the morphology of the excretory system and the use of fish as intermediate host.

The finding of *N. travassosi* in *B. meridionalis* represents a new host record.

***Tylodelphys brevis* Drago & Lunaschi, 2008**
(Fig. 7)

Host: *Busarellus nigricollis* (Latham), black–collared hawk (Accipitridae).

Site of infection: intestine.

Voucher specimens: MLP 6715.

Distribution and hosts: *Tylodelphys brevis* was described by Drago & Lunaschi (2008) parasitizing *Mycteria americana* L. (Ciconiidae) from Argentina.

Measurements: Based on 3 specimens. Body indistinctly bipartite, 386–440 (409) long. Forebody 238–280 (260) long by 233–270 (258) wide. Hindbody 143–160 (149) long by 193–224 (210) wide. Ratio of forebody length to hindbody length 1:0.56–0.6 (0.58). Oral sucker round, subterminal, 55–58 (57) long by 57–60 (58) wide. Ventral sucker transversely elongate, pre-equatorial, 40–49 (44) long by 67–78 (73) wide. Suckers width ratio 1:0.9. Pharynx longitudinally elongate, immediately posterior to oral sucker, 52–55 (54) long by 25–26 (26) wide. Ratio of oral sucker width to pharynx width 1:0.4–0.5 (0.4). Pseudosuckers well developed, 63–71 (69) long by 48–67 (56) wide. Ratio of pseudosuckers length to body length 1:5.4–6.4 (6). Ratio of oral sucker length to pseudosuckers length 1:1.1–1.3 (1.2). Holdfast organ round to elliptical, immediately posterior to ventral sucker, 60–83 (71) long by 74–95 (85) wide. Ratio of holdfast organ length to body length 1:4.7–7.4 (6). Testes tandem, extended transversally occupying whole width of hindbody; anterior testis 19–23 (21) long by 65–68 (67) wide; posterior testis 41–49 (45) long by 193–198 (195) wide. Ovary ovoid, pretesticular, 36 long by 100 wide. Vitellarium in fore– and hindbody; in forebody extend from nearly midway between intestinal bifurcation and ventral sucker, in hindbody extending to posterior end. Uterus without eggs or with 1 large egg, 74 long by 60 wide. Ratio of egg length to body length 1:5.2.

Remarks: The specimens obtained from *B. nigricollis* agree well morphologically with those described from *M. americana*, but differ by being smaller (386–440 vs. 570–851), by having larger ventral sucker (40–49 x 67–78 vs. 24–36 x 27–54), and smaller eggs (74 x 60 vs. 83–102 × 45–64). This could be related to the degree of development, because only one specimen was gravid. Dubois (1978) described specimens of *Tylodelphys* sp. in *B. nigricollis* from Colombia, that differ from specimens here studied in size (760–900 vs. 386–440) and arrangement of vitelline follicles, which extend from the level of the intestinal bifurcation. The life cycles of *Tylodelphys* species include fishes and amphibians as second intermediate hosts. In Argentina, no full life cycle has been studied, nevertheless Szidat (1969) described four metacercariae of this genus parasitizing freshwater fishes from northeastern Argentina: *Tylodelphylus jenynsiae* Szidat, 1969 in the pericardial cavity from *Jenynsia lineata* (Jenyns), *Tylodelphylus* sp. 1 in brain from *Hoplias malabaricus* (Bloch), *Tylodelphylus* sp. 2 in the pericardial cavity from *Gymnotus carapo* L. and *Tylodelphylus* sp. 3 in the visceral cavity from *Neofundulus paraguayensis* (Eigenmann & Kennedy). Unfortunately, it is not possible to compare them with our specimens because their descriptions are brief and their adults unknown.

According to Di Giacomo (2005), *B. nigricollis* from Formosa Province, mainly feeds on aquatic snails (*Pomacea* sp.) and fishes (*Hoplias* cf. *malabaricus*, *Synbranchus marmoratus* Bloch, *Hoplosternum* cf. *littorale* and *Hoplerythrinus unitaeniatus* (Spix & Agassiz). Therefore, the presence of *T. brevis* in this raptor is associated with its fish–eating habits.

The finding of this diplostomid in *B. nigricollis* represents a new host record.

***Posthodiplostomum macrocotyle* Dubois, 1937**
(Figs. 8–9)

Host: *Busarellus nigricollis* (Latham), black–collared hawk (Accipitridae).

Site of infection: small intestine.

Voucher specimens: MLP 6716, 6717.

Distribution and hosts: This species was described by Dubois (1937, 1970) based on material from *Rynchops niger* L. (Laridae) in Brazil. Later, Dubois & Macko (1972) reported it parasitizing ardeid birds from Cuba [*Ardea alba* (L.), *Butorides virescens maculata* (Boddaert), *Egretta caerulea* (L.), *Egretta tricolor ruficollis* Gosse, and *Nycticorax nycticorax hoactli* (Gmelin)]. Recently, Brandão *et al*. (2013) found specimens of *P. macrocotyle* parasitizing *Spheniscus magellanicus* (Forster) (Spheniscidae) from Brazil.

Measurements: Based on 5 specimens. Body distinctly bipartite, 435–1114 (814) long. Forebody 299–677 (521) long by 217–459 (316) wide. Hindbody 133–474 (319) long by 208–328 (266) wide. Ratio of forebody length to hindbody length 1:0.4–0.7 (0.8) Oral sucker round, subterminal, 29–45 (39) long by 26–45 (37) wide. Ventral sucker subspherical, located in second half of forebody, 40–48 (43) long by 44–52 (48) wide. Suckers width ratio 1:1.2. Pharynx oval, immediately posterior to oral sucker, 35–48 (41) long by 29–38 (33) wide. Pseudosuckers absent. Holdfast organ subspherical, 121–174 (154) long by 83–169 (124) wide. Testes tandem, continuous; anterior testis asymmetrical, oval to subtriangular, just posterior to junction of fore– and hindbody, 76–111 (93) long by 155–217 (182) wide; posterior testis symmetrical, horseshoe shaped, 107–198 (163) long by 228–275 (251) wide. Genital cone 67–107 (80) long by 93–193 (131) wide. Ovary elliptical, posterior to junction of fore– and hindbody, dextral, 43–72 (58) long by 117–169 (138) wide. Vitellarium in fore– and hindbody; vitelline follicles extending from midway between intestinal bifurcation and ventral sucker to posterior testis. Eggs 81–90 (85) long by 52–57 (55) wide.

Remarks: The specimens obtained from *B. nigricollis* possess morphological and morphometric characters similar to those described by Dubois (1937, 1970) and Dubois & Macko (1972). The specimens described by Brandão *et al*. (2013) from *S. magellanicus* agree well morphologically with our specimens, but differ by being larger (1192–1.529 vs. 435–1114), by having larger oral sucker (57–72 x 59–75 vs. 29–45 x 26–45), ventral sucker (84–102 x 69–98 vs. 40–48 x 44–52), pharynx (54–65 x 33–47 vs. 35–48 x 29–38) and holdfast organ (215–224 x 174–226 vs. 121–174 x 83–169). However, these authors consider that the differences in size are related to the high morphometric variability of this diplostomid and its presence in an unusual host.

The life cycle of *P. macrocotyle* has not been elucidated yet, but its metacercariae have been reported in freshwater fishes (see Brandão *et al*. 2013). This diplostomid has scarce specificity, because it parasitizes phylogenetically unrelated ichthyophagous birds. Then, the presence of this parasite is associated with the diet of the black–collared hawk, which is mainly ichthyophagous (Thiollay 1994).

The finding of *P. macrocotyle* parasitizing *B. nigricollis* represents a new host record and the first record of this species in Argentina.

Family Cyclocoelidae

***Spaniometra variolaris* (Fuhrmann, 1904)**
(Fig. 10)

Syns. *Bothriogaster variolaris* Fuhrmann, 1904; *Bothrigaster variolaris* (Fuhrmann, 1904) Dollfus, 1948; *Ophthalmophagus variolaris* (Fuhrmann, 1904)

Host: *Rostrhamus sociabilis* (Vieillot), snail kite (Accipitidae)

Site of infection: air–sacs.

Voucher specimens: MLP 6718, 6719.

Distribution and Hosts: This species was originally described by Fuhrmann, (1904) as *Bothriogaster variolaris* parasitizing *R. sociabilis* from South America. Later, it was reported in the same host in Brazil (Travassos 1922), Cuba (Perez Vigueras 1940, 1955) and USA (Cole *et al*. 1995), and in *Accipiter bicolor pileatus* from Paraguay (Masi Pallarés & Benítez Usher 1972).

Measurements: Based on 5 immature specimens. Body linguiform, 3.97–4.4 (4.2) mm long by 0.80–1.03 (0.95) mm wide. Mouth subterminal. Oral sucker absent. Ventral sucker round, immediately posterior to intestinal bifurcation, 126–130 (127) long by 133–145 (143) wide. Prepharynx 121–169 (145) long; pharynx slightly oval, 112–143(126) long by 107–126 (116) wide; esophagus 40–95 (69) long; ceca long, united near posterior extremity forming cyclocoel. Testes tandem, entire; anterior testis round, equatorial, 241–242 (242) long by 227–242 (235) wide; posterior testis subspherical, post-equatorial, 237–266 (250) long by 134–256 (214) wide. Ovary round, located anterior to posterior cecal union, 107–169 (141) long by 107–193 (146) wide.

Remarks: The morphological characters of the specimens here described agree with the descriptions of Perez Vigueras (1940, 1955), but they are smaller (3.97–4.4 mm vs. 6–7 mm) and have not reached sexual maturity. The specimens described by Masi Pallarés & Benítez Usher (1972) possess morphological and morphometric characters similar to our specimens. The life cycle of *S. variolaris* is unknown; however, considering the life cycle

pattern of cyclocoelids, probably the snail kites become infected by eating snails that harbor metacencariae. The high densities of *S. variolaris* can cause airsacculitis and bronchitis, and probably the death of birds from USA (see Cole *et al*. 1995). However, in this study the infection intensity was relatively low compared with the studies in the northern hemisphere (22 vs. 40–225).

The finding of this cyclocoelid parasitizing *R. sociabilis* from Formosa Province represents the first record of the genus *Spaniometra* Kossack, 1911 in Argentina.

Family Microphallidae

***Megalophallus deblocki* Kostadinova, Vaucher & Gibson, 2006**
(Fig. 11)

Hosts: *Rostrhamus sociabilis* (Vieillot), snail kite (Accipitidae); *Buteogallus meridionalis* (Latham), savanna hawk (Accipitidae).

Site of infection: intestine.

Voucher specimens: *R. sociabilis* MLP 6720, *B. meridionalis* MLP 6721.

Distribution and hosts: The adult forms of *M. deblocki* were described by Kostadinova *et al*. (2006) parasitizing *R. sociabilis* from Paraguay, and its metacercariae were found encysted in the digestive gland of the naturally infected crab, *Dilocarcinus dentatus* Randall (Decapoda: Trichodactylidae) from Venezuela (Díaz *et al*. 2012).

Measurements: Based on 7 specimens. Body pyriform, 420–561 (478) long by 270–319 (298) wide. Forebody 256–314 (277) long, 56%–61% (58%) of body length. Tegument covered with minute spines. Oral sucker round, subterminal, 41–44 (43) long by 39–53 (46) wide. Ventral sucker round, post-equatorial, 29–55 (46) long by 29–48 (41) wide. Suckers width ratio 1:1–1.3 (1.2). Prepharynx 13–15 (14) long; pharynx oval, 39–43 (41) long by 21–29 (25) wide; esophagus 81–121 (99) long; ceca short, reach to level of ventral sucker, 107–150 (130) long. Testes symmetrical, located in last third of body; right 44–71 (58) long by 39–76 (58) wide; left 39–69 (54) long by 53–107 (80) wide. Seminal vesicle 102–120 (110) long. Phallus ovoid, muscular, sinistral, located lateral to ventral sucker, 83–88 (85) long by 71–98 (87) wide, ornamented with 21–24 (23) stout spines. Ovary dextral, located at level of ventral sucker 29–38 (34) long by 53–71 (62) wide. Vitellarium in 2 lateral groups of 9–10 follicles, in testicular and post-testicular regions. Eggs numerous, 10–16 (12) long by 8–9 (8.2) wide.

Remarks: The specimens found in *R. sociabilis* and *B. meridionalis* from Argentina are in agreement with those originally described in Paraguay by Kostadinova *et al*. (2006), and those obtained experimentally in Venezuela (Díaz *et al*. 2012). The life cycle of this microphallid species has been partially elucidated by Díaz *et al*. (2012), the metacercariae were found in crabs, and the adult forms were experimentally obtained from chickens and rats.

Rostrhamus sociabilis has a highly specialized diet, composed almost entirely of apple snails (*Pomacea* spp.), but may take other preys including crabs, turtles and rodents (Thiollay 1994). In Argentina, Di Giacomo (2005) mentioned that it feeds on crabs, in addition to aquatic snails in the Reserva Bagual, Formosa Province. The most part of snail kites examined had remains of *Pomacea* sp. in the stomach, but the only specimen parasitized with *M. deblocki* had the stomach empty. This suggests that when there is limited availability of snails in the environment, these birds can eat crabs infected with metacercariae. On the other hand, *B meridionalis* feeds on small mammals, birds, snakes, lizards, frogs, toads, eels, crabs, and large insects (Thiollay 1994). This wide spectrum of food items can explain the low intensity of infection (1) of this microphallid in the savanna hawk. In Formosa Province, it mainly feeds on small vertebrates and large insects (Di Giacomo 2005), but the finding of *M. deblocki* suggests that it also eats crabs.

The finding of *M. deblocki* parasitizing *B. meridionalis* represents a new host record, and the first record of this species in Argentina.

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