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REDESCRIPTION OF *INGLISERIA CIRROHAMATA* (LINSTOW, 1888) (NEMATODA: ACUARIIDAE), INCLUDING NEW HOSTS AND GEOGRAPHICAL RECORDS

Julia I. Diaz, Frédéric Fonteneau*, Guillermo Panisse, Florencia Cremonte†, and Graciela T. Navone

Centro de Estudios Parasitológicos y de Vectores (CONICET-UNLP), Calle 2 #584. 1900 La Plata, Argentina. *e-mail: jidiaz@cepave.edu.ar*

ABSTRACT: *Inglisera cirrohamata* (Linstow, 1888) (Nematoda: Acuariidae) is redescribed based on specimens collected from the type host, *Phalacrocorax verrucosus* (Aves: Phalacrocoracidae), and the type locality, Kerguelen Island, in the southern Indian Ocean. Three new hosts and 2 new localities were recorded, i.e., *Phalacrocorax* [*atriceps*] *albiventer* and *P. brasilianus* from Puerto Madryn, Argentina and *P. magellanicus* from Puerto Williams, Chile. The structure of the cephalic ornamentations was observed and fully described. The presence of 6 pairs of postcloacal papillae is confirmed, a description of the tip of left spicule is given, and the presence of post-deirids is reported for the first time. This constitutes the first record of this nematode in South America and provides the first study of the genus by scanning electron microscopy.

Acuariid nematodes are parasitic primarily in birds and more rarely in mammals. The genera of this family are classified in 1 of 3 subfamilies (Acuariinae Railliet, Henry and Sisoff, 1912, Seuratiinae Chitwood and Wehr, 1912, or Schistorophinae Travassos, 1918) on the basis of cephalic characteristics (Chabaud, 1974). Only 9 genera among acuarids have been assigned to the Seuratiinae (*Streptocara* Railliet, Henry and Sisoff 1912; *Seuratia* Skrjabin 1916, *Rusguniella* Seurat 1919; *Aviculariella* Wehr 1931; *Stegophorus* Wehr 1934; *Proyseria* Petter 1958; *Ingliseria* Gibson 1968; *Tikunema* Hasegawa, Shiraishi and Rochman, 1992; and *Navonia* Diaz, Sepulveda and Kinsella 2007) (Chabaud, 1974; Diaz et al., 2007).

The nematode *Ingliseria cirrohamata* (Linstow, 1888) (Acuariidae: Seuratinae) was originally named as *Filaria* (*Spiroptera*) *cirrohamata* on the basis of 1 male and 1 female in a poorly preserved condition from the Kerguelen shag *Phalacrocorax verrucosus* (Cabanis, 1875) collected in the Kerguelen Islands, Indian Ocean (Cram, 1927; Gibson, 1968). Later, this species was transferred to *Streptocara* (Skrjabin, 1916) and reported in other species of Phalacrocoracidae from the sub-Antarctic region (Johnston and Mawson, 1945, 1953). Subsequently, Gibson (1968) erected *Ingliseria* (Seuratine) to contain this species, based on consideration of the features of the cephalic ornamentations, teeth, and deirids (Chabaud, 1974). *Ingliseria cirrohamata* was later reported parasitizing Anseriformes from Europe (Brglez, 1982; Kavetska, 2005a, 2005b). To date, *I. cirrohamata* is the only species in the genus.

Here, we provide a detailed redescription of *I. cirrohamata* on the basis of new specimens collected from the type host and locality, as well as 3 new hosts and 2 new localities. The species is studied for the first time by scanning electron microscopy; measurements are compared with those given by previous authors, and prevalence and mean intensity are provided.

MATERIALS AND METHODS

Two Kerguelen shags, *P. verrucosus* (Cabanis) (1 adult and 1 juvenile), were collected from Kerguelen Island, French Austral Islands in the southern Indian Ocean (49°20′S, 69°20′E), in January and February 2006, respectively. In addition, at irregular intervals from 1997 to 2006, 8 imperial cormorants, *P.* [*atriceps*] *albiventer* King, and 2 Neotropical cormorants, *P. brasilianus* (Gmelin 1789), were collected on different beaches of the north Patagonian Gulves (42°04′–42°53′S, 63°21′–65°04′W), Chubut Province, Argentina. Six Magellanic cormorants, *P. magellanicus* (Gmelin 1789), from Puerto Williams, XXI Región de Magallanes y de la Antártida Chilena, Chile (54°56′S, 67°37′W) were collected in 1995. All birds were dissected and the viscera and pellets were examined using stereomicroscopy. Nematodes were removed from the esophagus, fixed in 10% formalin, and stored in 70% alcohol. Specimens were cleared in 25% glycerine alcohol, observed using a light microscope (LM) (Olympus BX51, Olympus, Tokyo, Japan), and illustrated with the aid of a drawing tube. Six specimens were dehydrated in a graded series of alcohols, dried using the critical point method, examined using a Jeol® JSV 6063 LV, (Jeol, Tokyo, Japan) scanning electron microscope (SEM), and photographed. Measurements are given in micrometers, except when otherwise indicated, with the mean followed by the range in parentheses. Voucher specimens were deposited in the Helminthological Collection of the Museo de La Plata (CHMLP), La Plata, Argentina.

REDESCRIPTION

Ingliseria cirrohamata

(Figs. 1–13; Tables I, II).

Diagnosis: Acuarioidea, Acuariidae, Seuratiinae. Cuticle with fine transversal striations. Anterior end rounded (Figs. 1, 7, 10), pseudolabia well developed. Cephalic papillae at level of amphids located at short distance posterior to oral opening (Fig. 8). Each pseudolabium bears pronounced apical process with a pair of strong tooth-like structures at base. Cephalic ornamentation appears as 4 prolongations-like smooth cordons which arise in commissures of buccal lips and end on lateral surfaces of pseudolabia without anastomosing (Figs. 8, 9). Anterior to those and just posterior to cephalic papillae, cuticle of pseudolabia divided into 12–18 blunt, lappet-like teeth, forming 4 scalloped cordons from oral opening to midlines of each pseudolabium (Figs. 8, 9). Deep groove between smooth cordons and scalloped cordons, forming a collar laterally interrupted over each pseudolabium (Fig. 7). Short buccal capsule lined with fine transverse striations (Fig. 1). Conspicuous tricuspid deirids located anterior to nerve-ring at level of buccal capsule–esophagus junction. Esophagus divided into muscular and glandular portions. Lateral alae well developed (Fig. 6), extending from immediately posterior to deirids (Fig. 7), diminishing in size, and terminating near posterior end of body. Small post-deirids located close to lateral alae at end of second quarter of body (Fig. 10).

Precloacal papillae closely disposed; first and third pairs smaller than second and fourth pairs (Fig. 2). Six pairs of postcloacal papillae, first pair located just posterior to cloaca; next 2 pairs close to each other and to first pair; final 3 pairs located near tip of tail and considerably distant from others (Fig. 2). Last 2 pairs smaller than others. Phasmids lie just mid-ventrally to fifth pair of papillae. Last pair of papillae very small and located close to tip of tail (Figs. 2, 11).

Left spicule consists of cylindrical proximal portion and guttered distal part, each representing 50% of total spicule length (Fig. 3). Tip of left spicule formed by spiraled cap-like spatula with 2 membranous borders and foramen in dorsal side (Figs. 12, 13).

Vulva located commonly 52%–56% of total length of body from anterior end. Vagina divided in vagina vera and uterina, 69 (50–87) and

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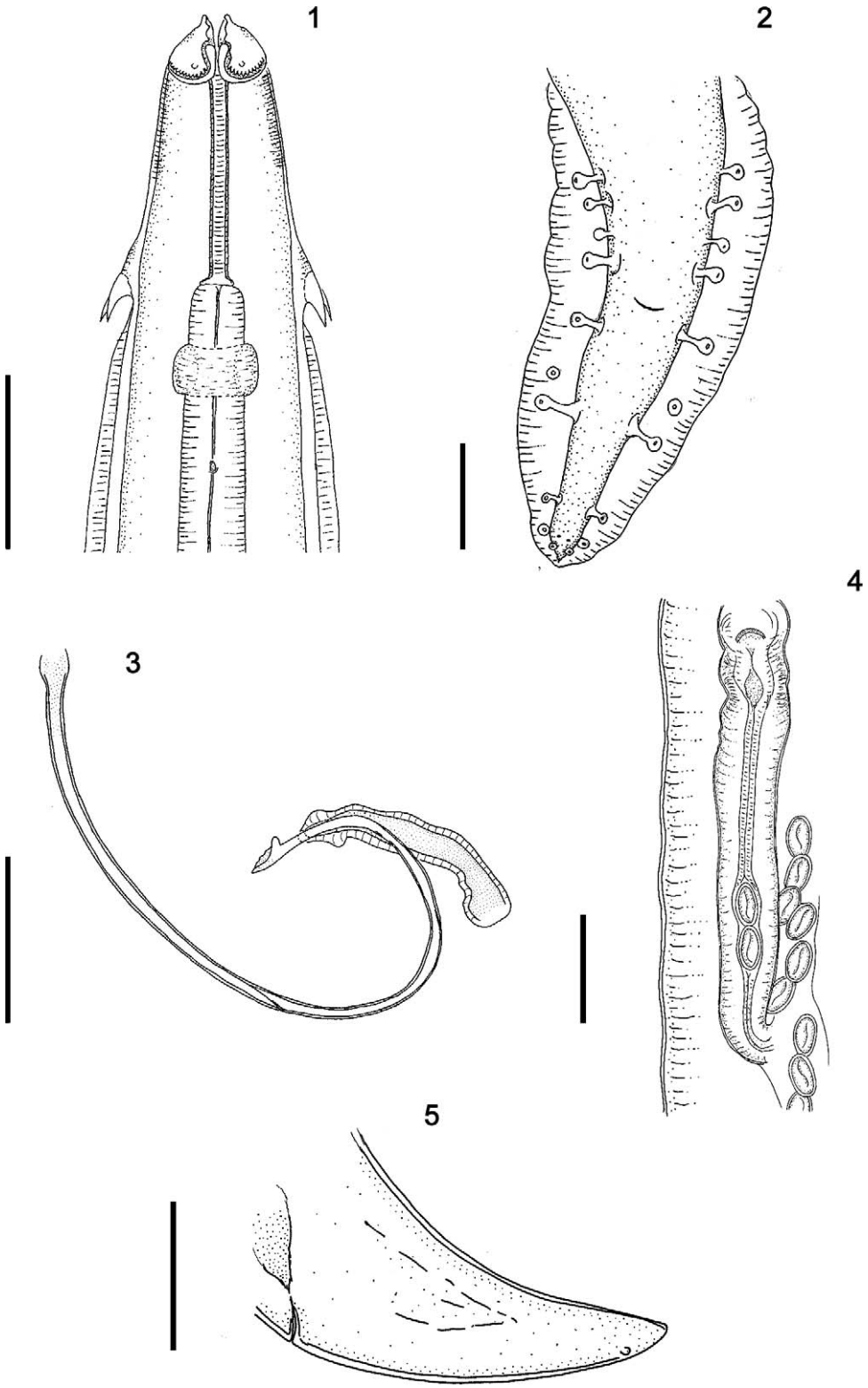
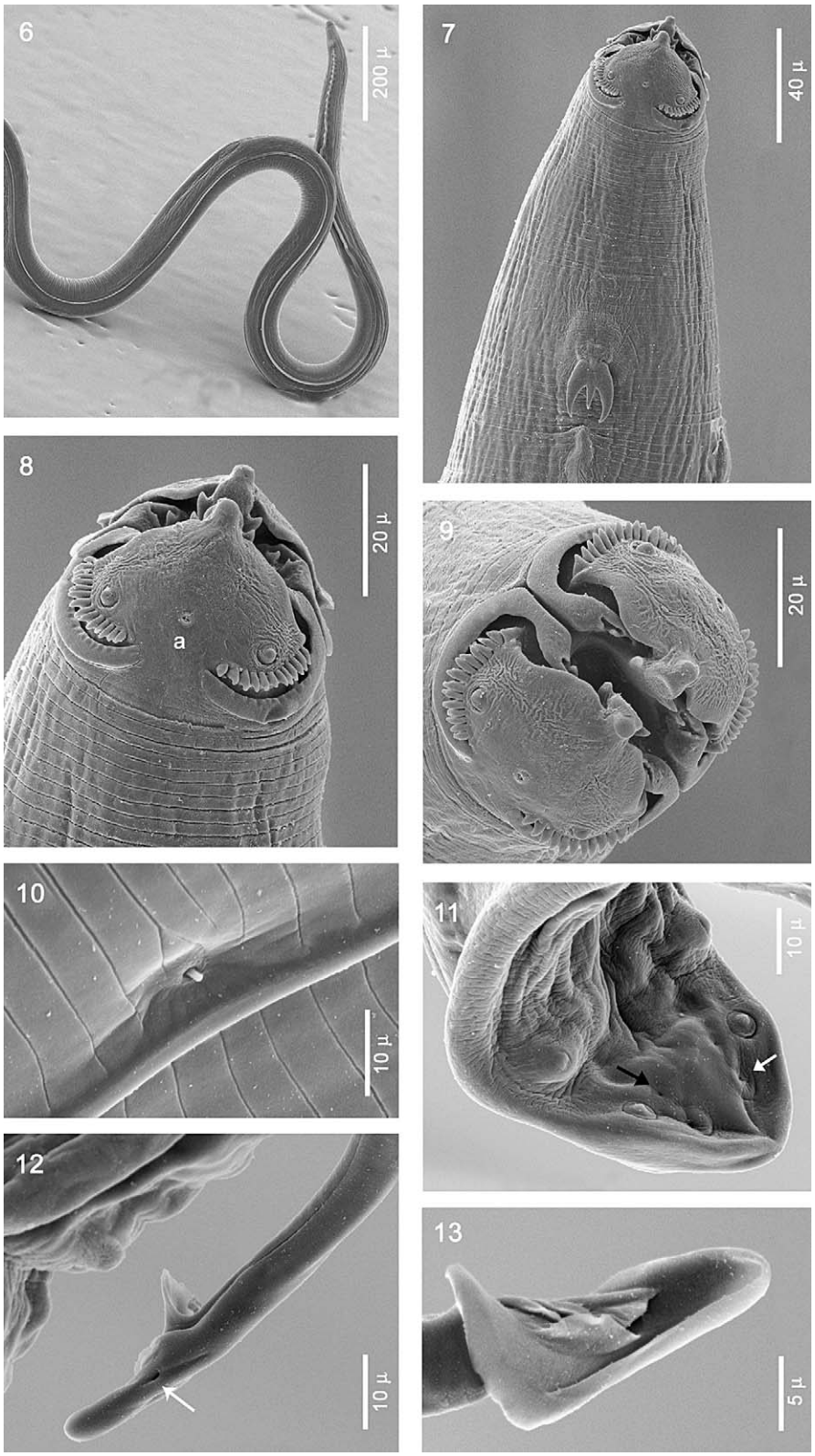
* UMR 6553 Ecobio CNRS, Université de Rennes 1, Campus de Beaulieu, Avenue du Général Leclerc, 35042 Rennes Cedex, France.

† Centro Nacional Patagónico (CONICET), Boulevard Brown 2825, U9120ACF Puerto Madryn, Argentina.



FIGURES 1–5. *Ingliseria cirrohamata* from *Phalacrocorax* (*a.*) *albiventer* from the Patagonian coast. (**1**) Anterior extremity showing cephalic collarette laterally interrupted, deirid, buccal capsule, and nerve ring; ventral view. (**2**) Caudal region of male showing caudal alae and papillae arrangement; ventral view. (**3**) Left and right spicules; left-lateral view. (**4**) Vulva, vagina, and eggs. (**5**) Posterior extremity of female. Scale bars = 100 μm.



FIGURES 6–13. *Ingliseria cirrohamata* from *Phalacrocorax* (*a.*) *albiventer* from the Patagonian coast (SEM). (**6**) Lateral view of worm showing the great extension of lateral alae. (**7**) Anterior extremity showing cephalic collarette laterally interrupted, tricuspid deirid, and starting of lateral alae; lateral view. (**8**) Details of anterior end showing teeth, cephalic papillae, amphids, and collarete; lateral view. (**9**) Apical view showing pseudolabia, teeth, and details of collarette structure. (**10**) Postdeirid. (**11**) Tip of tail showing last 3 pairs of papillae. Phasmids lie just mid-ventrally to the fifth pair of papillae (black arrow). Last pair of papillae is sessile, very small, and is located close to the tip of tail (white arrow). (**12**) Left spicule, protruded, showing a dorsal foramen. (**13**) Tip of left spicule showing 2 membranous lateral structures.

TABLE I. Main morphological features and measurements of *Ingliseria cirrohamata* males, as given by different authors.

Species	*Filaria* (*Spiroptera*) *cirrohamata*	*F.* (*Spiroptera*) *cirrohamata*	*Streptocara cirrohamata*	*Ingliseria cirrohamata*	*I. cirrohamata*	*I. cirrohamata*
Reference	Cram (1927), Gibson (1968)	Cram (1927), Gibson (1968)	Johnston and Mawson (1953)	Present study	Present study	Present study
Host	*Phalacrocorax verrucosus*	*P. verrucosus*	*P. colensoi*	*P. verrucosus*	*P.* [*a.*] *albiventer*	*P. magellanicus*
Localities	Kerguelen Island	Kerguelen Island	Aukland Island	Kerguelen Island	Peninsula Valdés Chubut, Argentina	Pt. Guilliams, Chile
Male (N)	Type male from Linstow*	Type male from Inglis*	Several	8	3	1
Total length (mm)	7.58	—	9.5–11	8.34 (7.35–9.55)	10.1 (8.4–11.7)	5.6
Maximum width	250	—	—	164 (130–195)	220 (207–245)	130
Collar (long)	—	—	—	31 (25–35)	34 (25–40)	25
Buccal capsule	—	—	—	155 (135–165)	161 (152–170)	125
Nerve ring (dfae)†	—	—	—	204 (188–225)	216 (210–225)	150
Deirids (dfae)	—	—	—	152 (140–175)	151 (137–165)	120
Deirids (long)	—	—	—	23 (20–25)	26 (25–26)	20
Excretory pore (dfae)	—	—	—	287 (250–325)	294 (270–317)	160
Muscular esophagus	—	—	—	837 (730–1,000)	1,017 (970–1,080)	637
Glandular esophagus (mm)	—	—	—	2.65 (2.1–3.0)	3.03 (2.76–3.25)	1.58
Esophagus total length	3	—	—	3.3 (2.9–4.0)	4.03 (3.73–4.33)	2.22
Left spicule	600	Broken	400	544 (519–580)	620 (587–685)	562
Proximal part of left spicule	—	—	—	290 (275–300)	(275–300)	312
Distal part of left spicule				260 (234–280)	(287–312)	250
Right spicule	140	116	150	132 (95–150)	133 (120–150)	125
Tail	380	240	—	254 (235–280)	295 (224–337)	180

* From Gibson, 1968.
† dfae = distance from anterior end.

TABLE II. Main morphological features and measurements of *Ingliseria cirrohamata* females, as given by different authors.

Species	*Filaria* (*Spiroptera*) *cirrohamata*	*F.* (*Spiroptera*) *cirrohamata*	*Streptocara cirrohamata*	*S. cirrohamata*	*Ingliseria cirrohamata*	*I. cirrohamata*	*I. cirrohamata*
Reference	Cram (1927), Gibson (1968)	Gibson (1968)	Johnston and Mawson (1945)	Johnston and Mawson (1953)	Present study	Present study	Present study
Host	*Phalacrocorax verrucosus*	*P. verrucosus*	*P. verrucosus*	*P. colensoi*	*P. verrucosus*	*P.* [*a.*] *albiventer*	*P. brasilianus*
Localities	Kerguelen Island	Kerguelen Island	Kerguelen Island	Aukland Island	Kerguelen Island	Peninsula Valdés Chubut, Argentina	Peninsula Valdés Chubut, Argentina
Female (N)	Type female from Linstow*	Type female from Inglis*	1	Several?	8	7	2
Total length (mm)	9.72	11	14	15–16	13.7 (9.8–16.4)	13.6 (9.65–20.1)	17.3–18.2
Width at vulva level	350	320	—	—	270 (170–350)	256 (230–285)	245–245
Collar (long)	—	—	—	—	38 (35–44)	42 (30–50)	50–45
Buccal capsule	—	145	140	180	167 (155–175)	163 (130–212)	172–200
Nerve ring (dfae)†	—	—	—	—	226 (200–250)	212 (180–262)	220–
Deirids (dfae)	140	149	150	180	162 (150–175)	135 (120–160)	140–160
Deirids (long)	—	25	—	—	25 (24–27)	27 (25–29)	22–25
Excretory pore	—	—	—	—	330 (285–440)	296 (260–342)	350–
Muscular esophagus	—	840	—	900†	920 (n = 1)	967 (820–1,140)	1,110–1,150
Glandular esophagus (mm)	—	2.9	—	2.8	4.1 (3.5–4.7) (n = 3)	2.82 (2.78–2.87)	2.3–2.5
Total esofago	—	3.74	—	3.7	4.36 (4.0–4.7)	3.7 (3.6–3.8)	3.4–3.7
Vulva (dfae)† (mm)	Pre-esofagica	7.1	8.7	7	7.5 (5.8–8.5)	7.85 (6.00–10.8)	8.95–10.2
Eggs length	39	—	35	35	37 (32–40)	37 (35–40)	34 (32–36)
Eggs width	19	—	19	19	20 (19–22)	21 (18–23)	20 (19–22)
Tail	120	162	170	—	223 (175–350)	183 (135–250)	200–190

* From Gibson, 1968.
† dfae = distance from anterior end.

275 (200–350), respectively (Fig. 4). Tail of female conical, anus ventrally located (Fig. 5).

Taxonomic summary

Host: Phalacrocorax verrucosus (Cabanis 1875) (Aves: Phalacrocoracidae).

Locality: Kerguelen Island, French Austral Islands, Indian Ocean.

Abundance: 149 adults and 58 larvae from 1 host.

Specimens deposited: CHMLP (5862).

Other hosts and prevalences (P): Phalacrocorax [*atriceps*] *albiventer* King, (*P* = 87.5%), (CHMLP 5863), *P. brasilianus* (Gmelin 1789), (*P* = 50%), (CHMLP 5864) and *P. magellanicus* (Gmelin 1789) (*P* = 12.5%).

Other localities: San José Gulf and Nuevo Gulf, Chubut Province, Argentina, and Puerto Williams, XXI Región de Magallanes y de la Antártida Chilena, Chile.

Remarks

Present specimens can be assigned to the Seuratiinae Chitwood and Wehr, 1932 on the basis of the cordons extending transversely on the cephalic region forming a collarette (Chabaud, 1974). Among the genera in the subfamily, *Ingliseria* is unique in that the cephalic collarette is interrupted on the lateral lines.

Previous contributions regarding this acuarioid had been based on a few, or on poorly preserved, specimens (Gibson, 1968). In the present study, a large number of specimens from both host and locality types were analyzed, allowing for a detailed redescription of the species. The comparison between specimens coming from different hosts and localities also suggests a great morphological stability of *Ingliseria cirrohamata*.

Despite some meristic discrepancies that were observed between specimens from different host species, the morphology of present specimens fully agrees with descriptions given by other authors for *I. cirrohamata*. Some discrepancies have been reported with reference to papillae in the male. Linstow (see Gibson, 1968) and Johnston and Mawson (1953) reported 5 pair of postcloacal papillae, while Johnston and Mawson (1945) did not describe males. In the present report, the presence of 6 pairs of postcloacal papillae is confirmed, as was suggested by Gibson (1968). Moreover, the post-deirids and the measurements of the vagina vera and vagina uterine are reported for the first time.

The single male recovered from *P. magellanicus* is shorter than the other specimens; however, the relationship between the total body length and the length of different structures, e.g., buccal capsule, esophagus, and tail, is similar. Additionally, the length of spicules in this specimen is similar to other males studied.

DISCUSSION

The present report extends the host and geographical distribution of *I. cirrohamata* with 3 new host species in 2 new localities (*P.* [a.] *albiventer* and *P. brasilianus* from Puerto Madryn, Argentina, and *P. magellanicus* from Puerto Williams, Chile). These constitute the first records of this nematode in South America and provide the first study of the genus using the scanning electron microscopy.

Most of the hosts of *I. cirrohamata* belong to the Phalacrocoracidae in the sub-Antarctic Region (Johnston and Mawson, 1945, 1953; Gibson, 1968; present study), suggesting both a high host specificity and a circumpolar distribution of the species. Some authors have reported this acuariod parasitizing freshwater hosts, e.g., Anseriformes in Eurasia (Brglez, 1982; Kavetska, 2005a, 2005b). Because the authors did not provide a detailed description of the studied specimens, the nematodes were not available; moreover, 2 of these cases were found in the intestine (Kavetska, 2005a, 2005b), making it unlikely that they belong to *I. cirrohamata*. Confirmation of these records is needed.

To date, only 3 acuariid species had been reported parasitizing seabirds along Patagonian coasts, i.e., *Cosmocephalus obvelatus* Creplin, 1825 from the Magellanic penguin *Spheniscus magellanicus* Forster, *Paracuaria adunca* (Creplin, 1846) from the kelp gull *Larus dominicanus* Lichtenstein, and *Stegophorus diomedeae* (Johnston and Mawson, 1942) from the albatross *Thalassarche melanophris* (Temminck) (Diaz et al., 2001; 2004; Cremonte et al., 2002). *Cosmocephalus* spp. from the penguins *Spheniscus humboldti* Mayen and *Eudyptes chrysocome* Forster, and *Navonia pterodromae* Diaz, Sepulveda and Kinsella, 2007 from the petrels *Pterodroma externa* (Salvin) and *P. neglecta* (Shlegel), are the only acuariods reported in marine birds from Chilean coasts (Hinojoza-Sáez and Gonzalez-Acuña, 2005; Diaz et al., 2007). Among them, only *S. diomedeae* and *N. pterodromae* belong to the Seuratinae; thus, the present study constitutes the third report of a Seuratiinae parasitizing seabirds from South America.

In this investigation, we accepted the classification proposed by Chabaud (1974) and assigned the specimens to Seuratiinae. However, we believe that, considering the new technological tools that allow us to observe in greater detail, the morphology and the diagnostic features in each group must be reviewed. Additionally, molecular analyses could help clarify the evolutionary relationships among groups in the family.

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