

Redescription of a rare cusk eel, *Pycnocraspedum squamipinne* (Actinopterygii, Ophidiiformes, Ophidiidae), from Bay of Bengal

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Abstract

Pycnocraspedum squamipinne Alcock, 1889 is a rare species of pelagic cusk eel described from specimens collected off the Bay of Bengal. The descriptive literature on *P. squamipinne* is limited to the original description owing to the rarity in collections. The genus and the species need a thorough revision to identify specific characters of taxonomic importance as the descriptive information regarding the species in the genus *Pycnocraspedum* is limited to the holotypes and syntypes. Fifteen fresh specimens of *P. squamipinne* were collected from the Chennai coast, Tamil Nadu, Bay of Bengal region. The syntypes of *P. squamipinne* (ZSI F 11700 and ZSI F 11703) available at the Zoological Survey of India, Kolkata were examined. The morphometric and meristic characters of *P. squamipinne* were compared with those of syntypes and other species of the genus. Molecular analysis was carried out using partial mtDNA cytochrome oxidase subunit I gene (COI). The specimen is deposited in the national fish repository of the ICAR, National Bureau of Fish Genetic Resources, Lucknow, India. A detailed redescription of *P. squamipinne* based on the syntypes and fifteen recently collected specimens are provided. A detailed comparison with other species of the genus is also provided which helps in establishing the taxonomic identity of *P. squamipinne*. Molecular information was generated which would help in the species identification of this rare deep-sea species. This study provides morphological and molecular information of the rare cusk eel, *P. squamipinne*, which would help in the precise identification of the species. However, due to paucity, the majority of species of the genus are still only known from single specimens and comprehensive examination of holotypes and intensive sampling is needed to better understand the species identity and distribution.

Keywords

Bay of Bengal, COI, cusk eel, redescription

Introduction

The order Ophidiiformes consists of five families, Aphyonidae, Bythitidae, Carapidae, Ophidiidae, and Parabrotulidae and is one of the diverse groups of deep-sea demersal ichthyofauna inhabiting the continental slope to the abyssal plain (Haedrich and Merrett 1988; Merrett and Haedrich 1997). Alcock (1891) compiled the first

list of deep-sea fishes from the Indian waters in his book ‘Indian deep-sea fishes in the Indian museum’. Nielsen et al. (1999) published a world catalog of fishes of the order Ophidiiformes, which included 48 genera and 218 species under the family Ophidiidae.

The family Ophidiidae consists of 266 species in four subfamilies: Brotulinae (7 species), Brotulotaeniinae (4 species), Ophidiinae (65 species), and Neobythitinae

(190 species) (Nielsen et al. 1999; Fahay and Nielsen 2003; Okiyama and Yamaguchi 2004; Fricke et al. 2020). The diagnostic characters for the genus *Pycnocraspedum* are the large head, longer than half of the preanal length, four developed gill rakers, eight branchiostegal rays, small granular teeth on premaxillaries, vomer and palatines, 2 basibranchial tooth patches, caudal-fin rays 10, pelvic fins as bifid filaments united basally; opercular spine present, 2–3 spines at the lower angle of preopercle and 12 precaudal vertebrae (Alcock 1889; Cohen and Nielsen 1978; Nielsen 1997).

According to Nielsen et al. (1999), the genus *Pycnocraspedum* has five nominal species, *Pycnocraspedum armatum* Gosline, 1954, *Pycnocraspedum fulvum* Machida, 1984, *Pycnocraspedum microlepis* (Matsubara, 1943), *Pycnocraspedum phyllosoma* (Parr, 1933), and *Pycnocraspedum squamipinne* Alcock, 1889. *Pycnocraspedum squamipinne* was originally described from specimens collected off the Bay of Bengal (Alcock 1889). The descriptive literature on *P. squamipinne* is limited to the original description. It has been suggested by many authors that the genus needs a thorough revision to identify specific characters of taxonomic importance (Cohen and Nielsen 1978; Nielsen 1997). The present paper provides a detailed redescription of *P. squamipinne* based on the syntypes and fifteen recently collected specimens.

Material and methods

Fifteen fresh specimens of *Pycnocraspedum squamipinne* were collected from the Chennai coast, Tamil Nadu, Bay of Bengal region. All the measurements were made with the digital vernier caliper to the nearest 0.1 mm, following Hubbs and Lagler (1947) and Cohen and Nielsen (1978). The body proportions were expressed in terms of standard length (SL: length from the snout tip to the base of the caudal fin) and head length (HL: length from the snout tip to the posterior margin of the opercle). The vertebral counts were taken from radiographs. The syntypes of *P. squamipinne* (ZSI F 11700 and ZSI F 11703) available at Zoological Survey of India, Kolkata were examined. The morphometric characters of *P. squamipinne* were compared with syntypes and other species of the genera (Tables 1, 2). The specimen is deposited in the National Fish Repository of the ICAR, National Bureau of Fish Genetic Resources, Lucknow, India (Accession numbers NBFGR/OPHPSQU1, NBFGR/OPHPSQU2, NBFGR/OPHPSQU3, NBFGR/OPHPSQU4, NBFGR/OPHPSQU5).

The molecular analysis was carried out using partial mtDNA cytochrome oxidase subunit I gene (COI). The genomic DNA was extracted using Qiagen Kit as per the manufacturer's protocol. The universal primers COI F (5'-TCA ACC AAC CAC AAA GAC ATT GGC AC -3') and COI R (5'-TAG ACT TCT GGG TGG CCA AAG AAT CA-3') (Ward et al. 2005) were used to amplify the partial COI gene. The amplifications were performed in

25 µL reactions containing 10× assay buffer (100 mM Tris, 500 mM KCl, pH 9.0) with 20 mM MgCl₂, 10 pmoles of each primer, 200 µM of each dNTP, 0.25 U TaqDNA polymerase and 25 ng of template DNA. PCR products were sequenced bi-directionally. DNA sequences developed in the presently reported study were aligned and edited using BioEdit sequence alignment editor version 7.0.5.2 (Hall 1999). Phylogenetic and molecular evolutionary analysis using Kimura 2-parameter method (Kimura 1980) was conducted using MEGA version 7.0 (Kumar et al. 2016). The edited sequences were submitted to GenBank (Accession No: MT231514, MT231515, MT231516, MT231517, MT231518, and MT231519).

Systematic account

Family Ophidiidae

Pycnocraspedum squamipinne Alcock, 1889

Figs 1–4, Tables 1, 2

Pycnocraspedum squamipinne Alcock, 1889 (Type locality: Bay of Bengal, 20°17'30"N, 88°50'E)

Materials examined. INDIA 1; Syntype of *P. squamipinne* (TL = 291 mm); Bay of Bengal; 20°17'30"N, 88°50'E R.I.M.S. Investigator coll. leg.; ZSI F11700 1; Syntype of *P. squamipinne* (TL = 299 mm) same collection data as preceding; ZSI F 11703 (1, 299 mm TL).

INDIA 5; Chennai coast, Tamil Nadu; March 2018; Teena Jayakumar T.K and T.T Ajith Kumar leg.; NBFGR / OPHPSQU1 to 5 • 10; same collection data as for preceding; NBFGR / CE1 to 10.

Diagnosis. Deep bodied cusk eel with head 3.0–3.9 times in SL; eye diameter 5.5–6.8 in HL; interorbital 4.8–6.3 in HL; snout 3.8–5.2 in HL; depth 4.3–6.8 in SL; predorsal length 3.3–4.7 in SL, distance between pelvic origin to anal origin 2.5–4.4 in SL; no pseudobranchiae and 12–13 pyloric caeca. Two median basibranchial tooth patches. Single opercular spine and 3 short blunt spines at lower angle of preopercle. *Pycnocraspedum squamipinne* differs from its congeners in origin of dorsal fin above preopercle, absence of pseudobranchial filaments, pectoral fins and pelvic fins short and not reaching anus.

Description. Body compressed, moderately deep and tapers caudally, its depth 4.3–6.8 in SL (Fig. 1). Body covered by small cycloid scales. Head large, compressed, fully scaled except lips, head length 3.0–3.9 in SL. Eye diameter 15.2%–18.4% HL; preorbital length 19.2%–23.6% HL and postorbital length 61.9%–72.7% HL. Head length in preanal distance 1.6–1.9. Anterior nostril tubular, behind snout rim with small skin flap, smaller than posterior nostril being simple pore in front of eye. Eyes moderately large, elliptical, snout length greater than diameter of eye, interorbital space wide equal to or slightly greater than eye diameter. Mouth large and oblique, snout blunt, maxilla extending beyond posterior margin of eye,

Table 1. Comparison of morphometric and meristic characters of *Pycnocraspedum squamipinne* ($n = 15$) and syntypes (ZSI F11700 and ZSI F 11703).

Measurements	<i>P. squamipinne</i> (ZSI F11700 and ZSI F 11703)	<i>P. squamipinne</i> (this study) $n = 15$		
		Min	Mean	Max
Total length [mm]	291–299	210	—	405
Standard length [mm]	270–277	190.4	—	380
As percentage of standard length				
Head length	29.6–30.4	25.6	29.0	33.0
Preorbital length	7.4–7.8	5.6	6.2	7.3
Eye diameter	4.3–4.8	4.1	4.8	5.8
Postorbital length	16.3–18.1	16.4	19.1	21
Interorbital width	4.8–5.9	4.8	5.5	6.4
Length of upper jaw	13.9–14.1	12.2	14.3	16.1
Predorsal length	25.1–25.6	21.2	25	30
Prepectoral length	33.5–33.5	26.7	31	35.7
Prepelvic length	24.8–27.1	19.8	21.6	24.5
Preanal length	50.0–50.5	46.2	50.6	59.9
Pelvic fin origin to anal fin origin	27.6–30.4	25.2	32.9	40.0
Length of longest pelvic filament	9.6–9.8	5.6	8.9	11.7
Length of pectoral fin	13.7–15.5	12.4	14.5	16.6
Body depth	16.7–17.3	14.7	18.3	23.1
Meristic counts				
Dorsal rays	63–68	69	—	92
Anal rays	56–58	54	—	79
Caudal rays	10	10	—	10
Pectoral rays	24	24	—	24
Pelvic filaments	2	2	—	2
Developed gill rakers	4	4	—	4
Branchiostegal rays	8	8	—	8
Transverse scale rows	58–60	49	—	86
Transverse scale rows ahead of anal origin	52–55	43	—	78
Scales above lateral line	11–15	10	—	24
Scales below lateral line	38–43	39	—	52

Table 2. Comparison of morphometric and meristic characters among *Pycnocraspedum* species.

Characters	<i>P. squamipinne</i>	<i>P. fulvum</i>	<i>P. armatum</i>	<i>P. microlepis</i>	<i>P. phyllosoma</i>
Proportional measurements in standard length					
Body depth at anal origin	4.3–6.8	5.1	4.4	—	—
Head length	3.0–3.9	3.7	3.9	4.2	4.4
Predorsal length	3.3–4.7	4.0	5.1	5.4	5.3
Preanal length	1.7–2.2	2.1	2.2	2.5	2.4
Prepelvic length	3.7–5.1	4.6	4.7	—	—
Proportional measurements in head length					
Eye diameter	5.5–6.8	6.4	5.8	5.9	5.0
Interorbital width	4.8–6.3	3.6	3.3	3.5	2.8
Upper jaw length	1.9–2.3	1.8	1.8	2.0	2.0
Snout length	3.8–5.2	4.3	3.9	4.2	3.5
Postorbital length	1.4–1.9	1.6	1.7	1.8	—
Pectoral fin length	1.7–2.2	1.7	1.6	1.4	1.4
Counts					
Dorsal fin rays	63–92	81	±90	81–98	97
Anal fin rays	54–79	63	±72	63–76	71
Pectoral fin rays	24	26/26	26	26	26
Pelvic fin rays	2	2	2	2	2
Caudal fin rays	10	10	10	10	10
Branchiostegal rays	8	8	8	8	8
Developed gill rakers	4	4	5–6	4	4
Pseudobranchiae	0	4	Rudimentary	0	6
Pyloric caeca	12–13	13	12	20	21
Preopercular spines	3	2	4	2	2
Scales above lateral line	10–24	~17	±20	25	21
Dorsal fin origin	About over preopercular margin	Slightly before opercular margin	Slightly before preopercular margin	About over preopercular margin	Before opercular margin
Vertebrae	47–49	52	—	52	—



Figure 1. (A) *Pycnocraspedum squamipinne*, 40.3 cm TL, off Chennai coast, Bay of Bengal; (B) *Pycnocraspedum squamipinne* syntype 29.9 cm TL, ZSI F11703, Bay of Bengal.

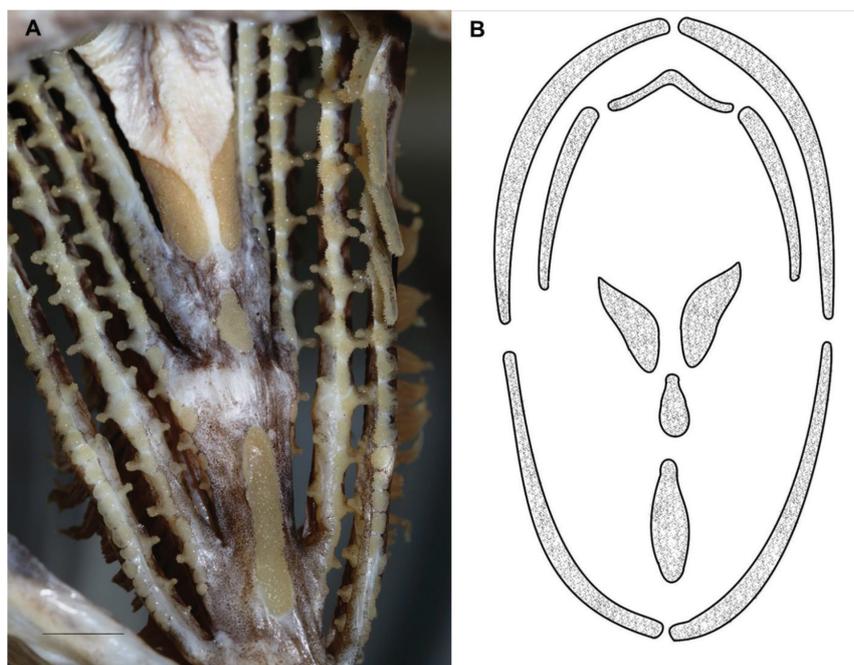


Figure 2. (A) Basibranchial tooth patches of *Pycnocraspedum squamipinne*, 29.8 cm SL, scale bar = 1 cm; (B) Dentition in jaws premaxillary, vomerine, palatine, dentary, and basibranchial tooth patches, scale bar = 1 cm.

wide posteriorly. Granular teeth in bands in jaws, vomer and palatines, vomerine tooth-patch narrow, v-shaped, tongue pointed, reaching below vomer. Median basibranchial with elongate tooth patch from first gill arch to third and second small tooth patch near fourth gill arch followed by pair of teardrop-shaped (rounded anteriorly and pointed posteriorly) lower pharyngeal tooth patches (Fig. 2). Sagittal otolith long and oval (Fig. 3A, B). Ratio

of length to height ranging from 2.4 to 2.9 times; length to thickness from 5.9 to 7.4 times. Pseudobranchial filaments absent. Developed gill rakers 4 on first gill arch, having small granular teeth (Fig. 3C). Branchiostegal rays 8; 6 in ceratohyal and 2 on epihyal. Opercle thin, soft with weak posterodorsal spine, three broad and blunt spines at lower angle of preopercle. Origin of dorsal fin above hind margin of preopercle. Pectoral fins elongate with

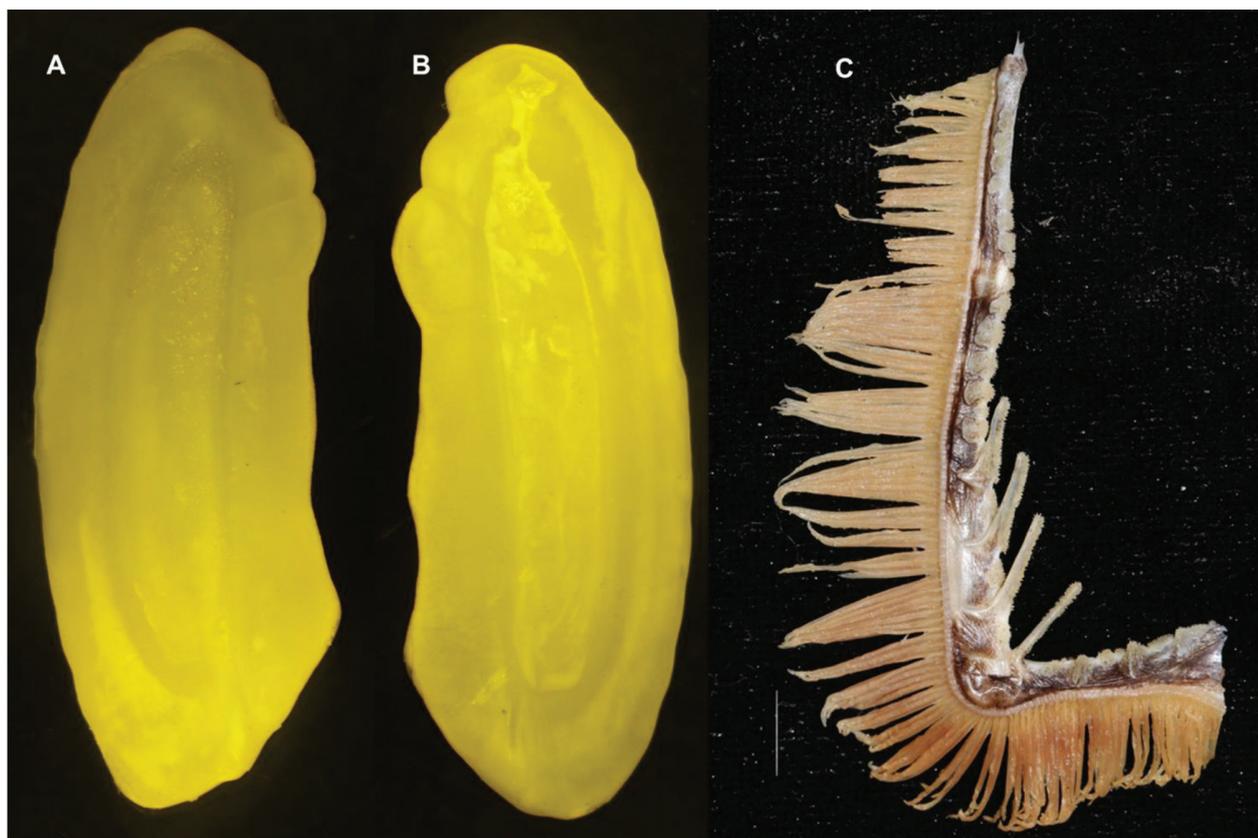


Figure 3. *Pycnocraspedum squamipinne*, 20 cm SL (A) left sagitta, (B) right sagitta; (C) First gill raker of *Pycnocraspedum squamipinne*, 29.8 cm SL, scale bar = 1 cm.

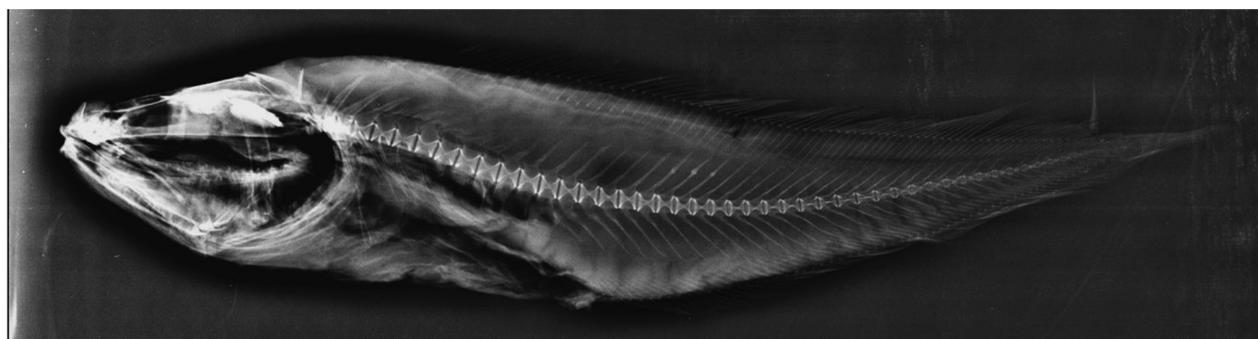


Figure 4. Radiograph of *Pycnocraspedum squamipinne*, 38 cm SL.

prominent skin flap above its base but not reaching anus. Pelvic fins united basally and separated distally. Caudal distinguishable from dorsal and anal by closer grouping of last 10 rays. Lateral line well developed, terminating at point about length of postorbit from caudal fin base. Stomach black with 13 long and finger-like pyloric caeca. Total of 12 precaudal vertebrae and 47–49 total vertebrae number (Fig. 4). Meristic and morphometric characters of the specimen are presented in Tables 1, 2.

Color. Body greyish brown but on ventral side dull silvery brown. Body without markings or spots. Distal margins of dorsal and anal fins dark black, ground color of dorsal and anal fin pale brown. Pectoral fins thick black but base of the pectoral light grey. Pelvic fin rays white with blackish tinge. Lateral line with blackish tinge. Orobranchial cavity greyish white, peritoneum black.

Discussion

Nielsen et al. (1999) reported five nominal species in the genus *Pycnocraspedum*, but noted that a thorough revision was required for confirming the validity of some species. *Pycnocraspedum fulvum*, *P. armatum*, *P. microlepis*, and *P. phyllosoma* have been described based on a single specimen and the descriptions are incomplete and need further elucidation (Gosline 1954; Machida 1984). The original description of *P. squamipinne* was lacking certain diagnostic characters such as the meristic counts and few measurements. The diagnostic features of *P. squamipinne* include short body with large head, eyes smaller than snout, single opercular spine, three preopercular spines, four developed gill rakers on first gill arch, two median basibranchial tooth patches, dorsal fin origin

above preopercular margin, and short pectoral and pelvic fins not reaching anus.

Norman (1939), reported *Pycnocraspedum squamipinne* from Zanzibar, Indian Ocean, however, has not provided a detailed description of the specimen. Nielsen (1997) described a species obtained from the waters of New Caledonia. The specimen was similar to *P. squamipinne*, but differed in the presence of 7 pseudobranchial filaments, dorsal fin origin, and also the length of pectoral fin which extends beyond the anus to the anal fin origin (fig. 20 in Nielsen 1997). Prokofiev (2005) described a species of *Pycnocraspedum*, collected off the east coast of Southern Africa, which closely resembled *P. squamipinne*. However, the specimen differed from *P. squamipinne* in the presence of 4 well developed pseudobranchial filaments (absent in *P. squamipinne*) and elongate pectoral and pelvic fins (short in *P. squamipinne*). The specimen shows similarity with *P. armatum* in having long pectoral fins, but distinguishable with the same in having weak spines in preopercle and the origin of the dorsal fin. The specimen had a single minute lateral basibranchial tooth-plate on the left side of the gill arch base which is not found in the rest of the species. The long pectoral fin, the presence of pseudobranchiae, and single lateral basibranchial tooth patch suggest that this may be a new species or a rare individual variation (Prokofiev 2005). Psomadakis et al. (2019), reported *Pycnocraspedum* cf. *squamipinne* from Myanmar, distinguished from *Pycnocraspedum squamipinne* in possessing a greater number of dorsal fin rays (90–91 vs. 63–92) and anal fin rays (57–62 vs. 54–79). Our data for *P. squamipinne*, encompasses a range that includes the Myanmar fish specimen, the only difference being the greater number of pectoral fin rays (27–30 vs. 24) for the specimen from Myanmar. Further analysis is required to verify the identity of the Myanmar fish.

Pycnocraspedum squamipinne resembles *P. armatum* with the pattern of basibranchial tooth patch but is distinguishable from the latter in the number of gill rakers (5–6 in the latter), absence of pseudobranchial filaments (rudimentary in latter), preopercular spines (4 in the latter), the origin of dorsal fin (originates forward of the preopercular border for latter), and shorter pectoral fin (long and reaches to the anus in the latter). The species differ from *P. fulvum* with the number of preopercular spines (2 in the latter), and the absence of pseudobranchial filaments, whereas *P. fulvum* has pseudobranchial filaments. Moreover, *Pycnocraspedum fulvum* has a pair of small tooth patches behind the anterior large tooth patch on the median basibranchial, whereas tooth patches on the lateral sides are absent in *P. squamipinne*. Furthermore, the dorsal fin origin of *P. fulvum* is located before the posterior margin of the opercle whereas, in *P. squamipinne* it is about over the preopercular margin. *Pycnocraspedum squamipinne* is clearly separable from *P. phyllosoma* in having a fewer number of pyloric caeca (12–13 vs. 20), the absence of pseudobranchiae (6 in the latter), a number of preopercular spines (3 vs. 2), and the differences in

proportions of the predorsal and preanal lengths, interorbital distance, eye diameter, snout, and pectoral length. Though *Pycnocraspedum microlepis* does not have pseudobranchiae, it differs from *P. squamipinne* with the number of preopercular spines, pyloric caeca, the proportion of head length, predorsal length, preanal length, interorbital length, and pectoral fin length. The counts of dorsal and anal fin rays are too variable to be used in discriminating related species in the genus.

Descriptive information regarding the species in the genus *Pycnocraspedum* is limited to the holotypes and syntypes mainly owing to the rarity in collections. A comprehensive study of their systematics is lacking. An in-depth study on the species of the genus *Pycnocraspedum* is required by examining holotypes and specimens to resolve their taxonomic ambiguity. As suggested by various authors, a revision of the genus is very much required to overcome the confusion in the species identification. Moreover, the molecular information generated for the species in the study would help in the species identification of this rare deep-sea species.

Recent studies have documented the diversity of deep-sea Ophidiiform fishes from the Indian ocean (Anderson 2005; Cubelio et al. 2009; Kurup et al. 2009; Nielsen and Møller 2011; Kannan et al. 2013a, 2013b; Kannan et al. 2014; Kannan 2017; Reethas et al. 2018; Uiblein and Nielsen 2018). More intensive deep-sea exploratory surveys and closer monitoring of deep-sea bycatch are required which may result in discoveries of more species in the Indian Ocean.

Conclusion

The morphological and molecular information generated for the cusk eel, *Pycnocraspedum squamipinne*, would help in the precise identification of the species. However, due to paucity, the majority of species of the genus are still only known from single specimens and comprehensive examination of holotypes and intensive sampling is needed to better understand the species identity and distribution.

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