

Some trichinelloid nematodes from marine fishes off New Caledonia, including description of *Pseudocapillaria novaecaledoniensis* sp. nov. (Capillariidae)

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Abstract

Examinations of materials of trichinelloid nematodes recently collected from the digestive tract of marine fishes off New Caledonia, South Pacific, revealed the presence of several species of the families Capillariidae and Trichosomoididae, including capillariids *Pseudocapillaria novaecaledoniensis* sp. nov. from the deep-sea *Pristipomoides argyrogrammicus* (Valenciennes) (Lutjanidae) and *Pseudocapillaria echenei* (Parukhin, 1967) from *Echeneis naucrates* Linnaeus (Echeneidae), and the trichosomoidid *Huffmanella* sp. (female) from *Bodianus perditio* (Quoy et Gaimard) (Labridae). *P. novaecaledoniensis* is characterized mainly by the structure and length (318–321 µm) of spicule and the presence of a dorsal cuticular membrane interconnecting both ventrolateral caudal lobes in the male (subgenus *Ichthyocapillaria* Moravec, 1982). The previously poorly known *P. echenei* is redescribed and recorded for the first time from the South Pacific Ocean. In addition, five morphologically different types of capillariid females without generic identification, designated as Capillariidae gen. spp. 1–5, each of them probably representing a new species, were recorded from *Fistularia commersonii* Rüppell (Fistulariidae), *Synodus dermatogenys* Fowler (Synodontidae), *Carangoides oblongus* (Cuvier) (Carangidae), *Diagramma pictum* (Thunberg) (Haemulidae) and *Stegostoma fasciatum* (Hermann) (Stegostomidae), respectively. *Capillaria decapteri* is transferred to *Pseudocapillaria* Mendonça, 1963 as *P. decapteri* (Luo, 2001) comb. nov.

Résumé

L'examen de Nématodes Trichinelloidea récemment récoltés dans le tube digestif de poissons marins de Nouvelle-Calédonie, Pacifique Sud, a révélé la présence de plusieurs espèces des familles Capillariidae et Trichosomoididae, à savoir les Capillariidae *Pseudocapillaria novaecaledoniensis* sp. nov. du poisson de profondeur *Pristipomoides argyrogrammicus* (Valenciennes) (Lutjanidae) et *Pseudocapillaria echenei* (Parukhin, 1967) chez *Echeneis naucrates* Linnaeus (Echeneidae), et le Trichosomoididae *Huffmanella* sp. (femelle) chez *Bodianus perditio* (Quoy et Gaimard) (Labridae). *P. novaecaledoniensis* est caractérisé principalement par la structure et la longueur (318–321 µm) du spicule et la présence d'une membrane cuticulaire dorsale connectant les deux lobes ventrolatéraux chez le mâle (sous-genre *Ichthyocapillaria* Moravec, 1982). L'espèce *P. echenei*, auparavant peu connue, est redécrite et mentionnée pour la première fois de l'Océan Pacifique Sud. De plus, cinq différents types morphologiques de Capillariidae femelles sans identification générique, désignés comme Capillariidae gen. spp. 1–5, chacun d'eux représentant probablement une nouvelle espèce, sont mentionnés respectivement chez *Fistularia commersonii* Rüppell (Fistulariidae), *Synodus dermatogenys* Fowler (Synodontidae), *Carangoides oblongus* (Cuvier) (Carangidae), *Diagramma pictum* (Thunberg) (Haemulidae), et *Stegostoma fasciatum* (Hermann) (Stegostomidae). *Capillaria decapteri* est transféré dans *Pseudocapillaria* Mendonça, 1963 comme *P. decapteri* (Luo, 2001) comb. nov.

Keywords

Parasitic nematode, Capillariidae, *Pseudocapillaria*, Trichosomoididae, *Huffmanella*, marine fish, New Caledonia, South Pacific

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Introduction

Although trichinelloid nematodes may be severely pathogenic in fish hosts (e.g., Ghittino 1961, Kutzer and Otte 1966, Bauer *et al.* 1977, Hoffman 1982, Moravec and Gut 1982, Vismanis *et al.* 1987, Pietrock *et al.* 1996, Košuth 1997, Moravec 2001), the knowledge of the fauna of these parasites in marine fishes of New Caledonian waters remains fragmentary. To date, only Moravec (2001) reported records of two unidentified capillariid species, designated as *Capillariidae* gen. sp. 7 and *Capillariidae* gen. sp. 8, from the digestive tract of *Siganus doliatus* Guérin-Méneville and *Naso unicornis* (Forsskal) (Siganidae and Acanthuridae, respectively; both Perciformes), based on single female specimens collected in New Caledonia by S. Morand and M. Rigby, and Justine (2004, 2005, 2007) described six new species of the trichosomoidid genus *Huffmanella* Moravec, 1987 from some fishes of the families Balistidae, Carcharhinidae, Labridae, Lethrinidae and Nemipteridae, and one unidentified species (*Huffmanella* sp.) from a nemipterid.

During recent years, while studying the parasites of marine fishes off New Caledonia, capillariid and trichosomoidid nematodes were collected from some teleost fishes of the orders Aulopiformes, Perciformes and Syngnathiformes, and a shark (Orectolobiformes). Results of their taxonomic evaluation are presented in this paper.

Materials and methods

Fishes were caught by line or speared, at distances less than 30 km from Nouméa, New Caledonia. All fish specimens were measured, weighed and photographed. A unique number (JNC) was assigned to each fish. Parasites from the digestive tract were generally collected by the “gut wash” method (Cribb and Bray 2010), sometimes without differentiating the contents of the stomach and intestine. The parasitological material was then assigned a corresponding JNC linked to the respective fish host. Capillariid nematodes used in this study were recorded from the following species of New Caledonian fishes: Carangidae: coachwhip trevally, *Carangoides oblongus* (Cuvier) (4 specimens examined); Echeineidae: live sharksucker, *Echeneis naucrates* Linnaeus (3); Fistulariidae: bluespotted cornetfish, *Fistularia commersonii* Rüppell (1); Haemulidae: painted sweetlips, *Diagramma pictum* (Thunberg) (7); Labridae: golden-spot hogfish, *Bodianus perditio* (Quoy et Gaimard) (40); Lutjanidae: *Pristipomoides argyrogrammicus* (Valenciennes) (15); Stegostomidae: zebra shark, *Stegostoma fasciatum* (Hermann) (1); and Synodontidae: sand lizardfish, *Synodus dermatogenys* Fowler (3). The nematodes for morphological studies were fixed in hot 4% formaldehyde solution in physiological saline, or sometimes in hot 70% ethanol. For light microscopical examination, they were cleared with glycerine. Drawings were made with the aid of a Zeiss microscope drawing attachment. All measurements are in micrometres unless

otherwise stated. Fish names follow FishBase (Froese and Pauly 2009). Specimens were deposited in Muséum National d'Histoire Naturelle, Paris (MNHN) and Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice (HCIP).

Results

Superfamily Trichinelloidea Ward, 1907 (1879)

Family Capillariidae Railliet, 1915

***Pseudocapillaria novaecaledoniensis* sp. nov.** (Fig. 1)

Description: General. Small filiform nematodes. Anterior end of body narrow, rounded; cephalic papillae indistinct. Two lateral bacillary bands extending along almost whole body length. Muscular oesophagus long, narrow. Stichosome consisting of single row of about 35–38 elongate stichocytes subdivided usually (mainly in middle and posterior parts of stichosome) into many (up to about 10) transverse annuli; nuclei of stichocytes large. Nerve ring encircling muscular oesophagus at about its one third. Two wing-like cells present at oesophago-intestinal junction.

Male (2 specimens; measurements of holotype, those of paratype in parentheses): Length of body 5.32 (5.18) mm, maximum width 45 (48). Width of lateral bacillary bands at region of posterior end of oesophagus 27 (24). Length of entire oesophagus 2.75 (2.42) mm, representing 48 (42)% of body length. Length of muscular oesophagus 201 (233), of stichosome 2.55 (2.19) mm; number of stichocytes 35 (36). Nerve ring situated 78 (81) from anterior extremity. Cloaca 396 (420) long; length of vas deferens 87 (150); seminal vesicle long, measuring 450 × 30 (405 × 30). Spicule well sclerotized, smooth, 318 (321) long. Proximal end of spicule somewhat expanded, 15 (15) wide; width of middle part of spicule 9 (9); distal end pointed, 6 (6) wide. Spicular sheath narrow, without spines, but finely transversely striated; extruded spicular sheath in holotype 42 long and 12 wide, with fine, dense transverse wrinkles giving serrated appearance to lateral sheath surfaces. Posterior end of body rounded, provided with two large, round ventrolateral lobes. Cloacal opening subterminal, length of tail 9 (12).

Female (2 gravid specimens; measurements of allotype, those of paratype in parentheses): Length of body 11.66 (11.82) mm, maximum width 69 (72). Width of lateral bacillary bands at region of posterior end of oesophagus 27 (27). Length of entire oesophagus 4.94 (3.75) mm, representing 40 (32)% of body length. Length of muscular oesophagus 300 (330), of stichosome 4.64 (3.42); number of stichocytes about 38 (37). Nerve ring situated 90 (93) from anterior extremity. Vulva located 4.08 (3.77) mm from anterior end of body, at 35 (32)% of body length, 30 (24) posterior to level of oesophago-intestinal junction. Vulval lips not elevated. Vagina short, muscular. Eggs arranged in single file in uterus. Eggs oval, without protruding polar plugs. Egg wall appearing as two-layered; in-

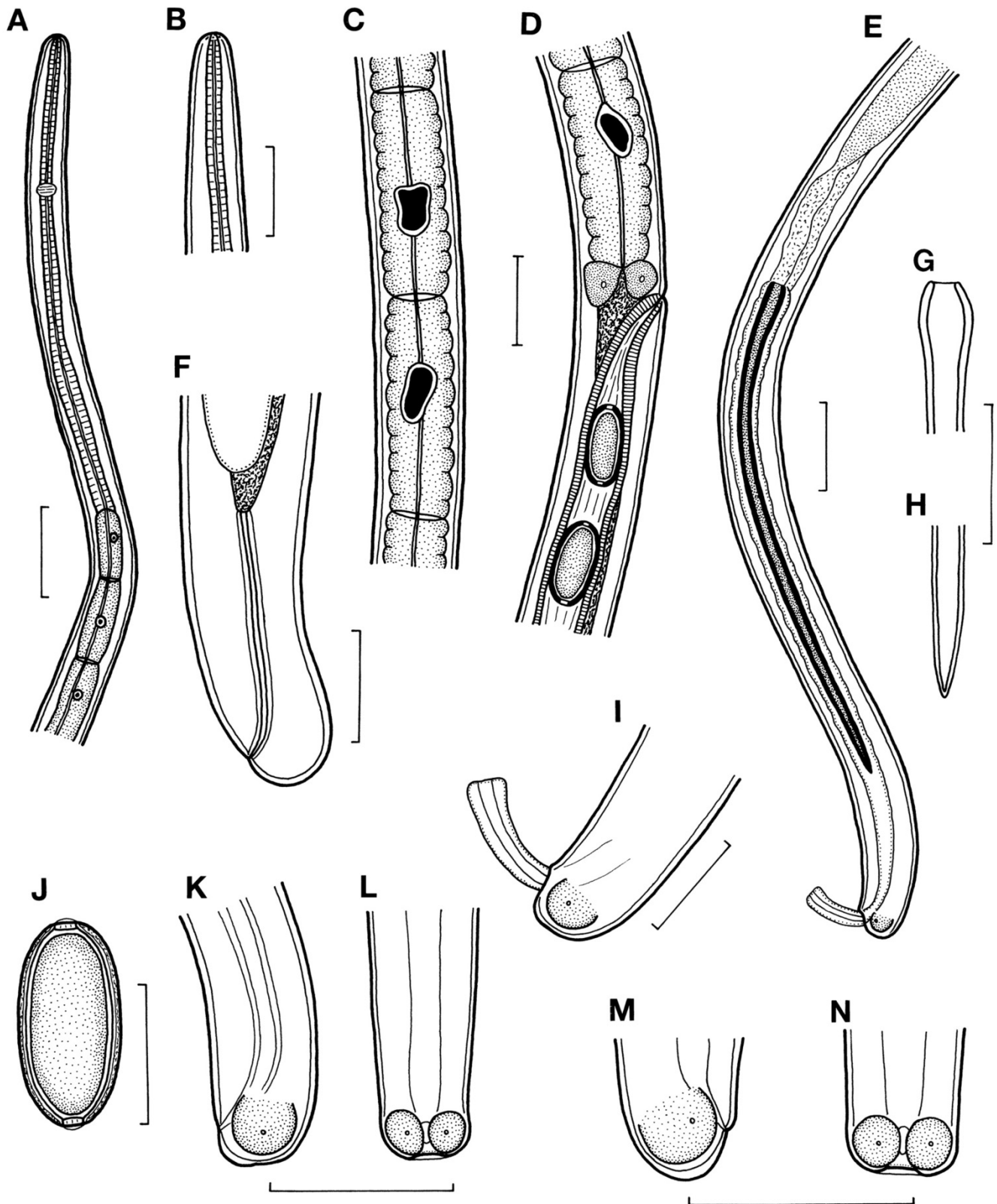


Fig. 1. *Pseudocapillaria novaecaledoniensis* sp. nov.: **A** – anterior end of female. **B** – cephalic end. **C** – stichocytes at middle part of stichosome. **D** – region of vulva, lateral view. **E** – posterior end of male, lateral view. **F** – caudal end of female, lateral view. **G** and **H** – proximal and distal ends of spicule, respectively. **I** – caudal end of male with extruded spicular sheath, lateral view. **J** – egg. **K** and **L** – caudal end of male, lateral and ventral views. **M** and **N** – same, higher magnification. Scale bars = 50 μ m (A-E, K-N); 30 μ m (F-J)

ner layer hyaline, outer layer with fine superficial net-like sculpture. Eggs including polar plugs $51\text{--}54 \times 21\text{--}24$ ($48\text{--}51 \times 24$), thickness of egg wall 2 (2); polar plugs 4 (4) long and 6 (6) wide. Content of fully developed eggs uncleaved. Caudal end rounded, anus subterminal; tail 12 (12) long. Rectum formed by hyaline tube 69 (72) long.

Type host: Ornate jobfish, *Pristipomoides argyrogrammicus* (Lutjanidae, Perciformes).

Site of infection: Digestive tract.

Type locality: Deep-sea off the Barrier Reef near Nouméa, New Caledonia (off Récif Mbere, depth ca. 200 m, $166^{\circ}14'E$, $22^{\circ}21'S$, collected 24 June 2008).

Prevalence and intensity: 4 specimens found in 1 of 15 fish examined.

Deposition of type specimens: MNHN JNC2604 (holotype and allotype), HCIP N-930 (paratypes).

Etymology: The specific name *novaecaledoniensis* relates to the country of its origin (i.e., New Caledonia).

Comments: The general morphology of these specimens corresponds to the genus *Pseudocapillaria* Freitas, 1959, as re-defined by Moravec (1982), comprising many species that are gastrointestinal parasites of fishes, amphibians, reptiles, birds and mammals. Only 15 species of this genus were reported from freshwater, brackish-water and marine fishes by Moravec (2001). However, an additional species, described as *Capillaria decapteri* Luo, 2001 from the marine fish *Decapterus maruadsi* (Temminck et Schlegel) (Carangidae, Perciformes) in Taiwan Strait (Luo 2001), should be transferred to *Pseudocapillaria* as *P. decapteri* (Luo, 2001) comb. nov.

By the length of the spicule ($318\text{--}321\text{ }\mu\text{m}$), *P. novaecaledoniensis* sp. nov. somewhat resembles only *P. indica* Moravec, Beevi, Radhakrishnan et Arthur, 1993 (spicule $240\text{--}282\text{ }\mu\text{m}$), *P. salvelini* (Polyansky, 1952) ($300\text{--}600\text{ }\mu\text{m}$), *P. tomentosa* (Dujardin, 1843) ($240\text{--}411\text{ }\mu\text{m}$) and *P. yucatanensis* Moravec, Scholz et Vivas-Rodríguez, 1995 ($218\text{--}295\text{ }\mu\text{m}$), whereas the spicule of other *Pseudocapillaria* spp. from fishes is distinctly shorter (at most $225\text{ }\mu\text{m}$). However, in contrast to the new species, all these four species are parasites of freshwater fishes (mainly Channidae, Cottidae, Cyprinidae, Heptapteridae and Salmonidae) in the Holarctic, Oriental or Neotropical Regions. Moreover, the dorsal cuticular membrane interconnecting both ventrolateral caudal lobes in the male of *P. novaecaledoniensis* is absent in *P. indica*, *P. tomentosa* and *P. yucatanensis*. The shapes of the spicule proximal and distal ends of these four species parasitizing freshwater fishes are also different. Distinction of *P. novaecaledoniensis* from the majority of individual congeneric species parasitizing cold-blooded vertebrates is apparent from the key provided by Moravec (2001). The inadequately described *P. decapteri* mainly differs in possessing a markedly shorter spicule ($105\text{ }\mu\text{m}$ long).

In accordance with the classification system used by Moravec (2001), species of the genus *Pseudocapillaria* parasitizing cold-blooded vertebrates can be assigned, based on the morphology of the male caudal end and the presence/absence of a vulval appendage, to four subgenera: *Discocapillaria* De

et Maity, 1996, *Ichthyocapillaria* Moravec, 1982, *Indocapillaria* De et Maity, 1995 and *Pseudocapillaria* Freitas, 1959. By the absence of a vulval appendage and the presence of two ventrolateral caudal lobes interconnected by a dorsal cuticular membrane in the male, *P. novaecaledoniensis* belongs to the subgenus *Ichthyocapillaria*.

Fish capillariids usually exhibit their specificity at the level of host families (Moravec 2001). *P. novaecaledoniensis* is the first known species of *Pseudocapillaria* so far described from the perciform family Lutjanidae. The only other capillariid parasitizing a fish of this family, inadequately described as *Capillaria* Zeder, 1800 s.l. sp. 1 solely from females found in the intestine of *Lutjanus lutjanus* (Bloch) (reported as *L. lineolatus*), was reported by Parukhin (1971) from the Monar Bay near the western coast of India. This nematode differed from *P. novaecaledoniensis* in having a terminal anus in the female.

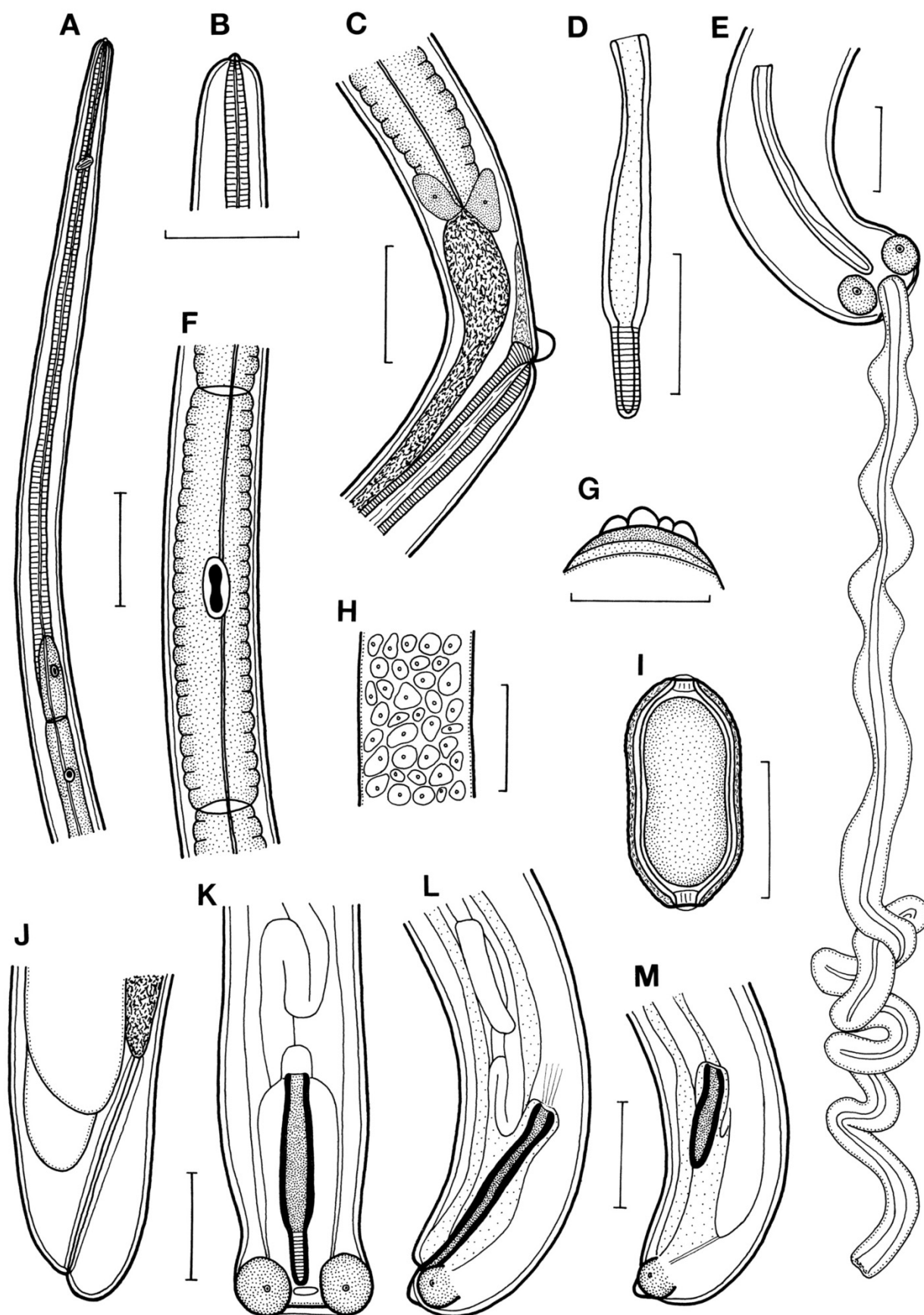
Pristipomoides argyrogrammicus is a common deep-sea fish off New Caledonia. The only other nematode found in this fish were unidentified anisakid larvae, and the only other helminth recorded is the digenean *Neolebouria blatta* Bray et Justine, 2009 (see Bray and Justine 2009). No capillariid was found in two specimens of four other deep-sea lutjanid species collected off Nouméa, i.e., *P. auricilla* Jordan, Evermann et Tanaka (2 specimens), *P. filamentosus* (Valenciennes) (2), *Etelis carbunculus* Cuvier (4), *E. coruscans* Valenciennes (6), nor in many specimens of 10 species of *Lutjanus* from the lagoon.

***Pseudocapillaria echenei* (Parukhin, 1967) Moravec, 1982 (Fig. 2)**

Syn.: *Capillaria echenei* Parukhin, 1967

Description: General. Medium-sized filiform nematodes. Anterior end of body narrow, rounded; central part of cephalic end distinctly elevated; cephalic papillae indistinct. Two lateral, fairly wide bacillary bands extending along almost whole body length. Muscular oesophagus long, narrow. Stichosome consisting of single row of about $36\text{--}48$ elongate stichocytes subdivided usually (mainly in middle and posterior part of stichosome) into many (up to about 25) transverse annuli; nuclei of stichocytes large. Nerve ring encircling muscular oesophagus at its second fourth. Two wing-like cells present at oesophago-intestinal junction.

Male (3 specimens): Length of body $21.94\text{--}23.28\text{ mm}$, maximum width $84\text{--}99$. Width of lateral bacillary bands at region of posterior end of oesophagus 36 . Length of entire oesophagus $8.69\text{--}8.84\text{ mm}$, representing $37\text{--}40\%$ of body length. Length of muscular oesophagus $516\text{--}549$, of stichosome $8.14\text{--}8.32\text{ mm}$; number of stichocytes about $40\text{--}44$. Nerve ring situated $99\text{--}102$ from anterior extremity. Cloaca very long, $4.39\text{--}5.82\text{ mm}$, containing numerous coils of withdrawn spicular sheath; posterior portion of cloaca forming distinct spicular canal $39\text{--}48$ long. Vas deferens $231\text{--}476$ long; seminal vesicle unusually elongate, $4.39\text{--}5.82\text{ mm}$ long. Body at region



of cloaca anterior to spicule somewhat narrowed. Spicule well sclerotized, 132 and 147 long in two specimens; spicule of third specimen appearing to be anomalous, only 66 long. Proximal end of spicule somewhat expanded, located inside short spicule canal; distal end narrowed, with numerous fine transverse superficial grooves, with rounded tip. Spicular sheath long, narrow, with smooth surface; extruded spicular sheath in one specimen about 600 long and 21 wide. Posterior end of body rounded, provided with two large, round ventrolateral lobes, each bearing one small papilla; both lobes interconnected between each other by small dorsal cuticular membrane, forming thus small caudal bursa. Cloacal opening subterminal, length of tail 15–21.

Female (4 gravid specimens): Length of body 36.38–45.87 mm, maximum width 102–114. Width of lateral bacillary bands at region of posterior end of oesophagus 36–42. Length of entire oesophagus 11.56–14.69 mm, representing 29–35% of body length. Length of muscular oesophagus 492–600, of stichosome 11.07–14.09; number of stichocytes about 46–48. Nerve ring situated 96–117 from anterior extremity. Vulva located 12.24–14.85 mm from anterior end of body (at 29–36% of body length), 135–165 posterior to level of oesophago-intestinal junction. Vulval lips not elevated; anterior lip bearing distinct inflation of cuticle appearing as single round lobe in lateral view and as four connected lobes in frontal view. Vagina short, muscular. Eggs arranged in single file in uterus. Eggs oval, usually somewhat narrowed equatorially, with slightly protruding polar plugs. Egg wall appearing as two-layered; inner layer hyaline, outer layer with fine superficial net-like sculpture. Eggs including polar plugs 57–63 × 27–30, thickness of egg wall 3; polar plugs 6 long and 6 wide. Content of fully developed eggs uncleaved. Caudal end rounded, anus subterminal; tail 12–21 long. Rectum formed by hyaline tube 87–165 long; its proximal end somewhat anterior to posterior border of ovary.

Host: Live sharksucker, *Echeneis naucrates* (Echeneidae, Perciformes).

Site of infection: Intestine.

Locality: Various places off Nouméa, New Caledonia (collected 7 September–10 October 2006 and 21 April 2009).

Prevalence and intensity: In 4 of 8 fish examined; 1–10 nematodes per fish.

Deposition of voucher specimens: MNHN JNC1962, JNC1947, JNC2916, HCIP N-929.

Comments: By the general morphology, particularly the structure of the male caudal end, the character of the stichosome and the presence of a nonspiny spicular sheath, specimens of the present material belong to the genus *Pseudoca-*

pillaria. Their relatively large body size, the length of the spicule and of the entire oesophagus, as well as the size of eggs, are very similar to those in *P. echenei* (Parukhin, 1967), a species inadequately described from the intestine of *Echeneis naucrates* from the South China Sea (Parukhin 1967). Generally somewhat greater measurements found in New Caledonian specimens are probably within the limits of intraspecific variability, and because the host species and the location in the host are identical and both forms occur in tropical waters of the Pacific Ocean, we consider our specimens to be *P. echenei*. Since the type specimens of *P. echenei* are probably lost (personal communication of Prof. A.V. Gaevskaya, Sevastopol), their re-examination was impossible.

As mentioned above, Parukhin (1967) described *Capillaria echenei*, later transferred to *Pseudocapillaria* by Moravec (1982), from *E. naucrates* of the South China Sea near Vietnam. However, the original species description is very incomplete and many taxonomically important features were not described at all. Consequently, for example, the presence of bacillary bands, wing-like cells at the oesophago-intestinal junction, the nerve ring, the dorsal caudal membrane on the male tail and the cuticular inflation on the anterior vulval lip, as well as the detailed structure of the oesophagus and male genital organs are reported in this paper for the first time.

Mainly by the unusual structure of the spicule and in possessing cuticular ornamentations on the anterior vulval lip, *P. echenei* differs distinctly from all its congeners. Among all capillariids, similar cuticular inflations on the anterior vulval lip occur, for example, in some species of *Aonchotheca* López-Neyra, 1947 parasitic in amphibians and mammals (e.g., Moravec 2000, 2001), but not in fish capillariids, except for *Paracapillaria sesokoensis* Hasegawa, Williams et Bunkley-Williams, 1991 (see Hasegawa *et al.* 1991).

Besides the South China Sea off Vietnam (Parukhin 1967), *P. echenei* was later also recorded in the same host species from the Monar Bay near the western coast of India (Parukhin 1971, 1976). The present finding of this capillariid species in New Caledonian waters is the first from the South Pacific. It may well be that the distribution of this parasite follows the circumtropical distribution of its host (Froese and Pauly 2009).

Capillariidae gen. spp. 1–5

Five morphologically different types of capillariid females, apparently each of them representing a new species, were recorded from the digestive tract of some fishes. Because some generic features of capillariids are found only in males (Moravec 1982), it was impossible to assign the available female speci-

Fig. 2. *Pseudocapillaria echenei* (Parukhin, 1967): **A** – anterior end of female. **B** – cephalic end. **C** – region of vulva, lateral view. **D** – spicule, ventral view. **E** – caudal end of male with extruded spicular sheath, subventral view. **F** – stichocyte at middle part of stichosome. **G** – cuticular ornamentation on anterior vulval lip, frontal view. **H** – bacillary band, lateral view. **I** – egg. **J** – caudal end of female, lateral view. **K** and **L** – caudal end of male, ventral and lateral views. **M** – caudal end of male with atypical spicule, lateral view. Scale bars = 100 µm (A, C, F), 30 µm (B, H–M), 50 µm (D, E, G)

mens to a genus. Their generic and specific identification will only be possible when conspecific males are available in newly collected material. Therefore, we refrain from giving their descriptions in this paper.

This material consists of: Capillariidae gen. sp. 1 from *Fistularia commersonii* (Fistulariidae, Syngnathiformes) (1 specimen in 1 fish examined); locality: Anse Vata, Nouméa, New Caledonia (collected 13 October 2008); deposition of specimen: MNHN JNC2684.

Capillariidae gen. sp. 2 from *Synodus dermatogenys* (Synodontidae, Aulopiformes) (in 3 of 3 fish examined; intensity 1–8); locality: off Nouméa, inside Lagoon, north of Récif Toombo, New Caledonia (22°32'S, 166°28'E, collected 4 and 5 November 2008); deposition of specimens: MNHN JNC2740, JNC2755, JNC2756B.

Capillariidae gen. sp. 3 from *Carangoides oblongus* (Carangidae, Perciformes) (1 specimen in 1 of 4 fish examined); locality: fish market, Nouméa, New Caledonia (collected 13 March 2009); deposition of specimen: MNHN JNC2880.

Capillariidae gen. sp. 4 from *Diagramma pictum* (Haemulidae, Perciformes) (1 specimen in 1 of 7 fish examined); locality: off Îlot Labris, near Ouano, New Caledonia (21°50'S, 166°45'E, collected 25 October 2007); deposition of specimen: MNHN JNC2342.

Capillariidae gen. sp. 5 from *Stegostoma fasciatum* (Stegostomidae, Orectolobiformes) (1 specimen in 1 *S. fasciatum* examined); locality: Récif Aboré, off Nouméa, New Caledonia (22°24'S, 166°18'E, collected 3 May 2005); deposition of specimen: MNHN JNC1529.

Family Trichosomoididae Hall, 1916

Huffmanella sp. (Fig. 3)

Description: Female (1 specimen): Small filiform nematode. Anterior end of body narrow, obtusely rounded, with indistinct cephalic papillae. Cuticle thin. Two lateral bacillary bands, 21 wide near end of oesophagus, extending along almost whole

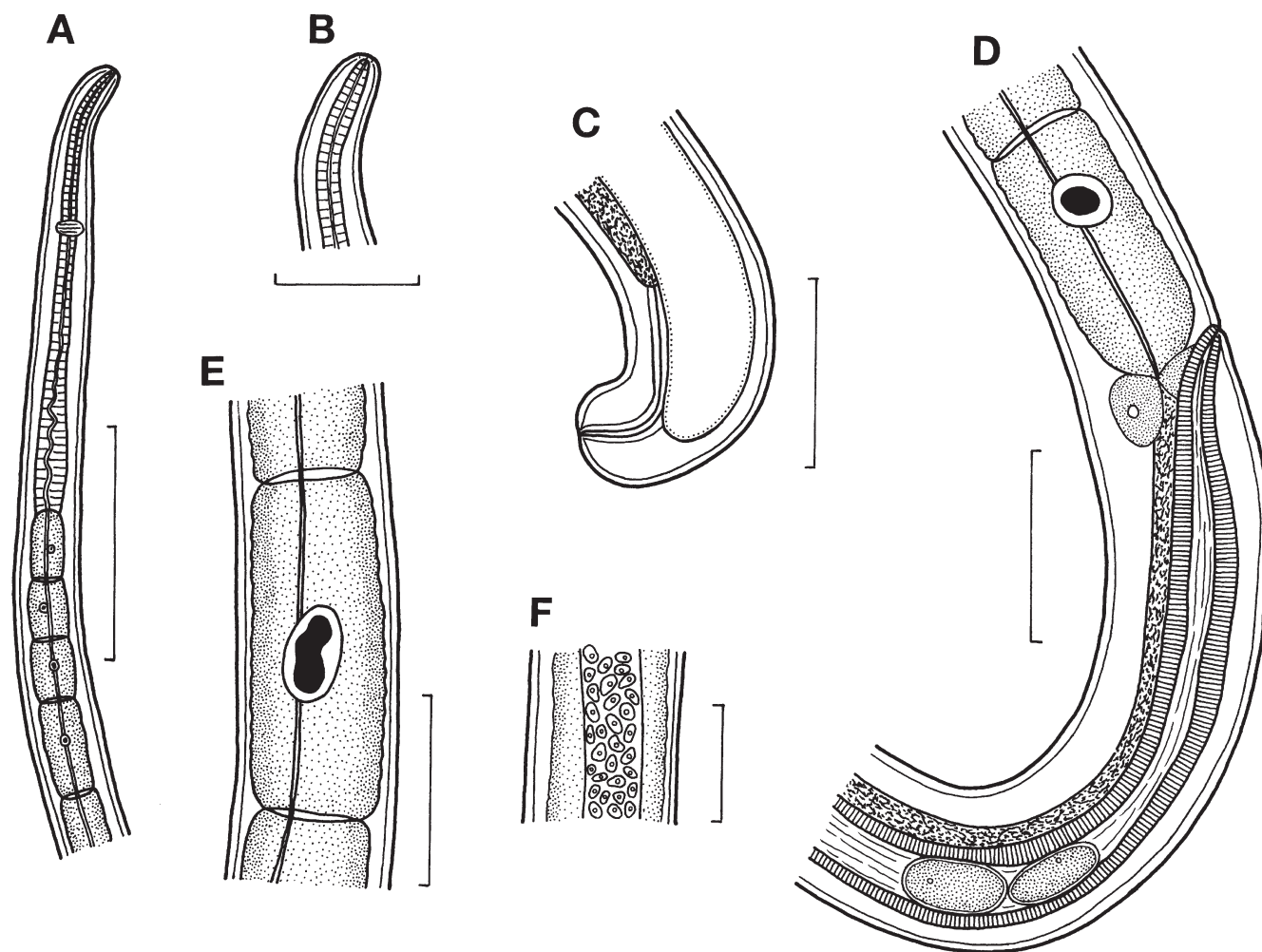


Fig. 3. *Huffmanella* sp. from *Bodianus perditio*, female: **A** – anterior end of body. **B** – cephalic end. **C** – caudal end, lateral view. **D** – region of vulva, lateral view. **E** – stichocyte at middle part of stichosome. **F** – section of oesophageal part of body with marked bacillary band, lateral view. Scale bars = 100 μ m (A), 30 μ m (B), 50 μ m (C–F)

length of body. Length of body 6.46 mm, maximum width 48. Length of entire oesophagus 3.14 mm, representing 30% of body length. Muscular oesophagus relatively short, 233 long, somewhat broader at its posterior third. Stichosome, 1.91 mm long, consisting of single row of about 42 stichocytes not clearly subdivided into transverse annuli; nuclei of stichocytes large. Nerve ring encircling muscular oesophagus at about its one third, 75 from anterior extremity. Two small wing-like cells present at oesophago-intestinal junction. Vulva located 3.14 mm from anterior end of body (at 49% of body length), at level of oesophago-intestinal junction; vulval lips not elevated. Vagina short, muscular. Only two oval immature eggs present; size of larger egg 42×18 . Ovary single, extending posteriorly to region of rectum. Rectum forming colourless tube; anus terminal.

Male: Unknown.

Host: Golden-spot hogfish, *Bodianus perditio* (Labridae, Perciformes).

Site of infection: Digestive tract.

Locality: Fish market, Nouméa, New Caledonia (collected 9 July 2008).

Prevalence and intensity: 1 specimen found in 1 of 40 fish examined.

Deposition of voucher specimen: MNHN JNC2619.

Comments: To date, 16 nominal species of *Huffmanella* Moravec, 1987 have been described as parasites of various tissues of fishes (Moravec 1987, 2001; Justine 2004, 2005, 2007; Moravec *et al.* 2005; Carballo and Navone 2007). Except for the type species *H. huffmanii* Moravec, 1987, a parasite of North American centrarchids, all other congeneric species were reported from marine fishes. Since only dark-coloured eggs are usually found in fish tissues, a great majority of these species was described solely from their characteristic eggs, whereas congeneric adults remain unknown. The adult worms were described only for *H. huffmanii*, *H. canadensis* Moravec, Conboy et Speare, 2005, *H. moraveci* Carballo et Navone, 2007, *H. balista* Justine, 2007 (male; female misidentified) and *H. longa* Justine, 2007 (female) (see Huffman and Moravec 1988, Moravec *et al.* 2005, Carballo and Navone 2007, Justine 2007). The single immature female of *H. balista* described by Justine (2007), which has a long sclerotized vestibule, was actually a rhabdochoniid and thus does not belong to *Huffmanella*.

The general morphology of the single female specimen found in *Bodianus perditio*, especially the characteristic terminal anus, short stichocytes, a relatively short muscular oesophagus and the presence of only immature eggs in the body indicate its belonging to the genus *Huffmanella*. The only trichinelloid recorded from *Bodianus* spp. in the same locality is *Huffmanella ossicola* Justine, 2004, a species described solely from eggs found in the bone system (especially in the gill-arch bones and the bones of the spinal chord) of the host (Justine 2004, 2007); heavy infections with eggs of this parasite were recorded frequently in three species of *Bodianus* Bloch, *B. loxozonus* (Snyder) (type host), *B. busellatus* Gomon and

B. perditio (Quoy et Gaimard), from off Nouméa, New Caledonia (Justine 2004, 2007).

The location of the specimen of the present material in the digestive tract contrasts with the location of *H. ossicola* eggs. There is no reason why a fish should have only one species of *Huffmanella*, and indeed the lethriniid *Gymnocranius grandoculis* (Valenciennes) harbours two distinct species, *H. filamentosa* Justine, 2004 in the gills and *H. longa* in the swim-bladder (Justine 2004, 2007). Therefore, the present specimen could be an intestinal species distinct from *H. ossicola* or a specimen of *H. ossicola* with an aberrant localization. Some tissue-dwelling nematodes can migrate considerably through various tissues of the fish host; for example, *Skrjabianus scardinius* Molnár, 1966 is generally located under the serosa of the swimbladder of *Scardinius erythrophthalmus* (Linnaeus), but infrequently it can be found in the host's abdominal cavity, kidneys, gonads, urinary bladder, intestinal lumen and even inside the eye (Moravec 1994). Until information about mature worms of *H. ossicola* is available, we consider the present specimen to possibly represent a new species designated, for the time being, as *Huffmanella* sp.

It is interesting that females of *Huffmanella* spp. lay their eggs with thin shells and uncleaved contents, and then, in the host's tissue, they continue to develop. As the larva gradually develops, the egg somewhat increases in size, and the outer layer of the egg proper (chitinous layer) becomes thicker and gradually turns from colourless to brown or even black (Huffman and Moravec 1988; Moravec *et al.* 1998, 2005; Moravec and Fajer-Avila 2000; Moravec and Garibaldi 2000; Justine 2004, 2005, 2007; Carballo and Navone 2007). The eggs found in the uterus of the present specimens were immature, with thin shells, confirming thus its appurtenance to *Huffmanella*.

Discussion

Adult trichinelloids parasitizing fishes belong to three families: Capillariidae Railliet, 1915, Cystoosidae Skryabin, 1923 and Trichosomoididae Hall, 1916. Although there are no problems concerning the genera of the two last-named families, the classification of the Capillariidae, especially as to the delimitation of genera, has always been one of the most difficult in the Nematoda (Moravec 2001). Much has been done in the taxonomy of capillariids during the last three decades, but there are still existing problems with the correct identification of these parasites. Moreover, capillariid genera in the presently recognised classification system are mostly based on the morphology of males, so that it is impossible to determine the genus in cases when only females are available and conspecific males are lacking.

At present, capillariid species parasitizing fishes are placed in eight genera considered valid (Moravec 2001): *Capillaria* Zeder, 1800, *Capillostrongyloides* Freitas et Lent, 1935, *Freitascapillaria* Moravec, 1982, *Gessyella* Freitas, 1959, *Para-*

capillaria Mendonça, 1963, *Paracapillaroides* Moravec, Salgado-Maldonado et Caspeta-Mandujano, 1999, *Piscicapillaria* Moravec, 1982 and *Schulmanella* Ivashkin, 1964. Of them, representatives of *Freitascapillaria*, *Paracapillaroides* and *Schulmanella* occur only in freshwater fishes.

The present study has revealed only two species of *Pseudocapillaria* from New Caledonian marine fishes, of which one is new to science and one is recorded for the first time from the South Pacific. However, five of the recorded species could not be identified to the genus, because no conspecific males were obtained. Of them, *Capillariidae* gen. sp. 4 may be conspecific with “*Capillaria* sp.” listed by Smales (2000) from the same host species (*Diagramma pictum*) from the Keppel Islands, Keppel Bay, Queensland, Australia.

To date, the fauna of capillariids parasitizing marine fishes in the whole Australian region (Australia and Oceania) is poorly known and it can be expected that many new species and new forms of these parasites will be discovered both in New Caledonia and the whole South Pacific. Whereas no capillariids from marine fishes have previously been described from Oceania, only seven species of the genera *Capillaria*, *Capillostrongyloides*, *Gessyella* and *Piscicapillaria*, and one species not identified to genus (*Capillaria* s.l.), have been reported from these hosts from Australian waters (Johnston and Mawson 1944, 1945a, b, 1951; Moravec 1987). It is interesting that the type species of the monotypic genus *Gessyella*, hitherto known only from Australia, has recently been reported from the South Atlantic near Argentina (Rossin and Timi 2009).

It has been mentioned above that trichosomoidids in marine fishes of New Caledonia are so far represented by six nominal species of *Huffmanella* (*H. balista* Justine, 2007, *H. branchialis* Justine, 2004, *H. filamentosa* Justine, 2004, *H. lata* Justine, 2005, *H. longa* Justine, 2007, *H. ossicola* Justine, 2004) and one additional unidentified species *Huffmanella* sp. (see Justine 2004, 2005, 2007). In contrast, these tissue-dwelling nematodes are rarely reported from other parts of the world, although it can be expected that they are widely distributed among marine fishes, but they probably remain unnoticed during routine fish dissections. These parasites are hitherto little known mainly due to their remarkable mode of life, but the number of their records in different fish hosts and different geographical regions seems to increase during recent years (e.g., MacLean *et al.* 2006, Carballo and Navone 2007, Justine 2007, Esteves *et al.* 2009).

In addition to the description of species, the purpose of this study is to evaluate the numerical biodiversity of nematodes in Coral Reef fishes, and thus species without names also give valuable information. The lagoon of New Caledonia is the largest of the World and study of its parasite fauna can give information that are of importance to all Reef systems. To date, 7 species of trichosomoidids and 8 species of capillariids have been found in about 300 species of fish examined. Given that the lagoon has 1,700 species (Fricke and Kulbicki 2007), a simple calculation suggests that there are about 40 species of capillariids and 40 of trichosomoidids in this environment.

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