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Epigonus okamotoi, a new species of deepwater cardinalfish from New Britain, Papua New Guinea, Solomon Sea, western Pacific Ocean (Teleostei: Epigonidae)

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Abstract

A new species of deepwater cardinalfish, *Epigonus okamotoi* from off southwestern New Britain, Papua New Guinea, is described on the basis of a single specimen collected with a trawl in 315-624 m depth in Ainto Bay. The new species is characterised by the following characters: dorsal-fin rays VII+I, 9; pectoral-fin rays 15; total gill rakers 22; pyloric caeca 4; pored lateral-line scales 47+4; scales below lateral line 8; vertebrae 10+15; opercular spine present; maxillary mustache-like process absent; ribs absent on last abdominal vertebra; upper margin of pectoral-fin base on level or upper margin of pupil; proximal radial of first anal-fin pterygiophore slender; mouth cavity light grey. The new species is compared with other species in the genus.

Keywords: Deepwater cardinalfishes, New species, Identification key, New Guinea.

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Introduction

The deepwater cardinalfishes of the family Epigonidae Poey 1861 are a group of bathydemersal marine fishes occurring on the continental and island slopes of all tropical and warm temperate oceans (Okamoto et al. 2011; Laan et al. 2014; Nelson et al. 2016), at depths of 100 to more than 1,000 m. The family is currently arranged in the order Perciformes (Laan et al. 2014; Nelson et al. 2016). Within the Epigonidae, the largest genus *Epigonus* Rafinesque 1810 is characterised by 8 suborbital bones, all lacking subocular shelves; large, thin-walled swimbladders with postero-dorsal ovals; first dorsal-fin with VII-VIII spines; second dorsal-fin with I,9 or I,10 fin elements; anal-fin with II,9 elements; pectoral-fin rays 15-23; gill rakers 17-35 (Mayer 1974). Abramov (1992) proposed four species groups, the *Epigonus denticulatus* group, *Epigonus oligolepis* group, *Epigonus robustus* group, and *Epigonus telescopus* group. Okamoto (2012) added the *Epigonus constanciae* group, which is characterised by the presence of a pungent opercular spine, more than 40 pored lateral-line scales to end of hypural, and dorsal-fin rays VII-I, 8–10. He included 16 species in this group, but three more species were subsequently added by Okamoto (2015, 2016), so that the group now includes a total of 19 species.

A single specimen of an undescribed species of the genus was collected during the MADEEP Expedition off southwestern New Britain, Papua New Guinea. As the species is apparently extremely rare, and not expected to be collected again in near future, it is described herein, bringing the total number of species known in the genus to 20.

Material and Methods

The holotype of the new species is deposited in the National Taiwan University, University Museum, Taipei, Taiwan (NTUM). Comparative materials are listed below. Abbreviations of museum collections (see below) follow Fricke and Eschmeyer (2017a).

Methods follow Mayer (1974); fin-ray counts follow Fricke (1983). The starting point for length measurements is the middle of the upper lip. The standard length (measured from the tip of the upper lip to the middle of the urohyal/caudal fin base) is abbreviated SL. Species classification and nomenclature follows Eschmeyer et al. (2017). Reference and journal citations follow Fricke (2017) and Fricke and Eschmeyer (2017b). The map was composed using QGIS 2.12.2.

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Results

Epigonus okamotoi new species

(Figs. 1-4)

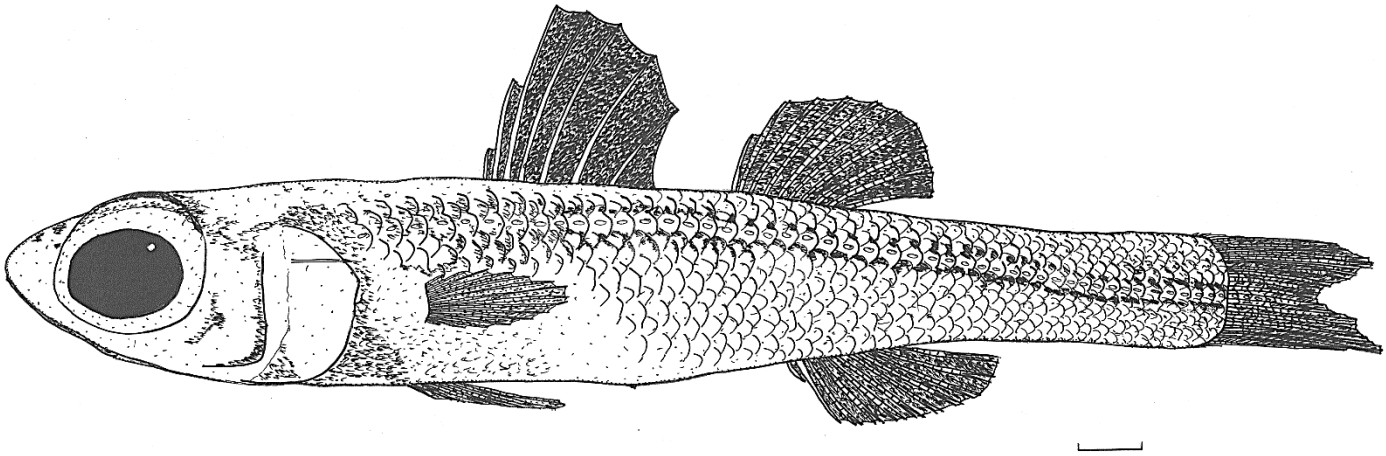

Figure 1. Lateral view of *Epigonus okamotoi*, NTUM 12701, holotype, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay (scale=10 mm).

Common name: Okamoto's deepwater cardinalfish

Holotype: NTUM 12701, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay, 06°06'04.7988"S 149°12'12.5136"E - 06°07'38.3376"S 149°12'06.4152" E, 315-624 m depth, trawl, R/V Alis, Cruise MADEEP, St. CP4330-2 (PNG 2250), 6 May. 2014, 10:45-11:30 h.

Diagnosis: Dorsal-fin rays VII+I, 9; pectoral-fin rays 15; total gill rakers 22; pyloric caeca 4; pored lateral-line scales 47+4; scales below lateral line 8; vertebrae 10+15; opercular spine present; maxillary mustache-like process absent; ribs absent on last abdominal vertebra; upper margin of pectoral-fin base on level or upper margin of pupil; proximal radial of first anal-fin pterygiophore slender; mouth cavity light grey.

Description: D VII+I, 9; A II, 9; P1 XV; P2 I, 5; C (vi),i,16,i,(iv); gill rakers 4+1+17=22; pored lateral-line scales 47+4; pyloric caeca 4; vertebrae 10+15. Measurements of the holotype are given in Table 1.

Body slender, laterally compressed, deepest at pectoral-fin base; nape not humped. Head large, slightly depressed. Maxillary mustache-like process absent. Snout very short, upper lip truncate, its length about two-thirds of interorbital width; two nostrils closely set at level of upper edge of pupil, anterior nostril without membranous tube, posterior nostril larger, triangular, with two short anterior dermal flaps. Eye large, round, orbital diameter nearly the double postorbital length; bony rim of orbit raised above dorsal profile; interorbital region flat. Mouth large, terminal; gape oblique; posterior margin of maxilla extending to below anterior margin of pupil; lower jaw slightly protruding when mouth closed; anteriorly projecting teeth or nub-like structure absent on symphysis of lower jaw. Teeth minute, arranged in single row on maxilla and dentary, in two rows on symphysis of lower jaw; vomerine teeth present, forming a narrow triangular patch; palatine teeth present, sparse, arranged in one row. Basihyal toothless. Opercular spine present, pungent, forming ridge (Fig. 2); preopercular edges smooth.

Origin of first dorsal fin above middle of pectoral fin; first dorsal-fin spine minute. Spine of second dorsal fin short, thinner than spines of first dorsal fin. First and second dorsal fins widely separated by gap more than twice snout length; isolated dorsal-fin spine absent. Origin of anal fin below posterior portion of second dorsal-fin base; first anal-fin spine minute; second anal-fin spine short. Posterior tip of pectoral fin not reaching vertical line drawn from anus. Upper margin of pectoral-fin base on level of middle of pupil (Fig. 1). Caudal fin forked.

Table 1. Measurements and proportions of *Epigonus okamotoi*, NTUM 12701, holotype, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay.

Measurements	Measurement (mm)	Proportions (% of SL)
Head length	51.0	31.6
Head width	29.3	18.1
Head depth	26.3	16.3
Body depth	30.2	18.7
Body width	28.0	17.3
Caudal-peduncle depth	13.7	8.5
Caudal-peduncle length	41.3	25.6
Orbit diameter	29.2	18.1
Interorbital distance	12.6	7.8
Postorbital length	15.6	9.7
Upper-jaw length	17.9	11.1
Lower-jaw length	22.9	14.2
Snout length	8.7	5.4
Predorsal(1) length	60.8	37.6
Predorsal(2) length	98.7	61.1
Prepectoral length	56.0	34.7
Prepelvic length	57.7	35.7
Preanus length	86.4	53.5
Preanal length	105.8	65.5
Length of 1st D1 spine	4.2	2.6
Length of 2nd D1 spine	13.7+ (broken)	8.5+
Length of 3rd D1 spine	24.2	15.0
Length of D2 spine	8.1	5.0
Length of 1st anal-fin spine	3.4	2.1
Length of 2nd anal-fin spine	9.7	6.0
Length of pelvic-fin spine	14.8	9.2
Distance between pelvic spines	10.2	6.3
Length of D1 base	19.2	11.9
Length of D2 base	15.5	9.6
Length of anal-fin base	13.3	8.2
Pectoral-fin length	18.2	11.3
Pelvic-fin length	20.5	12.7

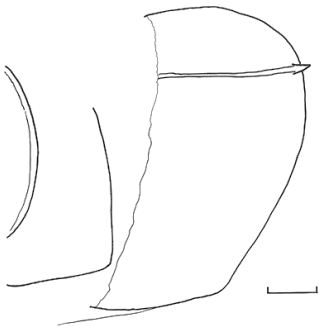

Figure 2. Sketch of opercle showing pungent spine in *Epigonus okamotoi*, NTUM 12701, holotype, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay (scale=3 mm).

Anus located slightly anterior to vertical line through origin of second dorsal fin. Ribs absent on last abdominal vertebra. Scales deciduous, all cycloid, covering whole body except area anterior to rim of orbit and surfaces of jaws; scales also present on bases of second dorsal, anal, and caudal fins; scales above lateral line 4, scales below lateral line 8; series of pored lateral-line scales complete, scales on body 47, pored scales on caudal fin 4. No trace of luminous organ around belly or visceral organ.

Figure 3. Lateral view of *Epigonus okamotoi*, NTUM 12701, holotype, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay (fresh specimen) (Photograph: Jhen-Nien Chen).

Figure 4. Dorsal view of *Epigonus okamotoi*, NTUM 12701, holotype, 161.5 mm SL; western Pacific Ocean, Solomon Sea, Papua New Guinea, West New Britain Province, off southwestern New Britain, Ainto Bay (fresh specimen) (Photograph: Jhen-Nien Chen).

Colour immediately after collection (Figs. 3-4): Head and body whitish, with a rosy stripe below the lateral line, scales edged with dark pigment which is most pronounced around the lateral line, which is left as a pale stripe over most of its length; eye silvery, pupil black, opercle silver; fins dark grey.

Colour in preservative: Head and body yellowish brown, eyes dark grey, mouth cavity light grey, opercle dark grey, peritoneum black; scales on sides of body surrounding lateral line with dark grey margins, but lateral line whitish; fin membranes dark grey.

Distribution: The species is only known from the type locality, in the Solomon Sea off southwestern New Britain, West New Britain Province, Papua New Guinea (Fig. 5). The species was collected at a depth of 315-624 m.

Etymology: This new species is named in honour of Makoto Okamoto, in appreciation of his valuable and thorough research on the family Epigonidae.

Comparisons: *Epigonus okamotoi* belongs to the *E. constanciae* group as defined by Okamoto (2012). The *E. constanciae* group is distinguished from the other three species groups of the genus (*E. oligolepis*, *E. pandionis*, and *E. telescopus* groups) in having a pungent opercular spine, more than 40 pored lateral line-scales, and VII-I, 8-10 dorsal-fin rays. Besides *E. okamotoi*, this species group comprises 19 other species (Okamoto 2012, 2016; Okamoto and Aungtonya 2013): *E. affinis* Parin & Abramov 1986, *E. atherinoides* (Gilbert 1905), *E. chilensis* Okamoto 2012, *E. constanciae* (Giglioli 1880), *E. crassicaudus* Buen 1959, *E. ctenolepis* Mochizuki & Shirakihara 1983, *E. draco* Okamoto 2015, *E. elegans* Parin & Abramov 1986, *E. heracleus* Parin & Abramov 1986, *E. lenimen* (Whitley 1935), *E. machaera* Okamoto 2012, *E. marimonticolus* Parin & Abramov 1986, *E. mayeri* Okamoto 2011, *E. megalops* (Smith & Radcliffe in Radcliffe 1912), *E. occidentalis* Goode & Bean 1896, *E. pectinifer* Mayer 1974, *E. robustus* (Barnard 1927), *E. thai* Prokofiev & Bussarawit in Parin et al. 2012 and *E. waltersensis* Parin & Abramov 1986. *Epigonus okamotoi* is distinguished from other species in the complex by having only 4 pyloric caeca (vs. 5-15 in the other species); otherwise, it is most similar to *E. atherinoides* and *E. draco* in lacking both a maxillary mustache-like process and ribs on last abdominal vertebra and in having a low number of just 22 gill rakers (Table 2), but differs in the head height 16.3% of SL (vs. 11.9-15.3% in *E. atherinoides*), body depth 18.7% of SL (vs. 11.2-

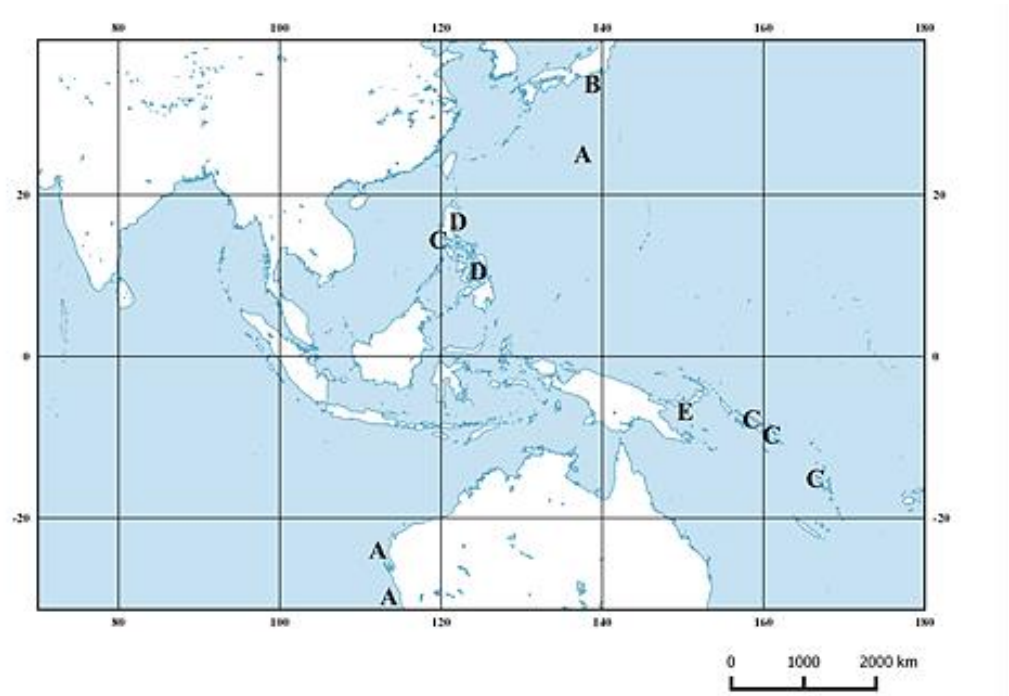

Figure 5. Geographical distribution of five similar species in the *Epigonus constanciae* complex in the western Pacific. (A) *E. atherinoides*, (B) *E. ctenolepis*, (C) *E. draco,* (D) *E. megalops* and (E) *E. okamotoi* (type locality).

17.6% in *E. atherinoides*), caudal-peduncle depth 8.5% of SL (vs. 6.5-8.2% of SL in *E. atherinoides*), orbit diameter 18.1% of SL (vs. 12.2-17.3% in *E. atherinoides*, 13.7-17.6% in *E. draco*), the interorbital width 7.8% of SL (vs. 5.1-7.0% in *E. atherinoides*), postorbital length 9.7% of SL (vs. 10.9-12.2% in *E. draco*), snout length 5.4% of SL (vs. 6.5-8.2% in *E. atherinoides*, 7.0-8.4% in *E. draco*), preanus length 53.5% of SL (vs. 55.9-62.7% in *E. atherinoides*, 54.8-57.8% in *E. draco*), preanal-fin length 65.5% of SL (vs. 6.3-69.0% in *E. draco*), and length of third spine of first dorsal fin 15.0% of SL (vs. 10.9-14.2% in *E. atherinoides* and *E. draco*).

Discussion

Within the complex of the similar species *E. atherinoides*, *E. ctenolepis*, *E. draco*, *E. megalops*, *E. occidentalis* and *E. okamotoi* (as defined by Okamoto 2016 and the present paper), three species are mainly found in warm temperate conditions (*E. atherinoides*, *E. ctenolepis* and *E. occidentalis*), while the three others live in tropical conditions in the western Pacific (*E. draco*, *E. megalops, E. okamotoi*) (Fig. 5). The knowledge about the distribution of the latter species is grossly incomplete, and it is possible that they occur sympatrically along the western Pacific rim.

This is the first species of *Epigonus* collected from the Bismarck Archipelago and Papua New Guinea. In spite of extensive deep-water surveys during the PAPUA NIUGINI 2012, MADEEP 2014, and KAVIENG 2014 expedition, the holotype was the only specimen of the genus that could be procured. Deepwater cardinalfishes are obviously extremely rare in this region.

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Table 2. Comparison of selected characters among 20 species of the *Epigonus constanciae* species group (based on Okamoto 2015, updated according to Okamoto 2016, present paper) (+ present; – absent).

Species	Maxillary moustache-like process	Ribs on last AV	Gill rakers (total)	Vertebrae (AV + CV)	D2 rays	Pyloric caeca	Distribution
E. affinis	–	–	30-33	10+15	I,9	8-10	Eastern Atlantic
E. atherinoides	–	–	20-22	10+15	I,9-10	11-15	western, central, southeastern Pacific
E.chilensis	1	+	28-31	11+14	I,8-10	6-8	Off Chile
E.constanciae	2	–	30-35	10+15	I,9	6-8	Eastern Atlantic, Mediterranean Sea
E. crassicaudus	–	+	31-34	11+14	I,9	6-7	Off Chile
E. ctenolepis	–	–	24-25	10+15	I,9-10	9-11	Japan
E. draco	–	–	22-23	10+15	I,10	7-10	Philippines, Solomon Islands, Vanuatu, Society Islands
E. elegans	–	+	30-33	10+15	I,9	6-8	Nazca Ridge
E. heracleus	–	+	28-32	11+14	I,9	7-9	New Zealand
E. lenimen	1	+	28-34	11+14	I,9	6-9	Australia, New Zealand
E. machaera	1	+	28-30	11+14	I,9	7	New Zealand
E. marimonticolus	–	–	29-32	10+15	I,10	12-14	Western Indian Ocean
E. mayeri	2	+	29-31	10+15	I,9	5	Eastern Atlantic
E. megalops	1	–	22-23	10+15	I,10	10-12	Philippines
E. occidentalis	–	–	24-26	10+15	I,10	8-10	Western Atlantic
E. okamotoi n. sp.	–	–	22	10+15	I,9	4	New Britain
E. pectinifer	2	+	26-30	10+15	I,9	5-7	Japan, Emperor Seamounts, Australia, western Atlantic
E. robustus	1	+	30-32	11+14	I,9	6-7	Southern circumglobal
E. thai	–	–	27	10+15	I,10	12	Andaman Sea
E. waltersensis	–	+	32	10+15	I,9	6	Western Indian Ocean

Maxillary moustache-like process: (1) blunt and (2) sharp-pointed.

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