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Cucullanus oceaniensis sp. n. (Nematoda: Cucullanidae) from Pacific eels (*Anguilla* spp.)

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Abstract. A new species of parasitic nematode, *Cucullanus oceaniensis* sp. n., is described from the intestine of the giant mottled eel *Anguilla marmorata* (type host) from Futuna Island (Wallis and Futuna Islands, Polynesia) and from *A. marmorata* and *Anguilla* sp. (cf. *obscura*) from Fiji Islands (Melanesia, South Pacific). The main distinguishing characteristics are the length of spicules (668–1,020 μm), situation of deirids (slightly anterior to the oesophago-intestinal junction) and the excretory pore (some distance posterior to the end of oesophagus), and the arrangement of caudal papillae in the male. It is the third known species of *Cucullanus* from Oceania and the first one reported from freshwater eels in the region of South Pacific. *Cucullanus faliexae* Morand et Rigby, 1998 is considered a junior synonym of *Cucullanus australiensis* Baylis, 1927.

During recent occasional examinations of freshwater eels in the region of Oceania, nematode specimens of a previously unknown species of *Cucullanus* Müller, 1777 were collected. The new species is described herein.

MATERIALS AND METHODS

Three specimens (2 males and 1 gravid female) of *Cucullanus* were collected from a giant mottled eel *Anguilla marmorata* Quoy et Gaimard (body length 73 cm) caught in the Vainifao River, Futuna Island (Wallis and Futuna Islands) on 12 October 2004. Two conspecific nematode specimens (1 male and 1 nongravid female) were collected from *Anguilla* sp. (cf. *obscura* Günther) from the Fiji Islands in 1995 and eight specimens (1 male and 7 females) from *A. marmorata* from the Fiji Islands in July 1996; unfortunately, the only information available for these materials is the host and date of collection (the nematodes were sent from the Fiji Islands to Germany). All nematodes were fixed in 70% ethanol. For light microscopical examination, the nematodes were cleared with glycerine. Drawings were made with the aid of a Zeiss microscope drawing attachment. After examination, the specimens were briefly placed in 4% formaldehyde solution and then transferred to 70% ethanol, in which they were stored. For scanning electron microscopy (SEM), two specimens (male and female from *A. marmorata* from Fiji) from 4% formalin were postfixed in 1% osmium tetroxide, dehydrated through a graded ethanol series, critical point dried, and sputter-coated with gold. They were examined with a JEOL JSM-6300 scanning electron microscope at an accelerating voltage of 15 kV. All measurements are in micrometres unless otherwise stated. For comparative purposes, type specimens of *Cucullanus australiensis* Baylis, 1927 (2 male syntypes, Natural History Museum, London, 1927.8.10.95–98) and *C. faliexae* Morand et Rigby, 1998 (4 paratypes: 2 males and 2 females, Muséum National d'Histoire Naturelle, Paris, 581 HF) were examined. The names of fishes follow Froese and Pauly (2005).

DESCRIPTION

Cucullanus oceaniensis sp. n. Figs. 1, 2

General: Medium-sized nematodes. Body whitish, slender, with slightly transversely striated cuticle. Lateral alae absent. Oral opening dorsoventrally elongate, surrounded by raised narrow membranous ala (collarette) supported by row of minute basal teeth. Four submedian cephalic papillae and pair of lateral amphids present. Oesophagus muscular, expanded at anterior end to form rather large pseudobuccal capsule (oesophastome); posterior part of oesophagus also expanded, but somewhat narrower than pseudobuccal capsule. Oesophagus opening into intestine through large valve. Nerve ring encircling oesophagus at distance representing 35–49% of oesophagus length. Deirids small, hooked, slightly asymmetrical, just anterior to oesophago-intestinal junction; excretory pore at short distance below end of oesophagus. Tail conical, with sharply pointed tip.

Male (3 specimens: holotype and 1 paratype from Futuna Island [measurements of latter in parentheses], and 2 paratypes from Fiji [in square brackets]): Length of body 7.14 (9.51) [5.86–7.78] mm, maximum width

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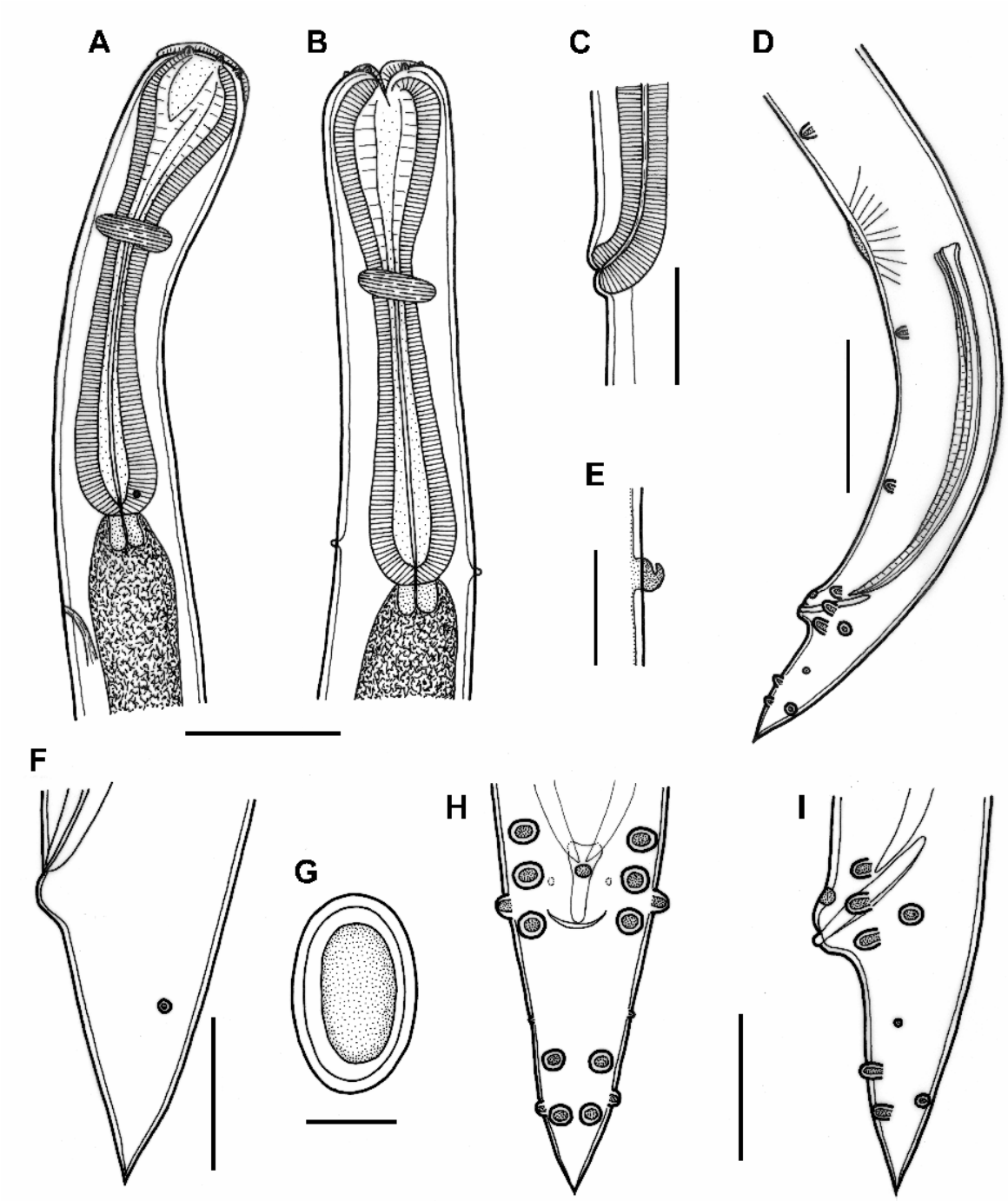

Fig. 1. *Cucullanus oceaniensis* sp. n. **A, B** – anterior end of male, lateral and dorsoventral views; **C** – vulva; **D** – posterior end of male, lateral view; **E** – deirid; **F** – tail of female, lateral view; **G** – egg; **H, I** – tail of male, ventral and lateral views. Scale bars: A, B, D = 200 μm; C, F, H, I = 100 μm; E, G = 30 μm.

190 (326) [299]. Length of entire oesophagus 707 (721) [816–884], length of oesophastome 258 (272) [258–299], its width 150 (190) [163–190]; minimum width of oesophagus 68 (95) [68–82]; maximum width of posterior part of oesophagus 122 (177) [136–177]. Oesophagus representing 10 (8) [11–14] % of whole body length. Distance of nerve ring from anterior extremity 299 (354) [313], representing 42 (49) [35–38] % of oesophagus length. Deirids and excretory pore 644 (656) [721–739] and 979 (857) [898–1,061], respectively, from anterior end of body. Ventral region of cloacal opening distinctly elevated. Spicules equal, 668

(990) [819–1,020] long, provided with wide membranous alae. Gubernaculum well sclerotized, 111 (111) [117–135] long, somewhat laterally expanded at proximal end. Ventral preanal sucker well developed. Preanal papillae: 5 subventral pairs, of which first pair well anterior to ventral sucker, second somewhat posterior to ventral sucker, third approximately in mid-way between second pair of papillae and cloacal opening, and fourth and fifth near cloacal aperture; one unpaired, median papilla-like formation present at level of fifth pair of preanals. One pair of lateral adanal papillae present. Postanal papillae: 4 pairs, of which first pair of subventrals just posterior to cloacal opening, second and fourth pairs of subventrals posterior to mid-length of tail and third pair of laterals situated between last two pairs of subventrals. Pair of small lateral papilla-like phasmids present between first and third pairs of postanal papillae. Length of tail 201 (163) [204].

Female (allotype from Futuna Island; measurements of 5 gravid and 1 nongravid specimens [all paratypes] from Fiji in parentheses and square brackets, respectively): Length of body 13.34 (9.49–13.78) [4.65] mm, maximum width 340 (354–503) [190]. Length of entire oesophagus 1,074 (1,020–1,088) [625], length of oesophastome 313 (313–381) [190], its width 204 (204–272) [136]; minimum width of oesophagus 95 (109–136) [60], maximum width of its posterior part 177 (190–231) [109]. Oesophagus representing 8 (8–11) [13] % of whole body length. Distance of nerve ring 394 (408–503) [258] from anterior extremity, representing 37 (39–46) [41] % of oesophagus length. Deirids and excretory pore 979 (870–1,061) [516] and 1,278 (1,170–1,197) [734], respectively, from anterior end of body. Length of tail 299 (272–299) [204]; pair of small lateral papilla-like phasmids present near mid-length of tail. Vulva postequatorial, 8.23 (5.20–7.66) [2.82] mm from anterior extremity, at 62 (55–59) [61] % of body length; vulvar lips elevated. Short muscular vagina directed anteriorly from vulva. Uteri opposed. Eggs numerous (eggs absent in 1 paratype); mature eggs oval, thin-walled, with uncleaved contents, 75–81 (75–84) long and 42–45 (42–45) wide; egg wall 6 (6) thick.

Type host: Giant mottled eel *Anguilla marmorata* Quoy et Gaimard, 1824 (Anguillidae, Anguilliformes).

Other host: *Anguilla* sp. (cf. *obscura*).

Site of infection: Intestine.

Type locality: Vainifao River (14°30'74"S, 178°14'28"W), Futuna Island (Wallis and Futuna Islands) (*A. marmorata*).

Other locality: Fiji Islands (*A. marmorata*, *Anguilla* sp. [cf. *obscura*]).

Prevalence and intensity: *A. marmorata*, Futuna Island: 3 specimens in one fish examined. *A. marmorata*, Fiji Islands: 8 specimens in 1 fish. *Anguilla* sp., Fiji Islands: 2 specimens in unknown number (1 ?) of fish examined.

Etymology: The specific name *oceaniensis* relates to the geographical region of the distribution, i.e., Oceania.

Deposition of type specimens: Holotype, allotype and 3 paratypes in the Helminthological Collection of the Institute of Parasitology in České Budějovice (Cat. No. N-844); one paratype (male) in the Muséum National d'Histoire Naturelle, Paris (Cat. No. 279HG).

DISCUSSION

The genus *Cucullanus* Müller, 1777 (Cucullanidae, Seuratoidea) contains a large number of species parasitizing various freshwater, brackish-water or marine fishes around the world; more rarely they are found in aquatic turtles (Petter 1974, Ivashkin and Khromova 1976). Their morphology is rather uniform and some of them have been inadequately described, so that a detailed comparison among all of them is practically impossible. Therefore, some authors prefer to deal with these parasites according to their host groups (Petter 1974) or their zoogeographical region (Moravec et al. 1997, Caspeta-Mandujano et al. 2000, Daniel et al. 2002).

In the description of *Cucullanus faliexae* Morand et Rigby, 1998 from the marine anguilliform fish *Gymnothorax javanicus* (Bleeker) from French Polynesia, Morand and Rigby (1998) noted that in addition to *C. faliexae*, there are only four other species of *Cucullanus* with a protruding cloacal region (considered by them to be a valid taxonomic trait): *C. micropapillatus* Törnquist, 1931, *C. sciaenae* Gupta et Gupta, 1979, *C. theraponi* Rasheed, 1968, and *C. laurotravassosi* Petter et Le Bel, 1992. However, this feature is characteristic of an additional nine species, of which *C. australiensis* Baylis, 1927, *C. filiformis* Yamaguti, 1935, *C. hians* (Dujardin, 1845), *C. muraenesocis* Yamaguti, 1961, *C. murenophidis* Campana-Rouget, 1957 and *C. robustus* Yamaguti, 1935 were described from marine anguilliform fishes.

The morphology and measurements of *C. faliexae* are almost identical with those of *C. australiensis* (only the gubernaculum is reported to be somewhat longer [0.21 mm] and the excretory pore was not observed in *C. australiensis*) (Baylis 1927, Morand and Rigby 1998). A re-examination of two male syntypes of *C. australiensis* showed the gubernaculum to be 183 and 195 μm long and the excretory pore to be situated somewhat anterior to the end of oesophagus (1.06 mm from the anterior extremity). On the other hand, the re-examination of the two male paratypes of *C. faliexae* showed the length of the gubernaculum to be evidently longer (168 and 192 μm) than reported by Morand and Rigby (1998); the length of the gubernaculum given by the latter authors (110–120 μm) is probably a mistake, because they illustrated (fig. 1) the gubernaculum about 238 μm long, as can be derived from the accompanying scale bar in their paper. The arrangement of male caudal

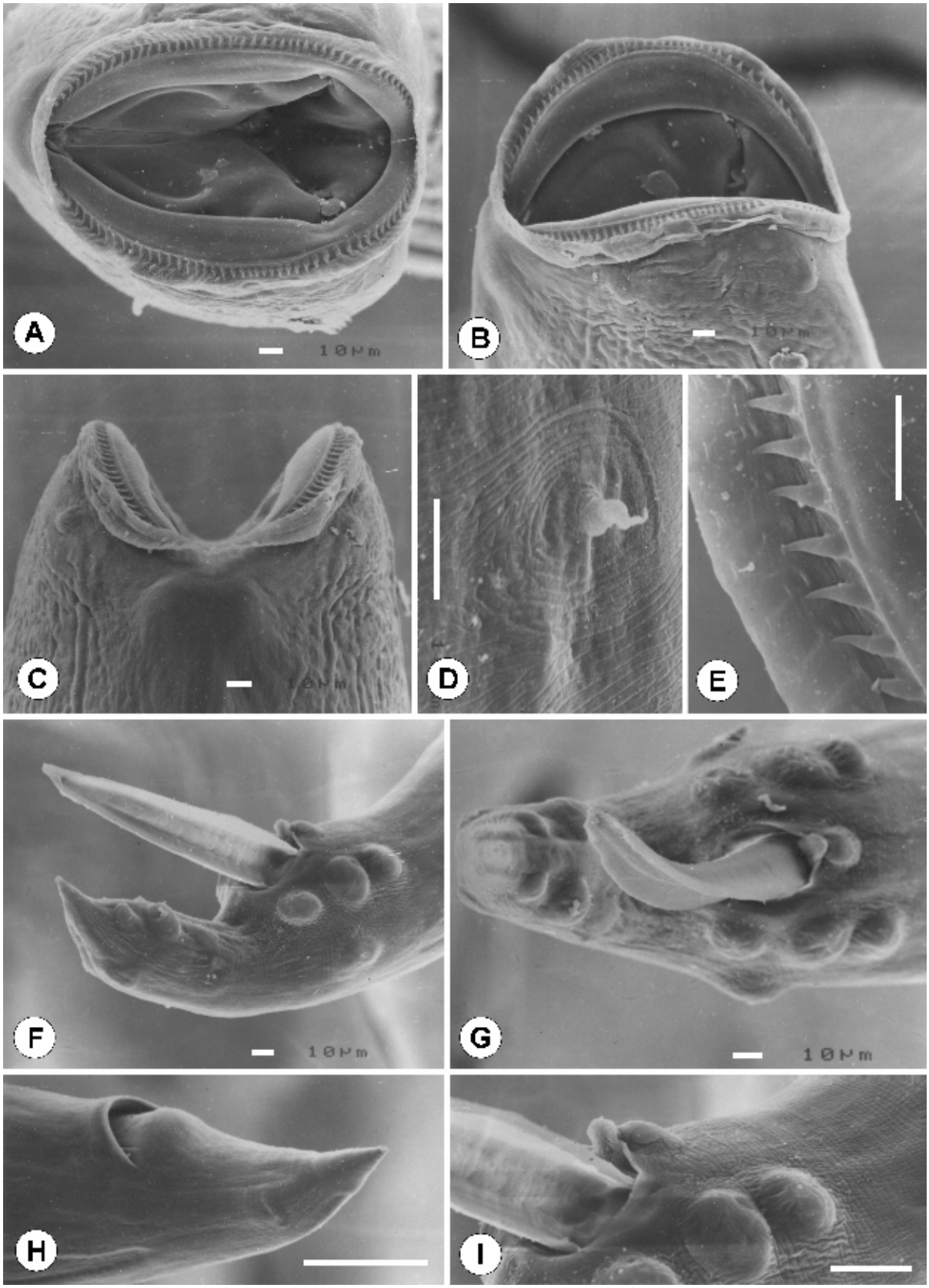

Fig. 2. *Cucullanus oceaniensis* sp. n., scanning electron micrographs. **A, B, C** – cephalic end, apical, sublateral and dorsoventral views; **D** – deirid; **E** – detail of cephalic denticles; **F, G** – tail of male, lateral and ventral views; **H** – tail of female, lateral view; **I** – region of cloaca (enlarged), lateral view. Scale bars: D, E = 10 μm; H = 100 μm; I = 20 μm.

papillae and the situation of deirids were found identical in both species. Since the morphology and measurements of *C. australiensis* and *C. faliexae* are practically identical (while describing *C. faliexae*, Morand and Rigby [1998] did not compare it with *C. australiensis*) and both species were described from the congeneric fish hosts (*Gymnothorax* spp.) of the South Pacific (Australia and French Polynesia) with similar areas of distribution (Froese and Pauly 2005), *C. faliexae* is considered a junior synonym of *C. australiensis*.

Cucullanus oceaniensis differs from *C. australiensis* in the position of deirids (near the end of the oesophagus vs. just posterior to the nerve ring), shorter spicules (669–1,020 μm vs. 990–1,200 μm) and the smaller body length (males 5.9–9.5 mm vs. 13–19 mm; gravid females 9.5–13.3 mm vs. 14–22 mm); from *C. filiformis* in the arrangement of caudal papillae and shape of the oesophagus (pseudobuccal capsule distinctly broader than the posterior part of oesophagus vs. pseudobuccal capsule equally broad as the posterior part of oesophagus); and from *C. muraenesocis* in the arrangement of postanal papillae and situation of the first pair of preanal papillae in relation to the ventral sucker (distinctly anterior to the sucker vs. at the middle of sucker) (Baylis 1927, Yamaguti 1935, 1941, 1961, Morand and Rigby 1998). Moreover, *C. oceaniensis* has been reported from Polynesia and Melanesia while both *C. filiformis* and *C. muraenesocis* have only been reported from Japan.

In contrast to the new species, *C. hians* has the excretory pore at the level of the oesophagus end, its spicules and the gubernaculum are distinctly longer (1.26 mm and 26 μm, respectively) and it occurs in the Atlantic Ocean and the Mediterranean Sea; *C. murenophidis* has a different distribution of the preanal and postanal papillae, shorter spicules (440 μm) and it occurs near the coast of West Africa; and *C. robustus* has deirids situated more anteriorly (between the end of oesophagus and the nerve ring), its spicules are distinctly longer (1.12–1.25 mm), and it was originally described from Japan, but later reported also from New Zealand and the Baltic Sea (Yamaguti 1935, Campana-Rouget 1957, Ivashkin and Khromova 1976).

In contrast to *C. oceaniensis* now reported from freshwater eels (Anguillidae), all the above mentioned species were described from marine anguilliform fishes of the families Congridae and Muraenidae. The only exception is *C. filiformis* originally described from *Conger myriaster* (Brevoort), but later reported by Yamaguti (1941) from the Japanese eel *Anguilla japonica* Temminck et Schlegel. Morphologically similar to *C. oceaniensis* seems to be *Cucullanus anguillae* Wang et Ling, 1975, an inadequately described species from *Anguilla japonica* from China (Wang and Ling 1975), but it has a different arrangement of caudal papillae.

Le-Van-Hoa and Pham-Ngoc-Khue (1967) described a new cucullanid species and genus, *Campanarougetia campanarougetae*, from *Anguilla mauritiana* (= *A. marmorata*) from Vietnam; although its gross morphology resembles that of *Cucullanus* spp., it differs considerably in the structure of the mouth and oesophagus (oral aperture triangular, lumen of oesophagus without pronounced cuticularized armature). In addition, *Campanarougetia campanarougetae* differs from *Cucullanus oceaniensis* in the position of the excretory pore at the level of the posterior end of oesophagus, different arrangement of postanal papillae, shorter spicules (48 μm), and in that the region of the cloacal aperture is not protruding.

Besides *C. australiensis* (syn. *C. faliexae*) from French Polynesia (Rangiroa, Tuamotu Archipelago) and *C. bourdini* Petter et Le Bel, 1992 from marine perciform and tetraodontiform fishes from New Caledonia and French Polynesia (Rangiroa) (Petter and Le Bel 1992, Morand and Rigby 1998), *C. oceaniensis* is the third known representative of *Cucullanus* in the southern region of Oceania.

Cucullanus oceaniensis co-occurred with *Procamallanus pacificus* Moravec, Justine, Würtz, Taraschewski et Sasal, 2005 (Nematoda, Camallanidae) in the freshwater eels of the Futuna Island (*Anguilla marmorata*) and the Fiji Islands (*Anguilla* sp.). However, it was absent from the eels (*Anguilla obscura* Günther, *A. reinhardtii* Steindachner) in New Caledonia, in which *Procamallanus pacificus* was found (Moravec et al. 2005).

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