# New Records of Four Parasitic Copepods (Crustacea, Siphonostomatoida) from Andaman and Nicobar Waters, India

Nashad M.†, Sijo P. Varghese†*, Swapnil Shivadas Shirke and Pratyush Das

## ABSTRACT

Our knowledge is limited of the parasitic copepods of the arhipelago known as the Andaman and Nicobar Islands within the Indian Exclusive Economic Zone. Here we report first records of parasitic copepod species form large pelagic fishes caught during exploratory longline operations conducted in Andaman and Nicobar waters. Four species of copepod parasites from three families (Eudactylinidae, Caligidae and Pseudocycnidae) were recovered; 1) *Nemesis aggregatus* Cressey, 1967 from the gills of pelagic thresher *Alopias pelagicus* Nakamura, 1935 2) *Gloiopotes huttoni* (Thomson G.M., 1890) from the body surface of black marlin *Istiompax indica* (Cuvier, 1832) 3) *Caligus lobodes* (Wilson C.B., 1911) from the body surface of great barracuda *Sphyraena barracuda* (Edwards, 1771) and 4) P*seudocycnus appendiculatus* Heller, 1865 from the gills of yellowfin tuna *Thunnus albacares* (Bonnaterre, 1788). *Alopias pelagicus* represents a new host record for *N. aggregatus*.

**Keywords:** *Caligus lobodes*, *Gloiopotes huttoni*, *Nemesis aggregatus*, Parasites, *Pseudocycnus appendiculatus*

## INTRODUCTION

Parasitic infections of fishes can affect their behavior, metabolism, morphology, appearance, fecundity and survival (Lagrue *et al*., 2011). Due to their association with economically important fishes, especially those which are candidate species for aquaculture, fish parasites are attracting significant academic attention. Further, fish parasites are important components of aquatic biodiversity, and it has been reported that more than 100,000 parasites infect the approximately 30,000 fish species (Rohde, 2002). Studies on fish parasites are, therefore, of prime importance for describing biodiversity and for successful aquaculture (Varghese and Unnikrishnan, 2015).

Copepods are small aquatic crustaceans constituting an important component of fish parasites. Most species of copepod fish parasites belong to the order Siphonostomatoida Thorell, 1859 (75%) and Poecilostomatoida Thorell, 1859 (20%) (Kabata, 1988, 1992). The order Siphonostomatoida includes 57 recognized families parasitizing a wide range of hosts (Boxshall, 2008). Members of Siphonostomatoida show parasitic adaptations such as short, subcylindrical tubelike mouths, siphons or rod-shaped mandibles with a flat distal part and a frontal filament to aid attachment to their hosts. The members of copepod families Eudactylinidae C. B. Wilson, 1932 and Pseudocycnidae C. B. Wilson, 1922 have elongated bodies, typically retaining indications of external

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segmentation. Most of these parasites inhabit the branchial chambers of their hosts, usually on the gills, where they attach using clawed antennae, maxillipeds or maxillae. The caligiform families in the order Siphonostomatoida have dorso-ventrally flattened bodies, which are divided into an anterior cephalothorax and a post-cephalothoracic genital trunk (Boxshall, 2005). The exclusively parasitic family Caligidae is the largest among them with 64 genera, most of which live on outer surfaces of marine fishes (Boxshall and Halsey, 2004; Boxshall, 2008). These parasites use a combination of claws and suction for attachment and most of them move freely on their host's body and are capable of moving from one host to other. The genus *Caligus* Muller, 1785 is among the most successful genera of the marine parasitic copepods, with 408 valid species (Boxshall, 2015), and they have characteristic lunules on their frontal plates (Kabata, 1988).

Parasitic copepod fauna of marine fishes of waters around mainland India is fairly well documented. These studies include those of Bassett-Smith (1898), Rao (1951), Gnanamuthu (1951), Rangnekar (1961), Tripathi (1962), Silas and Ummerkutty (1967) and Pillai (1985). However, our knowledge of the copepod parasites of large pelagics of the Andaman and Nicobar waters remains patchy. In this perspective, we surveyed the parasitic copepods from Teleostei and Chondrichthyes fishes from Andaman and Nicobar waters, and four copepod parasite species are newly recorded.

## MATERIALS AND METHODS

Parasite specimens for the present study were collected from the fishes caught by exploratory horizontal long lining for tunas in the oceanic waters of the Andaman and Nicobar waters (Figure 1) during the survey voyages of the vessel, MFV *Blue Marlin* of the Fishery Survey of India (FSI). Sampling was undertaken during April 2017. Copepods from the body surface and gill filaments of the fish specimens caught during fishing operations were carefully removed using fine forceps and preserved in 70% ethanol. After the completion of the voyage, preserved copepods were brought to the shore laboratory, cleared with lactic acid, and the appendages were dissected using fine needles for detailed study. The specimens were examined under a stereo microscope and measured using an ocular micrometer. The parasites were identified according to keys by Kirtisinghe (1964); Pillai (1985); Cressey (1967a,b); Williams and Bunkley-Williams (1996); Boxshall and Halsey (2004). Microphotographs of all the species were made using a digital camera attached to the stereo microscope. Voucher specimens were deposited at the Museum of the Port Blair Base of Fishery Survey of India.

## RESULTS AND DISCUSSION

**Order** Siphonostomatoida Thorell, 1859

**Family** Eudactylinidae Wilson C.B., 1932

**Genus** *Nemesis* Risso, 1826

***Nemesis aggregatus* Cressey, 1967**

*Nemesis aggregatus* Cressey, 1967a: 6; Pillai 1985: 658.

We studied 83 specimens (27 males and 56 females) of *N. aggregatus* recovered from the tips of gill filaments of two pelagic threshers *Alopias pelagicus* Nakamura, 1935 collected by exploratory horizontal long lining conducted in the Andaman and Nicobar waters, India, April 2017. Geographic location of specimen collection was 10°28.8'N; 94°28.8'E. Total lengths of the female specimens sampled were in the range of 4.1–4.4 mm, trunk width ranged between 1.4 and 1.6 mm, whereas the lengths of egg strings were in the range of 4.9–5.4 mm. The total length of males ranged between 3.1 and 3.6 mm, trunk width was in the range of 0.8–0.95 mm (Figure 2). *Nemesis aggregatus* recorded a prevalence of 100% on *A. pelagicus*. The mean intensity of infestation for the population (number of parasites per fish) and the mean intensity per infected fish were both 41.5, whereas the range of parasite load per infested fish was from 38 to 45. Swelling and damage of

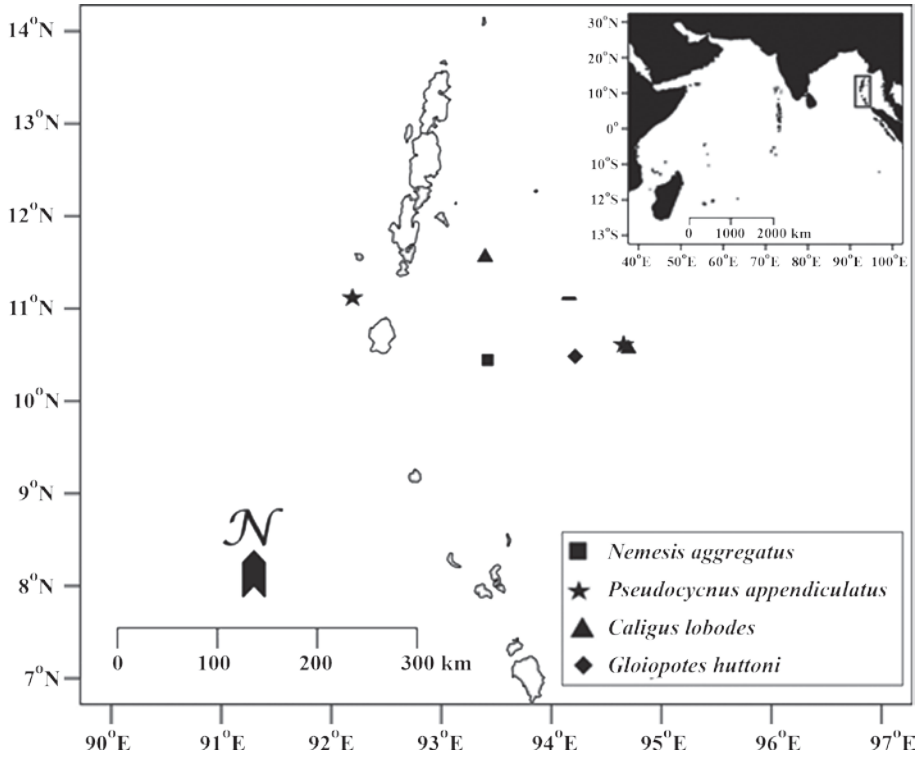


Figure 1. Map showing collection sites of parasite specimens

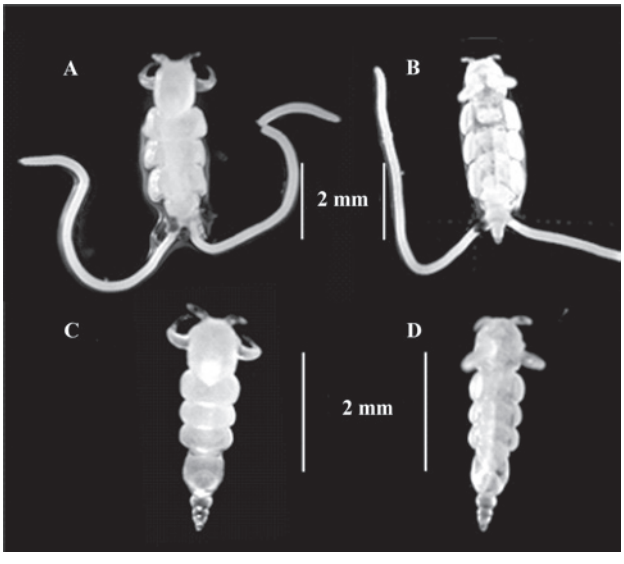


Figure 2. *Nemesis aggregatus* collected from the gill filaments of *Alopias pelagicus*-dorsal and ventral sides of female (A and B) and male (C and D)

tissues were observed on the gill filaments of fish infected with this parasite. *Nemesis aggregatus* is reported to infect the common thresher, *Alopias vulpinus* (Bonnaterre, 1788) (Cressey, 1967a; Pillai, 1985; Walter and Boxshall, 2015) in the Indian Ocean. Pelagic thresher, *A. pelagicus* reported here is a new host record for this parasite.

The copepod species *N. aggregatus* was described by Cressey (1967a) while studying parasitic copepods collected during the International Indian Ocean Expedition. However, Hewitt (1969) suggested that *N. aggregatus* should be treated as a synonym of *N. robusta* since the most important character distinguishing the two species as described by Cressey (1967a), namely the number of spines on the second segment of the antenna, is variable. Later, Pillai (1985) identified easily recognizable differences between these two congeners, especially in males, since *N. aggregatus* has a stouter antennule, a stouter antenna, a sharp process on the basal segment of the maxilliped (blunt in *N. robusta*), and blunt spines on the caudal rami (drawn out in *N. robusta*). Notable differences in the armatures of legs, cephalothorax (is narrow behind in *N. aggregatus* but broad in *N. robusta*), and abdomen (three-segmented in *N. aggregatus* and four-segmented in *N. robusta*) also were identified. The specimens observed during the present study had the above distinguishing features of *N. aggregatus* as described by Pillai (1985). *N. aggregatus* has been reported from the western Indian Ocean, infecting *A. vulpinus* (Bonnaterre, 1788). Therefore, our report represents the first distributional record of this parasite for Andaman and Nicobar waters.

**Order** Siphonostomatoida Thorell, 1859

**Family** Caligidae Burmeister, 1835

**Genus** *Gloiopotes* Steenstrup & Lütken, 1861

***Gloiopotes huttoni* Thomson, 1890**

*Lepeophtheirus huttoni* Thomson, 1890: 353; Wilson, 1907: 701

*Gloiopotes huttoni* Shiino, 1954: 278; Yamaguti, 1963: 104; Hewitt, 1964: 86; Lewis, 1967: 57; Cressey, 1967: 6; Pillai, 1985: 485; Ho and Nagasawa, 2001: 1; Maran *et al*., 2015: 352

*Gloiopotes costatus* Wilson, 1919: 313; Hewitt, 1964: 94

*Gloiopotes zeugopteri* Rao, 1951: 248; Hewitt, 1964: 95

We studied 178 specimens (72 males and 106 females) of *G. huttoni* collected from the body surface of a single black marlin *Istiompax indica* (Cuvier, 1832) (Perciformes: Istiophoridae) collected by exploratory horizontal long lining conducted in the Andaman and Nicobar waters, India, April 2017. Location of specimen collection was 10°30.2'N; 94°18.3'E. Total lengths of the females sampled were in the range of 8.9–11.2 mm, carapace length ranged between 4.8 and 5.9 mm, carapace breadth ranged between 3.3 and 5.1 mm, whereas the lengths of egg strings were in the range of 3.3–3.9 mm. The male specimens collected ranged in total length from 8.5–8.9 mm, and carapace breadth ranged between 3.3 and 3.8 mm (Figure 3). *Gloiopotes huttoni* was recorded with a prevalence of 100% on *I. indica*. The mean intensity of infestation for the population (abundance) and the mean intensity per infected fish were both 178. However, it may be noted that we could examine only a single specimen of the host for parasite collection. Most of the sampled male copepods (43 out of 72) were found to be clinging to the genital segment of the females.

*Gloiopotes huttoni* has been reported from fish hosts distributed in the Indo-Pacific area (Pillai, 1985). It infects at least six hosts including *Acanthocybium solandri* (Cuvier, 1832), *Istiophorus platypterus* (Shaw, 1792), *Istiompax indica* (Cuvier, 1832), *Kajikia audax* (Philippi, 1887), *Makaira nigricans* Lacepède, 1802 and *Xiphias gladius* Linnaeus, 1758 (Rao, 1951; Walter, 2008; Maran *et al*., 2015).

Cressey (1967b) concluded that *G. huttoni* can be distinguished from its closely resembling congener *G. watsoni* by differences in their genital segments, since in *G. watsoni* the genital segment

is wider than long, whereas in *G. huttoni*, it is longer than wide. Further, the fifth leg does not reach the tip of the abdomen in *G. huttoni* while it does reach in *G. watsoni*. The specimens sampled during this study had the above features of *G. huttoni* as described by Cressey (1967b). In the Indian Exclusive Economic Zone (EEZ), Rao (1951) reported *G. huttoni* from a swordfish caught off the coast of Lawson's Bay, while the present report extends the distributional limit of this copepod parasite in the Indian EEZ to Andaman and Nicobar waters.

**Order** Siphonostomatoida Thorell, 1859

**Family** Caligidae Burmeister, 1835

**Genus** *Caligus* O.F. Müller, 1785

***Caligus lobodes* Wilson, 1911**

*Midias lobodes* Wilson, 1911: 625; Wilson, 1913: 225; Causey, 1953: 11; Rangnekar, 1956: 52; Shiino, 1958: 98; Yamaguti, 1963: 107; Kirtisinghe, 1964: 71; Pillai, 1966: 130; Lewis, 1967: 94

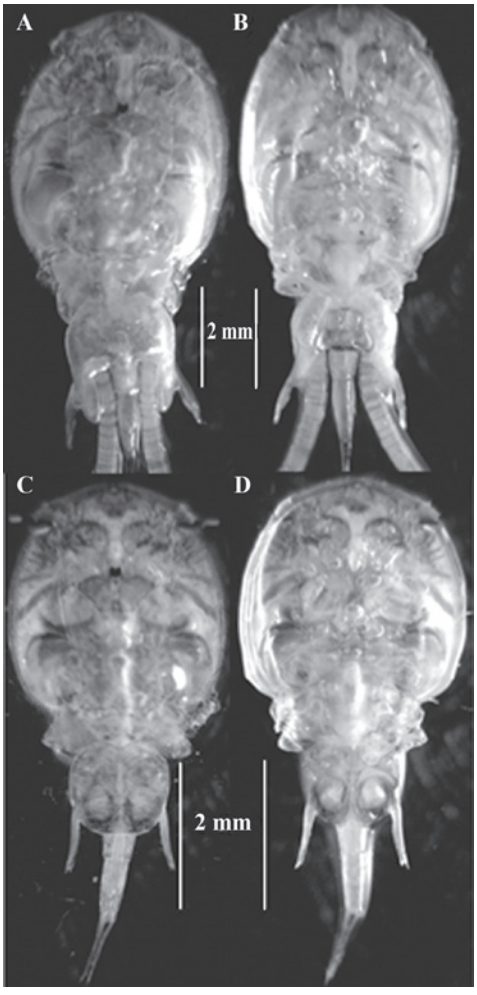


Figure 3. *Gloiopotes huttoni* collected from the body surface of *Istiompax indica*-dorsal and ventral sides of female (A and B) and male (C and D)

*Caligus lobodes* Kabata, 1979: 170; Dojiri, 1983: 256; Pillai, 1985: 310; Williams and Bunkley-Williams, 1996:185; Alvarez-Leon, 2007: 81; Varela and Lucero-Salcedo, 2012: 118; Fogg *et al*., 2016: SC1

A total of 84 specimens (36 males and 48 females) of *C. lobodes* was found on the body surface of seven great barracuda *Sphyraena barracuda* (Edwards, 1771) collected by exploratory horizontal long lining conducted in the Andaman and Nicobar waters, India, April 2017. The host specimens were collected from the geographic locations 10°40.1'N; 94°42.8'E, 11°08.2'N; 94°09.3'E and 11°31.2'N; 93°28.2'E. Total length of the female specimens were in the range of 8.9–9.8 mm, cephalothorax length ranged between 4.1 and 4.3 mm. The male specimens ranged from 5.9–7.1 mm in total length, and the cephalothorax length ranged from 3.6–3.9 mm (Figure 4). *Caligus lobodes* was recorded with a prevalence of 77.78% on *S. barracuda*. The mean intensity of infestation for the population (abundance) was 9.33 and the mean intensity per infected fish was 12, whereas the range of parasite load per infested fish was between 9 and 21.

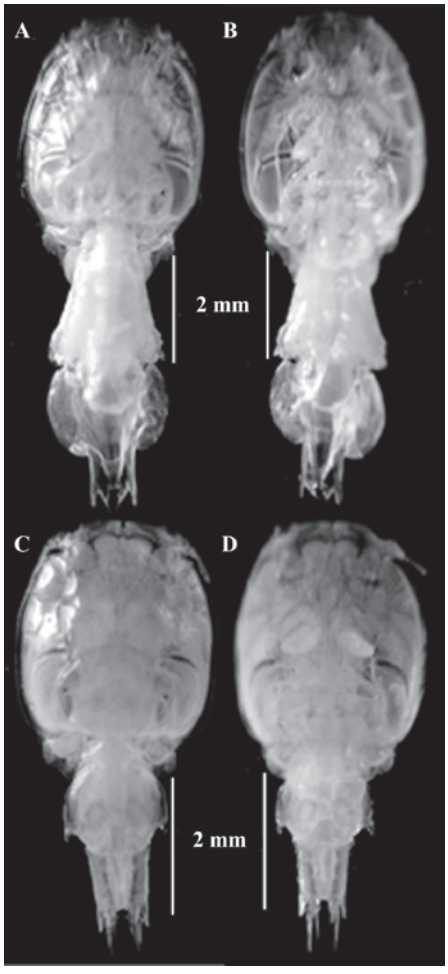


Figure 4. *Caligus lobodes* collected from the body surface of *Sphyraena barracuda*-dorsal and ventral sides of female (A and B) and male (C and D)

*Caligus lobodes* has been reported worldwide, infecting the great barracuda (*S. barracuda*), *Sphyraena* sp. and red lionfish, *Pterois volitans* (Linnaeus, 1758) (Pillai, 1985; Williams and Bunkley-Williams, 1996; Fogg *et al*., 2016). In the Indian EEZ, *C. lobodes* has been reported from the Arabian Sea (Pillai, 1985). Our report extends the distributional limit of this copepod parasite in Indian EEZ to Andaman and Nicobar waters.

**Order** Siphonostomatoida Thorell, 1859

**Family** Pseudocycnidae Wilson C.B., 1922

**Genus** *Pseudocycnus* Heller, 1865

***Pseudocycnus appendiculatus* Heller, 1865**

*Pseudocycnus appendiculatus* Heller, 1865: 280; Wilson, 1922: 75; Kirtisinghe, 1935: 339; Shiino, 1959: 325; Yamaguti, 1963: 170; Pillai, 1964: 73; Silas and Ummerkutty, 1967: 925; Hewitt, 1969: 169; Pillai, 1985: 695; Williams and Williams, 1996: 204; Purivirojkul *et al*., 2011: 81; Deveney *et al.,* 2005: 279; Nagasawa, 2017: 511

*Pseudocycnus spinosus* Pearse, 1952: 5

*Pseudocycnus thunnus* Brandes, 1955: 190

We examined four specimens (three females and one male) of *P. appendiculatus* collected from the gill filaments of two yellowfin tuna *Thunnus albacares* (Bonnaterre, 1788) (Perciformes: Scombridae) collected by exploratory horizontal long lining conducted in the Andaman and Nicobar waters, India, April 2017. Geographic locations of specimen collections were 11°04.3'N; 92°14.4'E and 10°40.6'N; 94°40.6'E. Total length of the female specimens sampled were in the range of 14.2–16.1 mm, width of trunk ranged between 0.85 and 0.9 mm, length of caudal rami was 3.6–4.1 mm, whereas the lengths of egg strings were in the range of 14.8–21.2 mm. The male specimen was much shorter; the total length recorded being 3.6 mm, width of trunk 0.79 mm and the length of caudal rami 0.61 mm (Figure 5). *Pseudocycnus appendiculatus* was recorded with a prevalence of 20% on *T. albacares*. The mean intensity of infestation for the population (abundance) was 0.4, the mean intensity per infected fish was 2, whereas the range of parasite load per infested fish was between 1 and 3. Distribution range of *P. appendiculatus* is reported to be cosmopolitan (Pillai, 1985) and this parasite infects at least 13 hosts, including *Coryphaena hippurus* Linnaeus, 1758, *Euthynnus affinis* (Cantor, 1849), *Euthynnus alletteratus* (Rafinesque, 1810), *Katsuwonus pelamis* (Linnaeus, 1758), *Sarda chiliensis* (Cuvier, 1832), *Sarda sarda* (Bloch, 1793), *Thunnus alalunga* (Bonnaterre, 1788), *Thunnus thynnus* (Linnaeus, 1758), *Thunnus albacares* (Bonnaterre, 1788), *Thunnus obesus* (Lowe, 1839), *Thunnus tonggol* (Bleeker, 1851), *Thunnus maccoyii* (Castelnau, 1872) and *Thunnus orientalis* (Temminck & Schlegel, 1844) (Boxshall, 2004; Deveney *et al*., 2005; Nagasawa, 2017).

In the Indian EEZ, *P. appendiculatus* has been reported from both the Arabian Sea (Silas and Ummerkutty, 1967; Pillai, 1985) as well as from the Bay of Bengal from 81° E, 11°45'N (Shiino, 1959). In the Andaman Sea, infestation of yellowfin tuna with *P. appendiculatus* has been reported from the EEZ of Thailand (Purivirojkul *et al*., 2011). Our report extends the distributional limit of this copepod parasite in the Indian EEZ to Andaman and Nicobar waters.

This study provides the first report of four copepod parasites including a new host record from the waters of the Andaman and Nicobar islands. However, since the parasite collection in the present study was opportunistic, many of the parasites could not be collected and documented. Considering the utility of parasites in stock identification of host species and their contribution to species richness and biodiversity, intensive studies on the parasites of large pelagic predators need to be undertaken in the Andaman and Nicobar waters, which have received little or no previous attention.

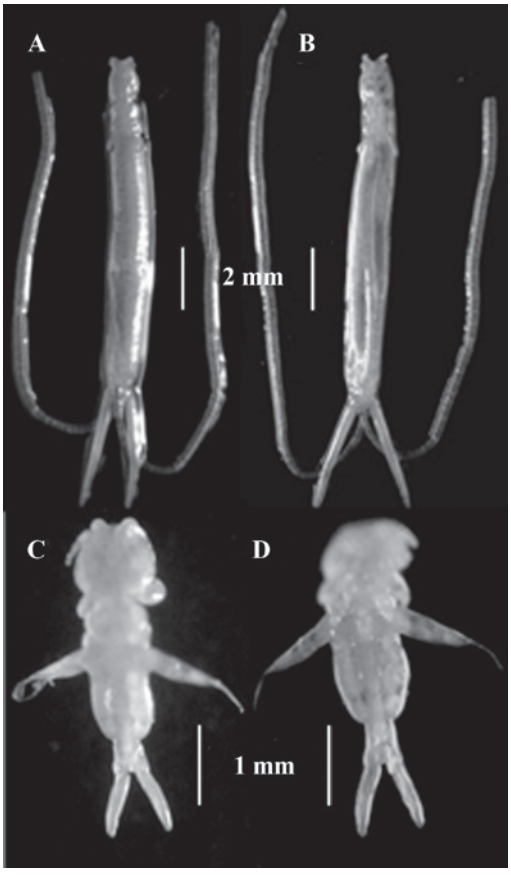


Figure 5. *Pseudocycnus appendiculatus* collected from the gill filaments of *Thunnus albacares*-dorsal and ventral sides of female (A and B) and male (C and D)

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