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TWO NEW SPECIES OF *ASCAROPHIS* (NEMATODA: CYSTIDICOLIDAE) IN MARINE FISHES FROM CHILE

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ABSTRACT: In this study, we describe 2 new species of *Ascarophis* van Beneden, 1871 (Nematoda: Cystidicolidae), found in fishes from southern Chile. *Ascarophis carvajali* n. sp. was found in *Austrolycus depressiceps* and *Patagonotothen cornucola*, whereas *Ascarophis draconi* n. sp. was taken from *Champsocephalus gunnari*. These new *Ascarophis* species differ from other species in a combination of several morphometric and morphological characteristics. Although *A. carvajali* n. sp. was morphologically close to *Ascarophis minuta*, the new species has a larger ratio between glandular and muscular esophagus, filaments on both egg poles, and a shorter right spicule than *A. minuta*. *Ascarophis draconi* n. sp. was morphologically similar to *Ascarophis adioryx* and *Ascarophis filiformis*. However, *A. adioryx* has eggs without filaments, a smaller ratio between glandular and muscular esophagus length, and a smaller ratio between left and right spicule lengths in contrast to *A. draconi* n. sp., whereas *A. filiformis* has a shorter glandular esophagus and left spicule length than *A. draconi* n. sp. Only 1 *Ascarophis* species has been recorded in a single fish from Chile (i.e., *Ascarophis sebastodis* in *Sebastes capensis*). Consequently, this study constitutes not only new species and records of *Ascarophis* in fishes from Chile, but also new records for the Pacific coast of South America.

Ascarophis van Beneden, 1871, is a cosmopolitan group of nematodes that inhabit marine fishes from Antarctic to Arctic waters, as well as from littoral, demersal, and pelagic habitats. In addition, this genus contains the largest number of species within the Cystidicolidae. Fifty-two species have been described, although some of them have been placed in other genera, and others have been considered as inquierendae species (Ko, 1986). In the Ko (1986) monograph regarding species of *Ascarophis*, an emended diagnosis of the genus and taxonomic revisions of several species were provided. Moreover, in that study, 22 species were considered valid. Some species were not included in that monograph, whereas others were subsequently described; thus, it is likely that the number of valid species has increased. Since Ko's (1986) study, there has been a great effort to produce better quality studies than in the past. Nonetheless, there is still a great deal of confusion in the taxonomy of *Ascarophis* spp. because of insufficient descriptions for several species.

Cystidicolid nematodes in Chile seem to be relatively common parasites from fishes (Muñoz et al., 2004), after anisakids (Fernández and Villalba, 1985). Cystidicolids have, for example, been found in 12 fish species (Torres et al., 1990, 1992; Balboa and George-Nascimento, 1998; González and Acuña, 2000; Muñoz and George-Nascimento, 2001; Muñoz et al., 2001, 2004). However, only 4 species have been identified (González and Acuña, 2000; Muñoz and George-Nascimento, 2001; Muñoz et al., 2004). Despite the fact that *Ascarophis* spp. is a large and widespread group of nematodes, only 1 species has been recorded (i.e., *Ascarophis sebastodis* Olsen, 1952) in the fish *Sebastes capensis* (Gmelin, 1789) (see González and Acuña, 2000), plus some unidentified *Ascarophis* that have been reported in other fishes (Balboa and George-Nascimento, 1998; Muñoz et al., 2001). Hence, our main objective in this study is to describe 2 new species of *Ascarophis* from fish species of Chile.

MATERIAL AND METHODS

Ascarophis nematodes were found in 3 fish species: *Austrolycus depressiceps* Regan, 1914; *Champsocephalus gunnari* Lonnberg, 1905; and *Patagonotothen cornucola* (Richardson, 1833), which were collected from Punta Arenas (54°S, 71°W), southern Chile, in February 2001. Nematodes were fixed in 10% buffered formalin and cleared in chlorolactophenol for observation. Measurements and drawings were performed directly under light microscopy. The prevalence and abundance of nematodes were calculated according to Bush et al. (1997).

Thirty-two nematodes from these 3 fish species were considered in this study. Morphometry of nematodes was measured in microns (μm) unless otherwise stated. Ratio between morphometric characteristics such as left spicule/right spicule (LS/RS), glandular esophagus/muscular esophagus (GE/ME), and vulva position from posterior end/body length calculated as a percentage were also included.

Morphological distinctions on the cephalic and caudal regions of the nematodes were observed through scanning electron microscopy (SEM). Two or 3 female and male individuals from each host species were used for this purpose. Specimens were dehydrated through an alcohol series and critical point–dried in CO_2 with a Balzers Union machine (Laboratory of Electronic Microscopy, Universidad de Concepción, Concepción, Chile). They were then sputter-coated with gold, making a layer of 500 Å, with a model Edwards Sputter Coater S150 (Laboratory of Electronic Microscopy, Universidad de Concepción, Concepción, Chile). Finally, they were examined with an Etec-Autoscan scanning electron microscope (Laboratory of Electronic Microscopy, Universidad de Concepción, Concepción, Chile).

DESCRIPTION

Ascarophis draconi n. sp.
(Table I, Figs. 1–11)

General: Filiform worms. Cuticular striations well defined from anterior end to tail (Fig. 1). Four cephalic papillae located ventrolaterally and dorsolaterally. Oral opening dorsoventrally elongated (Fig. 2). Two pseudolabia, each with anterior protrusion of conical shape (Fig. 5). One side of base of each pseudolabium connected to buccal wall; other side exhibits a projection toward central oral opening. This projection, wider than pseudolabium base, in shape of a T from an apical view. Four wide submedial labia, each located on a central and dorsal quadrant of oral opening (Fig. 2). Four thin sublabia connected to buccal wall beneath each submedial labia. Under each pseudolabial midprojection is a structure similar in aspect to sublabia (Fig. 2). Amphids

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TABLE I. Range of values (μm, unless otherwise stated) for morphological and morphometric characteristics of males and females of *Ascarophis draconi* n. sp. in the fish *Champsocephalus gunnari*.

Nematode characteristic	Male	Female
Specimens	6	8
Body length (mm)	9.88–13.25	20.90–28.63
Body width	70–113	140–200
Vestibule	175–250	168–205
Position of nerve ring*	225–283	200–283
Muscular esophagus	357–460	425–525
Glandular esophagus (mm)	2.70–3.47	3.23–4.20
Excretory pore*	238–347	360–435
Deirids	197†	213†
Anus‡	118–175	53–113
Left spicule	482–640	
Right spicule	93–125	
Pairs of preanal papillae	4	
Pairs of postanal papillae	6	
Terminal knob		Most of them
Position of vulva (mm)‡		8.08–11.33
Egg length		47–50
Egg width		22–25
Polar egg filaments		Two filaments on each polar egg

* Distance from anterior extremity.
† Variable measured in only 1 specimen.
‡ Distance from the posterior extremity.

lateral to pseudolabia. Oral opening followed by vestibule (also called buccal cavity or stoma in other studies) and esophagus (muscular and glandular portions). Nerve ring close to beginning of muscular esophagus (Fig. 6). Excretory pore posterior to nerve ring. Deirids simple and small papillae, located between beginning of muscular esophagus and nerve ring (Fig. 6).

Male (6 individuals): Absolute measurements in Table I. Glandular esophagus 7.4–9.2 times longer than muscular portion. Posterior portion of body usually coiled (Figs. 3, 7, 8). Right spicule slightly arched shape (Fig. 7). Left spicule 4.5–7.2 times larger than right one (Table I, Fig. 7). Most caudal papillae pedunculated (except the last 2 pairs). Four pairs of preanal papillae and 6 pairs postanal papillae. One papilla nonpedunculated, morphologically similar to last 2 pairs of postanal papillae. Unpaired papillae located between sixth pair of postanal papillae (Fig. 4). Phasmids close to the fifth and sixth pairs of postanal papillae (Fig. 4). Caudal alae narrow, supporting caudal papillae (Fig. 8). Cuticular elevations of area rugosa long and plain. Area rugosa distribution 420–750 (Figs. 3, 9).

Female (8 gravid individuals): Absolute measurements in Table I. Larger and wider than male specimens. Glandular esophagus 6.2–9.9 times longer than muscular portion. Didelphic and amphidelphic uterus. Anterior ovary located at third anterior portion of body, quite posterior to glandular esophagus. Posterior ovary some distance to anus (Fig. 10). Vulva approximately located in third posterior portion of body (29.7–45.0% of body length). Embryonated eggs bearing knob at each pole with 2 filaments (Fig. 11).

Taxonomic summary

Type host: Champsocephalus gunnari Lonnberg, 1905 (Channichthyidae).

Host body length (cm): 24.0–38.3.

Type locality: Punta Arenas (54°00′S, 71°00′W), Chile.

Habitat of the host: Pelagic.

Site of infection: Intestine.

Prevalence and abundance: Prevalence 74.4%, mean abundance 5.7 individuals from 39 host specimens examined, and mean intensity 7.6 individuals from 29 fish parasitized.

Etymology: The specific name of this species relates to the vernacular name of the host (i.e., ''draco'').

Deposition of specimens: Museo Nacional de Historia Natural, Chile: MNHNCL #11660 (paratypes), U.S. National Parasite Collection, USNPC-99672 (voucher specimens).

Remarks

Ascarophis draconi n. sp. differs morphometrically from several *Ascarophis* species (Table II). This new species was closest to *Ascarophis adioryx* Machida, 1981, and *Ascarophis filiformis* Polyansky, 1952. Only females of *Ascarophis japonica* Zhukov, 1960, and *Ascarophis holocentri* Parukhin, 1984, and males of *Ascarophis parupenei* Moravec, Orecchia, and Pagi, 1988; *Ascarophis distorta* Fusco and Overstreet, 1978; and *Ascarophis curvicauda* Zhukov, 1960, were close to *A. draconi* n. sp.

The buccal structure of *A. draconi* n. sp. was similar only to *A. adioryx*; wide submedial labia were clearly distinct because of furrows and small structures underneath pseudolabial projections and submedial labia. Those characteristics are not common in most *Ascarophis* species. Body length of *A. draconi* n. sp., principally of females, is double the length of *A. adyoryx*. Nevertheless, the vestibule length of *A. draconi* n. sp. is shorter than *A. adioryx*. Moreover, these species differ in egg filament arrangement: *A. adioryx* eggs are without filaments. The left spicule length of *A. draconi* n. sp. and *A. adioryx* have similar ranges (Table II), even though the body lengths differ; the right spicule length is larger in *A. adioryx* than in *A. draconi* n. sp. (Table II). Thus, the LS/RS ratio is larger in *A. draconi* n. sp. (Table II).

The nerve ring and vulva of *A. draconi* n. sp. are more posterior in position, and there is a longer glandular esophagus; females have longer tails than in *A. filiformis* (Polyansky, 1952; Appy, 1981; Table II). Also, *A. draconi* n. sp. has a larger spicule length than *A. filiformis*, even though males of these 2 species are similar in body lengths (Table II). There are 4 pairs of preanal and 5 postanal caudal papillae in *A. filiformis* according to Polyansky (1952) and 4 and 6 pairs, respectively, according to Appy (1981). *Ascarophis draconi* n. sp. has 4 pairs of preanal and 6 pairs of postanal papillae and unpaired papilla between the sixth postanal pair, which is unusual in any other *Ascarophis* species. However, some species of Cystidicolidae have shown an unpaired caudal papilla (e.g., Moravec, 1996), whereas other species have occasionally exhibited an unpaired caudal papilla (e.g., Moravec and Nagasawa, 1999). The unpaired papillae on *A. draconi* n. sp. were observed in a few individuals by light microscopy and SEM, but it is

TABLE II. Some morphometric characteristics of 28 *Ascarophis* species,* including the new species, and bibliographic sources are shown. Species organized by egg filament arrangements and then by left spicule length. All ratios were calculated between minimum values only and between maximum values only to obtain the range.

		Males					Females				
Species	Bibliographic source	Body length (mm)	Left spicule (μm)	Ratio LS/RS	Ratio GE/MS	Pairs postanal papillae	Body length (mm)	Tail (μm)	Ratio GE/ME	% Ratio vulva/body length	Egg poles with filaments
A. distorta	Fusco and Overstreet (1978)	9.5–11.4	624–662	5.2–6.8	4.6–4.9	4	14.1–18.0	230–302	4.4–5.0	51–52	0
A. adioryx	Machida (1981)	7.0–9.0	530–610	3.6–3.8	4.0–4.6	5	12.4–15.9	61–87	4.2–4.6	43–44	0
A. parupenei	Moravec et al. (1988)	6.7–8.3	533–600	3.5–3.5	12.9–14.3	6	10.9–15.8	51–60	13.5–16.1	27–31	0
A. upenei	Parukhin (1978)	6.0–7.1	450–580	4.1–5.2	5.3–5.4	5	12.2–12.6	100–110	6.7–7.6	42–52	0
A. crassicollis	Dollfus and Campana-Rouget (1956), Rahman (1965)	3.5–3.9	385–410	3.0–4.0	5.4–5.4	5	7.1–7.9	110–130	6.2–7.1	36–43	0
A. brasiliensis	Magalhães-Pinto et al. (1984)	10.7–12.9	360–380	1.7–1.8	1.2–1.4	5†	10.7–19.0	64–82	5.3–7.4	25–32	0
A. holocentri	Parukhin (1984)	13.5	2,300	19.2	3.7	6	13.7–24.4	80–170	3.9–4.0	44–58	1
A. mexicana	Moravec et al. (1995)	3.3–4.1	1,580–2,050	8.5–10.5	4.5–5.7	6	5.9–6.2	57–66	4.3–5.1	43–52	1
A. morrhuae	Ko (1986)	5.1–7.2	740–790	7.7–7.9	5.1–8.2	6	8.5–12.7	72–146	5.1–7.9	47–55	1
A. capelanus	Naidyonova and Nikolaeva (1968) *fide* Ko (1986)	3.6–5.8	375–403	4.2–4.3	4.02–5.7	5	5.7–11.1	43–59	5.2–6.9	41–59	1
A. exalticola	Appy (1981)	4.0–6.3	276–359	4.5–4.3	4.6–5.6	6	5.9–8.7	37–66	6.2–6.7	28	1
A. japonica	Zhukov (1960)	6.4–9.2	272–305	3.7–3.8	5.9–6.8	5	14.5–16.2	50–71	6.9–7.2	32–40	1
A. minuta	Ko (1985)	3.0–6.5	183–250	3.1–3.7	3.4–4.2	6	6.0–12.0	48–72	3.8–4.7	33–39	1
A. epinepheli	Wang (1984)	5.8	175	2.6	4.5	5	5.3	45	4.6	46‡	1
A. slankisi	Solov'eva (1987)	3.9–4.6	156–268	2.6–3.8	3.5–3.9	5	8.8–13.4	76–93	4.7–5.3	51–56	1
A. sebastodis§	Olsen (1952), Ko (1986)	5.1	135	2.8	7.4	6	8.7–11.5	55–74	6.7–8.2	25–38	1
A. longispicula	Zhukov (1960)	5.2–7.5	824–1,015	7.9–8.9	4.0–4.9	5	9.2–11.4	33‖	4.3–5.1	38	2
A. arctica§	Appy (1981), Fagerholm and Berland (1988)	5.7–8.7	595–980	7.0–10.0	5.7–6.7	5	9.7–15.4	34–71	3.9–7.4	41–47	2
A. litoralica	Zhukov (1960)	4.3–5.1	590–670	7.1–7.7	3.3–3.8	5	6.6–12.0	29–33	3.0–3.4	39–44	2
A. draconi n. sp.	This study	9.8–13.2	482–640	4.5–7.2	7.4–10.5	6	20.9–28.6	83–113	6.2–9.9	29–44	2
A. pontica	Nicolaeva (1970)	4.2–9.8	360–495	4.7–5.9	4.9–5.1	4	11.3–15.5	39–89	5.6–5.7	28–29	2
A. curvicauda	Zhukov (1960)	8.3–10.0	354–476	3.4–4.2	4.9–5.0	5	12.8–15.8	104–142	5.3–6.1	41–47	2
A. nototheniae	Ko (1986)	6.4–10.8	322–395	3.4–3.9	7.5–7.9	5	8.7–19.3	44–62	8.1–10.3	36–48	2
A. mullusi	Naidyonova and Nikolaeva (1968)	5.9	322	5.1	4.7	5	11.7–11.9	40–53	8.3–7.5	41–34	2
A. filiformis§	Zhukov (1960), Appy (1981)	9.0–14.7	250–390	3.0–3.6	5.1–8.5	5	19.3–40.0	58–120	5.5–7.4	47–52	2
A. pacifica	Zhukov (1960)	6.3–10.2	270–310	2.9–3.1	—	5	12.4–20.0	46–71	—	54–59	2
A. carvajali n. sp.	This study	5.2–7.2	170–305	2.7–3.6	5.9–6.6	6	10.0–17.0	40–58	5.4–6.5	31–37	2
A. ayalai	Gonzales-Solis et al. (2002)	3.0–4.7	122–141	2.6–2.7	5.0–5.4	6	8.0–9.8	94–125	6.3–7.9	51–53	2

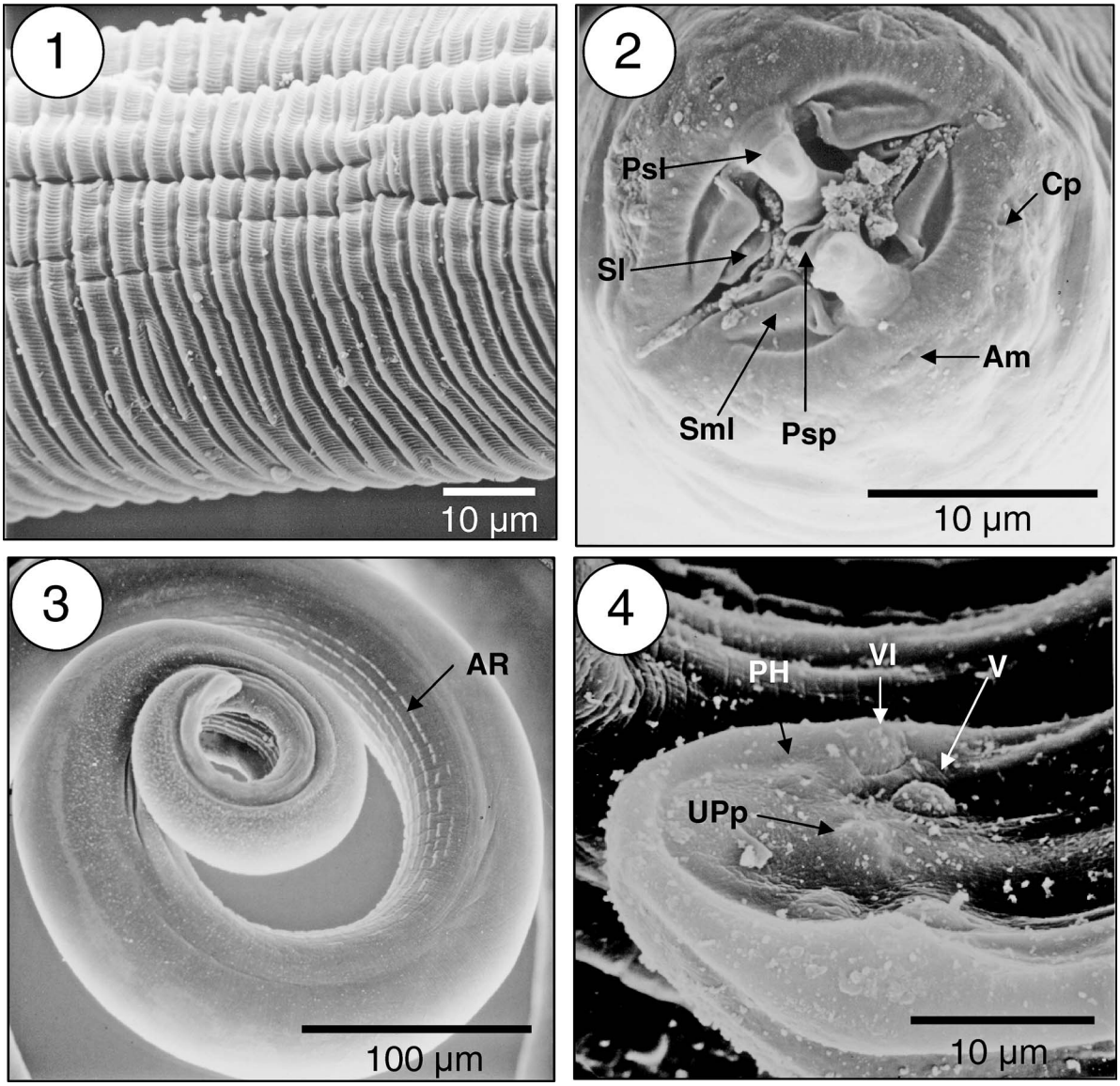
* *Ascarophis cooperi*, *A. girellae*, *A. gymnocrani*, *A. prosper*, and *A. upeneichthys* were not included in this table because they have incomplete morphological descriptions. However, they were mentioned in taxonomic remarks for discussion (see text).

† This species also has 1 adanal pair.

‡ Probably the vulva was located posterior to the midbody, although a certain translation could not be done.

§ When 2 bibliographic sources were used, combined morphometric ranges are shown. Those measurements without ranges were based on 1 individual, except for *A. sebastodis*, which was based on averages.

‖ Measurement from a drawing.



FIGURES 1–4. SEM of *Ascarophis draconi* n. sp. (**1**) Cuticular striations (third anterior portion of the body). (**2**) Oral opening (Sml: submedial labium; Psl: pseudolabium; Psp: pseudolabium projection to the central oral opening; Sl: sublabium; Am: amphid; Cp: cephalic papilla). (**3**) Posterior portion of the male body (AR: area rugosa). (**4**) Postanal papillae (V: fifth pair; VI: sixth pair; UPp: papilla; PH: phasmids).

uncertain whether this is a strong characteristic of the species or morphological variation within the species.

Ascarophis parupenei differs from males and females of *A. draconi* in possessing a large ratio between lengths of glandular and muscular esophagi and a large vestibule (Moravec et al., 1988). Also, *A. parupenei* has eggs without filaments, in contrast to *A. draconi* n. sp. (Table II).

Ascarophis japonica and *A. holocentri* differ from *A. draconi* n. sp. in egg filament arrangements; the 2 species have a single egg pole with filaments, in contrast to *A. draconi* n. sp. with filaments on each egg pole (Table II). Other differences show females of *A. draconi* n. sp. as being almost twice as large as *A. japonica*; however, relative measurements of vestibule and esophagus lengths are larger; the left spicule is shorter, and the anus is more posterior in *A. japonica* than *A. draconi* n. sp.; *A. holocentri* has a left spicule 4 times larger than in *A. draconi* n. sp. (Table II).

Males of *A. curvicauda* have a shorter glandular esophagus and a shorter ratio of GE/ME and LS/RS than *A. draconi* n. sp. However, *Ascarophis mexicana* Salgado-Maldonado and Vivas-Rodriguez, 1995, and *A. holocentri* possess a longer left spicule than *A. draconi* n. sp. (Table II).

Several species with incomplete morphometric information have also been considered, but most are only based on a few characteristics. *Ascarophis draconi* differs from *Ascarophis collaris* Petter, 1970; *Ascarophis cooperi* Johnston and Mawson, 1945; *Ascarophis girellae* (Yamaguti, 1935); *Ascarophis gymnocrani* (Yamaguti, 1935); and *Ascarophis upeneichthys* Johnston and Mawson, 1945, in that these latter species have no egg filaments. In contrast, *Ascarophis capellanus* Nikolaeva and Naidyonova, 1965, and *Ascarophis epinepheli* Wang, 1984, have filaments on 1 egg pole (see comparative tables in Ko, 1986; Ferrer et al., 2005). Those species that possess egg filaments in both poles—*Ascarophis pacifica* Zukhov, 1960, and *Ascarophis prosper* Naidyonova and Nikolaeva, 1969—have shorter left spicules than *A. draconi* n. sp. (Ko, 1986; Ferrer et al., 2005). *Ascarophis mullusi* Naidyonova and Niykolaeva, 1968, has a short body length, approximately the half that of *A. draconi* n. sp. (Table II).

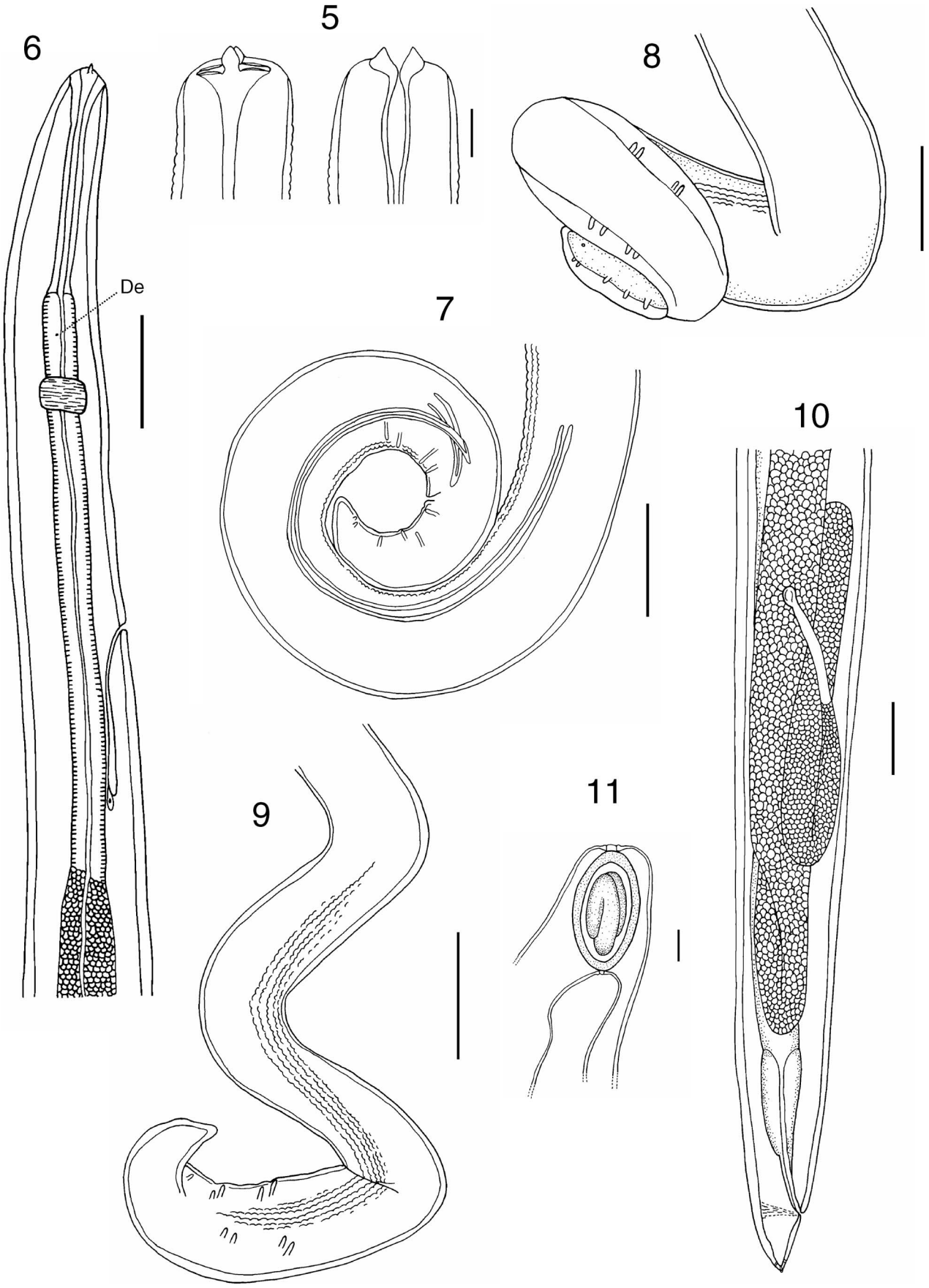

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TABLE III. Range of values (μm, unless otherwise stated) for morphological and morphometric characteristics of males and females of *Ascarophis carvajali* n. sp. in 2 fish host species.

	Patagonotothen cornucola		*Austrolycus depressiceps*	
Characteristic	Male (n = 3)	Female (n = 8)	Male (n = 4)	Female (n = 3)
Body length (mm)	5.20–7.23	10.0–14.78	4.76–6.95	8.27–9.623
Body width	48–58	83–103	43–73	75–88
Vestibule	83–113	88–113	95–113	110–120
Position of nerve ring*	125–153	113–163	125–145	138–150
Muscular esophagus	193–280	208–330	205–263	275–325
Glandular esophagus (mm)	1.27–1.71	1.40–1.80	1.17–1.52	1.10–1.62
Excretory pore*	158–213	118–203	183–218	198–225
Deirids	135†	112–133	89–113	113–120
Anus‡	90–120	40–70	90–104	48–50
Left spicule	62–84		63–85	
Right spicule	170–305		170–233	
Pairs of preanal papillae	4		4	
Pairs of postanal papillae	6		6	
Terminal knob		Some	4.76–6.95	Some
Position of vulva (mm)†		3.35–5.03	43–73	2.8–3.37
Egg length		37–43	95–113	39–41
Egg width		21–25	125–145	19–24
Polar egg filaments		Two filaments on each polar egg	205–263	Two filaments on each polar egg

* Distance from the anterior extremity.
† Variable measured in only 1 specimen.
‡ Distance from the posterior extremity.

***Ascarophis carvajali* n. sp.**
(Table III, Figs. 12–23)

General: Filiform worms. Cuticular striations well defined from anterior extremity to tail (Figs. 12, 15). Four cephalic papillae located ventrolaterally and dorsolaterally (Figs. 13–16). Oral opening dorsoventrally elongated (Figs. 13, 16). Two pseudolabia with conical anterior protrusion; one side of base of each pseudolabium connected to buccal wall, other side with a projection extending toward central oral opening. Projection wider than pseudolabium base; T-shaped in apical view (Figs. 13, 16). Some specimens with bilobed sublabia (Fig. 13). Submedial labia present, each located in margin ventral and dorsal to both sides (Figs. 13, 16). Sublabia slim and connected to buccal wall beneath each submedian labia. Amphids lateral to base of pseudolabia. Oral opening followed by vestibule and esophagus (muscular and glandular portions). Nerve ring close to beginning of muscular esophagus. Excretory pore posterior to nerve ring (Fig. 19). Deirids simple and small papillae, located between beginning of muscular esophagus and nerve ring (Fig. 19).

Male (3 individuals): Absolute measurements in Table III. Glandular esophagus 5.2–6.6 times longer than muscular. Posterior portion of body usually coiled (Fig. 20). Monorchid. Left spicule 2.4–3.7 times larger than right one (Table III). Most caudal papillae pedunculated, the last pair observed as nonpedunculated. Four pairs of preanal papillae and 6 pairs of postanal papillae (Fig. 21). Cuticular elevations of area rugosa long and flat (Fig. 17). Area rugosa distribution 280–327 (Fig. 21). Phasmids close to sixth pair of postanal papillae. Caudal alae narrow, supporting caudal papillae (Fig. 20).

Female (8 gravid individuals): Absolute measurements in Table III. Larger and wider than male specimens. Glandular esophagus 3.4–8.0 times longer than muscular portion. Didelphic and amphidelphic uterus. Anterior ovary located at first quarter portion of body, posterior to glandular esophagus. Posterior ovary some distance to anus (Fig. 22). Vulva (Fig. 23) situated at third posterior portion of body (31.3–37.6% of body length). Embryonated eggs bearing a knob at each pole with 2 filaments. Short tail (Figs. 14, 22).

Taxonomic summary

Type host: Patagonotothen cornucola (Richardson, 1833) (Nototheniidae).

Other host: Austrolycus depressiceps Regan, 1914 (Zoarcidae).

Range of host body length (cm): P. cornucola 4.5–12.4 and *A. depressiceps* 21–34.5.

Type locality: Fuerte Bulnes (53°35′S, 70°55′W), Punta Arenas, Chile.

Habitat of the hosts: Intertidal.

Site of infection: Intestine.

Prevalence, intensity, and abundance: Prevalence 12.1%, mean abundance 0.7 individuals from 58 fish specimens examined, and mean intensity 5.8 from 7 fish parasitized of *P. cornucola*; prevalence 100%, mean abundance and intensity 7 individuals from 3 host specimens of *A. depressiceps*.

Etymology: The specific name "carvajali" is in honor of Dr. Juan Carvajal for his contribution to marine parasitology in Chile.

Deposition of specimens: Museo Nacional de Historia Natural, Chile: MNHNCL #11661 (paratypes). U.S. National Parasite Collection, USNPC-99773 (voucher specimens).

Remarks

Ascarophis carvajali n. sp. is morphometrically closer to *Ascarophis minuta* Ko, 1985. Only females of *Ascarophis longispicula* Zhukov, 1960, *Ascarophis brasiliensis* Magalhães-Pinto, Vicente and Noronha, 1984, and *A. sebastodis* and only males of *Ascarophis ayalai* Machida, 1984, and *Ascarophis slankisi* Solov'eva were similar to *A. carvajali* n. sp.

Ascarophis minuta possesses a glandular esophagus that is shorter

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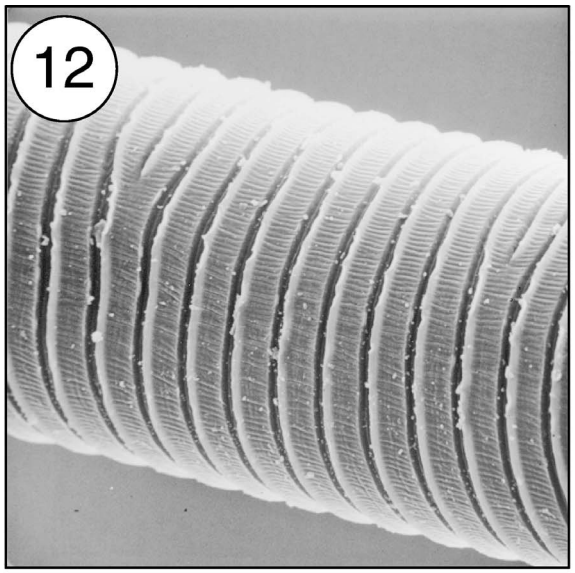
FIGURES 5–11. Drawings of the morphology of *Ascarophis draconi* n. sp. (**5**) Cephalic region. (**6**) Anterior portion of the body (De: deirid). (**7**) Male tail showing spicules and papillae. (**8**) Male tale showing caudal alae. (**9**) Male tail showing the length of area rugosa. (**10**) Posterior portion of the female body. (**11**) Embryonated eggs. Scale bar = 10 μm for Figs. 5 and 11, 100 μm for Figures 6–10.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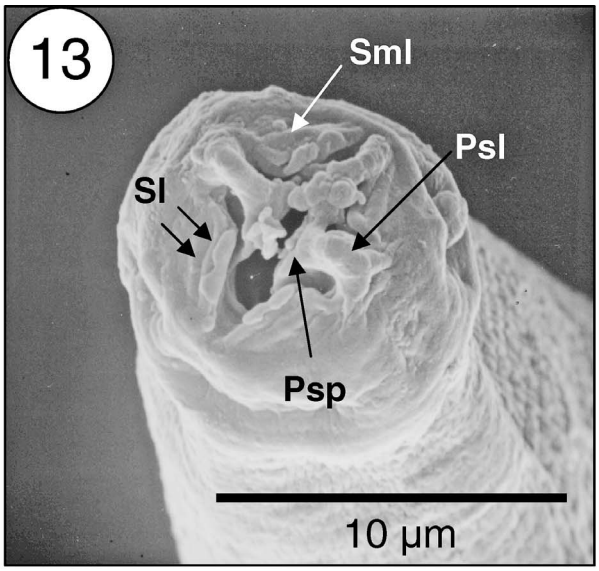
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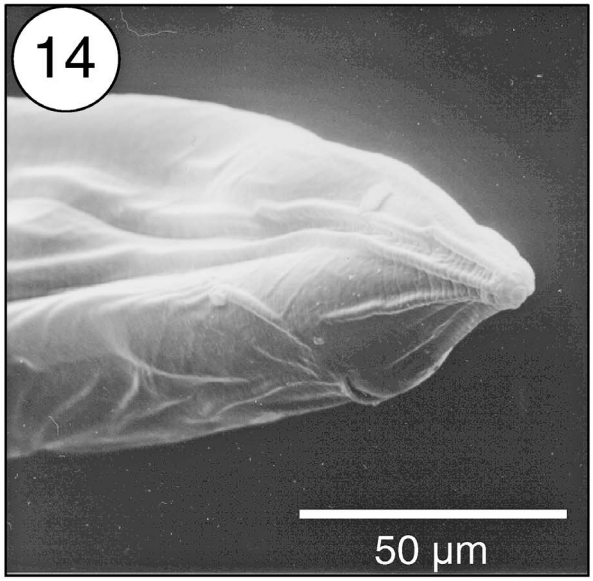
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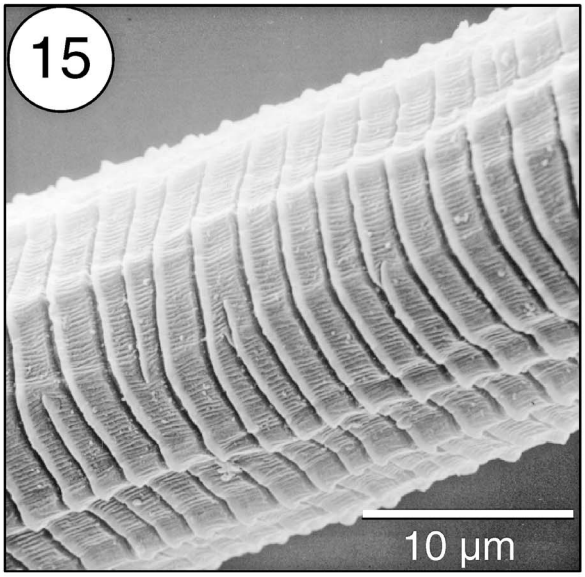
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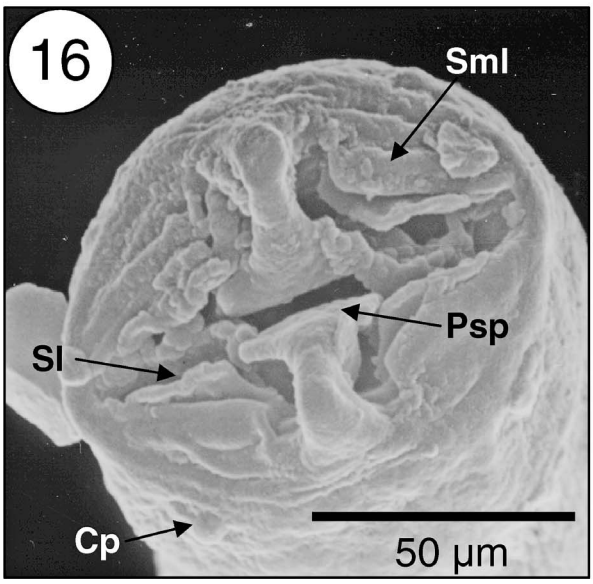
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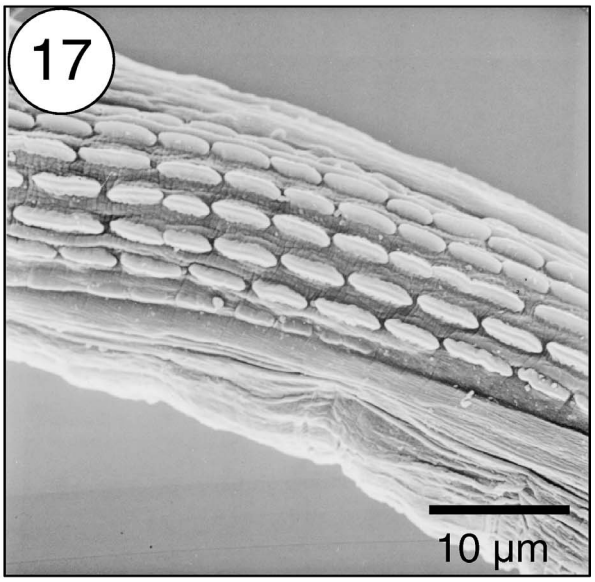
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than in *A. carvajali* n. sp. (Ko, 1985). The ratio of GE/ME in males was 3.4–4.2 for *A. minuta* compared with 5.9–6.6 for *A. carvajali* n. sp., and in females it was 3.8–4.7 compared with 5.4–6.5, respectively. *Ascarophis minuta* has eggs with filaments on 1 pole (Ko, 1985), in contrast to *A. carvajali* n. sp., which has filaments on both egg poles (Table II).

Ascarophis sebastodis differs from *A. carvajali* in the egg filament arrangements (Table II) and in having a larger glandular esophagus (see Olsen, 1952; Ko, 1986). In males, *A. carvajali* n. sp. has a larger left spicule than *A. sebastodis*. This needs confirmation because the left spicule was measured in only 1 specimen of *A. sebastodis*, without mentioning its body length; thus, the range of left spicule length is not known (see Ko, 1986).

Female nematodes of *A. brasiliensis* and *A. longispicula* are similar to *A. carvajali* n. sp. Principal differences in egg filament arrangements and length of tails in females. Male of *A. brasiliensis* with small glandular esophagus, a small GE/ME ratio, and larger spicules and body length compared with *A. carvajali* n. sp. (Table II). *Ascarophis longispicula* has long spicules that differ greatly from *A. carvajali* n. sp. (Table II).

Ascarophis slankisi and *A. ayalai* have bifurcated left spicules at the tip (see Solov'eva, 1987; González-Solis et al., 2002), and vulva position is near the middle of the body, differing from *A. carvajali* n. sp. (Table II). *Ascarophis slankisi* also has 5 pairs of postanal papillae, and *A. carvajali* 6 pairs (Table II).

Ascarophis carvajali n. sp. differs from other *Ascarophis* species, in that *A. mexicana* and *A. holocentri* have longer left spicule lengths than *A. carvajali* n. sp. *Ascarophis collaris*, *A. cooperi*, *A. distorta*, *A. girellae*, *A. gymnocrani*, *A. parupenei*, and *A. upeneichthys* lack egg filaments; *A. capellanus* and *A. epinepheli* have filaments on 1 egg pole (see comparative tables in Ko, 1986; Ferrer et al., 2005), in contrast to *A. carvajali* n. sp., which has filaments on both egg poles. Species with egg filaments on both poles include *Ascarophis pontica* Nikolaeva, 1970; *A. mullusi*; and *A. prosper*; these species also have large spicule length, in contrast to *A. carvajali* n. sp. (Ko, 1986; Ferrer et al., 2005).

DISCUSSION

Many descriptions of *Ascarophis* species have been deficient and with poor discussions of morphological comparisons among species. In fact, in this study, morphometric comparisons were done between the 2 new species and another 31, although not all of them had sufficient taxonomic information (Table II). We considered species with enough taxonomic description as those that have ranges (from several specimens) of morphometric measurements for males and females, in at least 9 characters (i.e., body length, vestibule, lengths of muscular and glandular esophagi, nerve ring position, tail [= anus/cloaca position from the posterior extremity], vulva position, and lengths of the left and right spicules).

Moreover, cephalic and buccal characteristics are essential to describe cystidicolid nematodes because some genera exhibit very similar cephalic features under light microscopy (e.g., *Capillospirura* Skrjabin, 1926; *Caballeronema* Margolis, 1977; *Pseudascarophis* Ko, Margolis, and Machida, 1985; and *Similascarophis* Muñoz, González, and George-Nascimento, 2004), making it difficult to differentiate between genera except by SEM. For example, 8 species originally placed in *Ascarophis* (*A. argumentosa*, *A. collaris*, *A. ovotrichuria*, *A. acipenserina*, *A. malmae*, *A. ochracea*, *A. marina*, and *A. nasonis*) were later placed into other genera on the basis mainly of cephalic and buccal structures (see Ko, 1986; Muñoz et al., 2004). However, this produces a large problem in *Ascarophis* because more than half of the species described do not have any micrographs, drawings, or clear descriptions of the cephalic and mouth structures. Ko (1986) proposed that 22 could be considered valid species, and another 7 species have been subsequently described, except that among the latter, several have unsatisfactory morphological and morphometric information (e.g., *A. sebastodis*, *A. cooperi*, *A. girellae*, *A. gymnocrani*, *A. prosper*, *A. epinepheli*, *A mullusi*, and *A. upeneichthys*) and require additional work. Moreover, the cephalic and mouth structures, although important for taxonomy of cystidicolids, have been not considered in evaluating the validity of several *Ascarophis* so far described.

According to the descriptions of *Ascarophis* given by Ko (1986) and Muñoz et al. (2004), the buccal structure is characterized by the presence of conical pseudolabia, sublabia, and pseudolabia with medial extension or projections; usually, submedial labia are also present. On examining these characteristics here, we suggest that *A. adioryx* and *A. exalticola* represent valid species because they exhibit the general characteristics of *Ascarophis*, in contrast to Ko (1986), who classified these species as ''with uncertain generic affinities.'' In addition, *A. adioryx* has a bifurcated deirid (= cervical papilla) (Machida, 1981), which is not a common characteristic for *Ascarophis* spp. (Ko, 1986). However, most of the studies do not mention the morphology of these papillae. Most differences among genera have been based on the mouth structure and sexual characteristics. The use of differences in deirid morphology can be employed to distinguish species within *Ascarophis* but might be not enough to differentiate between genera. *Ascarophis extalicola* Appy, 1981 was originally placed in *Ascarophis*, although the original description stated that this species might belong to another genus because of some distinct morphological characteristics from *Ascarophis*, such as a small blunt elevation on the anterior protrusion of pseudolabia, a hexagonal oral opening, and indistinct submedial labia (see Appy, 1981). However, these characteristics are closer to *Ascarophis* than to any other genera within Cystidicolidae. Actually, submedial labia are reduced, considering the mouth morphology and SEM shown by Appy (1981). The oral opening form is dorsoventrally elongated, which is the principal mouth shape for *Ascarophis*; thus, the ''hexagonal form'' would not be an important feature because this particular shape could be caused by fixation. Consequently, *A. exalticola* could be considered a valid species on the basis of its morphology, although a determinant conclusion would be only obtained from molecular analysis.

Ascarophis sebastodis was originally described by Olsen (1952) on the basis of only a single female specimen. Later, Ko (1986) gave a general description for males and females. However, that description was incomplete because the length of the left spicule and vulva position were measured for just 1 male

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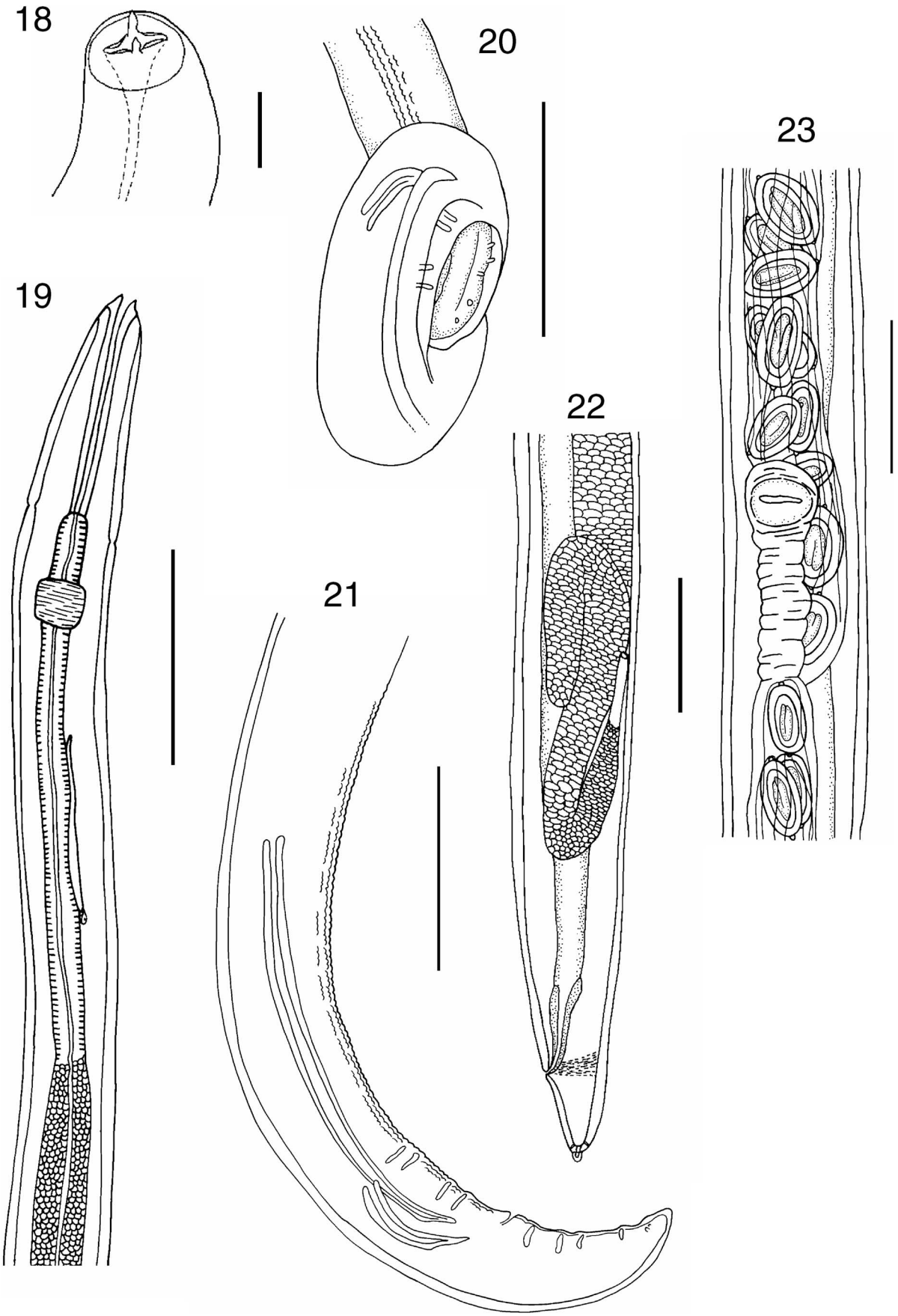
FIGURES 12–17. SEM of *Ascarophis carvajali* n. sp. from *Patagonothoten cornucola*. (**12**) Cuticular striations (third anterior portion of the body). (**13**) Oral opening (Sl: sublabium; arrows indicate 2 lobes; other abbreviations are in Fig. 2). (**14**) Tail of female. SEM of *A. carvajali* n. sp. from *Austrolycus depressiceps*. (**15**) Cuticular striations (third anterior portion of the body). (**16**) Oral opening (abbreviations are in Fig. 2). (**17**) Area rugosa.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and female individual, respectively. The validity of *A. sebastodis* could not be determined on the basis of these incomplete descriptions, although this species was included in Table II, in that *A. sebastodis* has been recorded in Chile, in the fish *S. capensis* (see González and Acuña, 2000). However, its presence along the Chilean coasts is in doubt because the validity of this species is unclear.

We excluded *Ascarophis marina* Ivanov, Navone, and Martorelli, 1997; *Ascarophis nasonis* Machida, 1981; and the recently described species *Ascarophis valentina* Ferrer, Aznar, Balbuena, Kostadinova, Raga, and Moravec, 2005, from this analysis because these species belong to *Similascarophis* according the diagnosis given by Muñoz et al. (2004).

In this study, we have described and recorded 2 new cystidicolid species, *A. carvajali* n. sp. and *A. draconi* n. sp., in fishes from Chile and for the South American Pacific coast. It is important to note that several species have *Ascarophis*-like morphology (*Pseudascarophis* and *Similascarophis*) that must be considered in future cystidicolid studies, especially from the Pacific coast. Taxonomic identifications of these species must be undertaken with caution to provide trustworthy records of parasites and their hosts.

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FIGURES 18–23. Drawings of the morphology of *Ascarophis carvajali* n. sp. (**18**) Cephalic region. (**19**) Anterior portion of the body. (**20**) Male tale showing caudal alae. (**21**) Male tail showing spicules, papillae, and area rugosa. (**22**) Posterior portion of the female body. (**23**) Vulva. Scale bars = 10 μm for Figure 18, 100 μm for Figures 19–23.

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