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Colobomatus kimi sp. nov. (Copepoda: Philichthyidae) parasitic in the dwarf goatfish *Upeneus parvus* Poey, 1852 (Perciformes: Mullidae) in the South Atlantic Ocean

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Abstract

A new species of copepod, *Colobomatus kimi* **sp. nov.**, belonging to the cyclopoid family Philichthyidae Vogt, 1877, is proposed based on female specimens collected from the pores of the cephalic sensory system of the dwarf goatfish, *Upeneus parvus* Poey from the southeastern Brazilian coastal zone. The new species can be distinguished from its closest congeners by the unique combination of characters displayed by the female, including the forked caudal rami, the position of the midventral cephalic process shorter in relation to the lateral cephalic processes, and the presence of paired genital processes. The new species is the first member of *Colobomatus* Hesse, 1873 found to parasitize mullids of the genus *Upeneus*

Key words: Copepoda, Philichthyidae, Internal Parasites, Actinopterygii, Mullidae, Neotropics

Introduction

The order Cyclopoida is a diverse group of copepods having entered in symbiotic relationships with a wide array of aquatic organisms (Boxshall & Montú 1997). In the coastal zone of Brazil eight families of this order are known to utilize fish hosts, including the family Philichthyidae. Members of this family are highly modified, internal parasitic species found in the subcutaneous spaces associated with the sensory canals of the lateral line and skull bones of marine actinopterygians (Boxshall & Halsey 2004; Madinabeitia & Iwasaki 2013).

Currently, nine valid genera of Philichthyidae are recognized: *Colobomatoides* Essafi & Raibaut, 1980; *Colobomatus* Hesse, 1873; *Ichthyotaces* Shiino, 1932; *Leposphilus* Hesse, 1866; *Lernaeascus* Claus, 1886; *Philichthys* Steenstrup, 1862; *Procolobomatus* Castro Romero, 1994; *Sarcotaces* Olsson, 1872; and *Sphaerifer* Richardi, 1876. Records of the family along the eastern seaboard of South America are few with only three species of *Colobomatus* having been recorded so far, *i.e., C. belizensis* Cressey & Schotte, 1983 parasitizing *Haemulon steindachneri* (Jordan & Gilbert) and *Orthopristis ruber* (Cuvier), *C. stelliferi* Pombo, Turra, Paschoal & Luque, 2015 parasitizing *Stellifer brasiliensis* (Schultz), *S. rastrifer* (Jordan) and *S. stellifer* (Bloch), and *C. sudatlanticus* Pereira, Timi, Lanfranchi & Luque, 2012 parasitizing *Mullus argentinae* Hubbs & Marini (Luque & Tavares 2007; Pombo *et al.* 2015).

During a parasitological survey of specimens of the dwarf goatfish *Upeneus parvus* Poey (Perciformes, Mullidae) from the Brazilian coastal zone a number of internal parasitic copepods were recovered. A detailed morphological study of these specimens revealed an as yet unknown species of *Colobomatus*, which is described below.

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Materials and methods

Philichthyid specimens were collected from the pores of the cephalic sensory system of the dwarf goatfish, *Upeneus parvus*, caught in the littoral zone of the State of Rio de Janeiro (22°55'S, 43°12'W) and State of Espírito Santo (20°19'S, 40°20'W), along the southeastern Brazilian coast. The copepods were collected using the procedures by Madinabeitia & Nagasawa (2012) and subsequently fixed and preserved in 70% ethanol. For microscopical observation, specimens were cleared in 85% lactic acid and the appendages were dissected and examined using the wooden slide procedure by Humes & Gooding (1964). Drawings were made with the aid of an Olympus BX53 microscope (Olympus Corporation, Tokyo, Japan) equipped with a drawing tube. For scanning electron microscopy specimens were postfixed in OsO_4, dehydrated through a graded ethanol series, critical-point dried with liquid CO_2, sputter-coated with gold, and examined in a Quanta 200 FEI scanning electron microscope, operating at 10 kV. Measurements are based on ten females with the average values being followed by the range given in parentheses. The descriptive terminology follows Boxshall & Halsey (2004). The common and scientific names of host fishes follow Froese & Pauly (2014). Holotype and paratypes were deposited in the Crustacea Collection of the National Museum of Rio de Janeiro (MNRJ).

Results

Order Cyclopoida Burmeister, 1834

Family Philichthyidae Vogt, 1877

Colobomatus kimi sp. nov.

(Figs. 1–2)

Material examined. Holotype ♀ (MNRJ- 25208) and four paratype ♀♀ (MNRJ- 25207) extracted from the pores of the cephalic sensory system of *Upeneus parvus* (Perciformes: Mullidae) (12 necropsied individuals) from the coastal zone of the State of Rio de Janeiro, Brazil (22°55'S, 43°12'W) (type locality); and one dissected paratype ♀ (MNRJ- 25234) from the pores of the cephalic sensory system of *U. parvus* (three necropsied individuals) from the coastal zone of the State of Espírito Santo, Brazil (20°19'S, 40°20'W). Four female specimens were used for scanning electron microscopy.

Description of female. Body elongate (Fig. 1A), 2.42 mm (2.01–2.95 mm; n = 10) long; all body processes spindly (Fig. 2A–E). Pre-oral area of cephalosome with three anterior cephalic processes (Figs. 1A, 2A); paired lateral processes forked apically, with rounded tips, length 209 µm (158–269 µm); midventral process simple, spinulose, with rounded tip, length 111 µm (96–148 µm), representing 53.1% (55.1–60.1%) of lateral ones. Cephalosome trapezium-like (Fig. 1A), longer than wide, length 328 µm (275–394 µm), width 229 µm (192–290 µm). First to fourth pedigerous somites fused, forming octagonal to ovoid thoracic region; length 759 µm (598–898 µm), representing about 30% of total body length; width 495 µm (335–629 µm), excluding thoracic processes. Prosomal region with two pairs of apically forked thoracic processes arising from dorsolateral surfaces (Figs. 1A, 2D); both pairs similar in size, with first pair measuring 237 µm (196–305 µm) and second pair 253 µm (198–310 µm). First to four pairs of legs located on ventro-lateral surface of fused somites. Fifth pedigerous somite longer than wide, and separated from preceding fused somites by slight constriction; length 302 µm (268–329 µm), width 253 µm (194–320 µm). Genital somite ovoid, length 183 µm (113–220 µm), width 203 µm (144–288 µm), with pair of lateral processes (Fig. 2E), length 196 µm (138–275 µm). Abdomen four-segmented, first three abdominal somites longer than wide, measuring 216 µm (158–258 µm) × 183 µm (143–237 µm), 193 µm (141–230 µm) × 164 µm (130–205 µm), 188 µm (141–235 µm) × 148 µm (120–190 µm), respectively. Last abdominal somite shorter, length 90 µm (75–112 µm) long. Caudal rami forked and fused to last abdominal somite, with one proximolateral seta (Fig. 1I).

Antennule (Fig. 1B) apparently four-segmented, with armature formula 4, 4, 3 and 7 + 1 aesthetasc; all setae naked. Buccal area forming tube-like capsule covered anteriorly by modified antennae and bordered posteriorly by simple and undivided labium (Fig. 1C). Labrum not seen. Maxillule (Fig. 1C) minute, 1-segmented, located mid-

laterally in buccal area and bearing two apical spines. Maxilla (Fig. 3C) robust, two-segmented; basal segment large, bearing one semicircular row of spinules and distolateral spinulated element; distal segment short, ornamented with spinules along distal margin. Maxilliped (Fig. 1C) with basal segment and one distal spine.

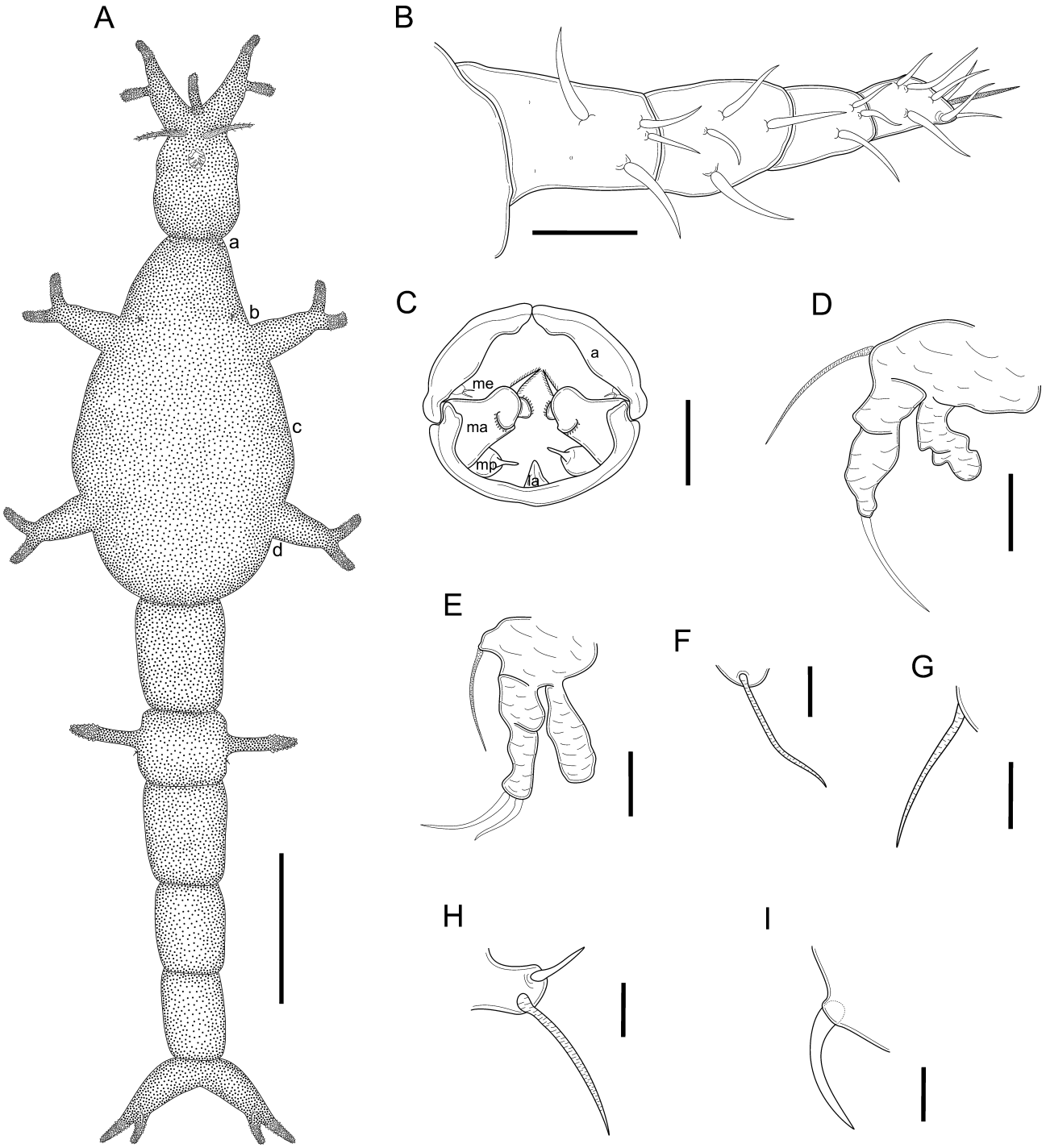

FIGURE 1. *Colobomatus kimi* **sp. nov.** (female, ventral view). A**,** habitus and position of legs on the fused pedigerous somites: leg 1 (a), leg 2 (b), leg 3 (c) and leg 4 (d); B, antennule; C, buccal area, showing position of antenna (a), maxillule (me), maxilla (ma), maxilliped (mp) and labium (la); D, leg 1; E, leg 2; F, leg 3; G, leg 4; H, leg 6; I, proximolateral seta of caudal rami. Scale bars: A = 300µm; B–C = 20µm; D–G and I= 10µm; H = 5µm.

Legs 1–2 inserted in rugose area. Leg 1 (Fig. 1D) biramous, located immediately posterior to junction of cephalosome and fused somites; protopod with one irregularly annulated lateral seta; endopod vestigial, unsegmented and unarmed; exopod indistinctly 2-segmented, armed with one distal seta. Leg 2 (Fig. 1E) biramous, located below the anterior leg, in the second part of the fused somites; protopod with one irregularly annulated lateral seta; endopod vestigial, unsegmented and unarmed; exopod indistinctly 2-segmented, armed with two distal

setae. Leg 3 (Fig. 1F), located in the third part of the fused somites, and reduced to one irregularly annulated seta. Leg 4 (Fig. 1G), located in the last part of the fused somites, and reduced to single seta. Leg 5 absent. Leg 6 (Fig. 1H) located near genital apertures, represented by one irregularly annulated seta and one minute seta.

Male. Unknown.

Etymology. The new species is named in honour of Prof. Il-Hoi Kim from the Republic of Korea, for his contribution to our knowledge of symbiotic copepods.

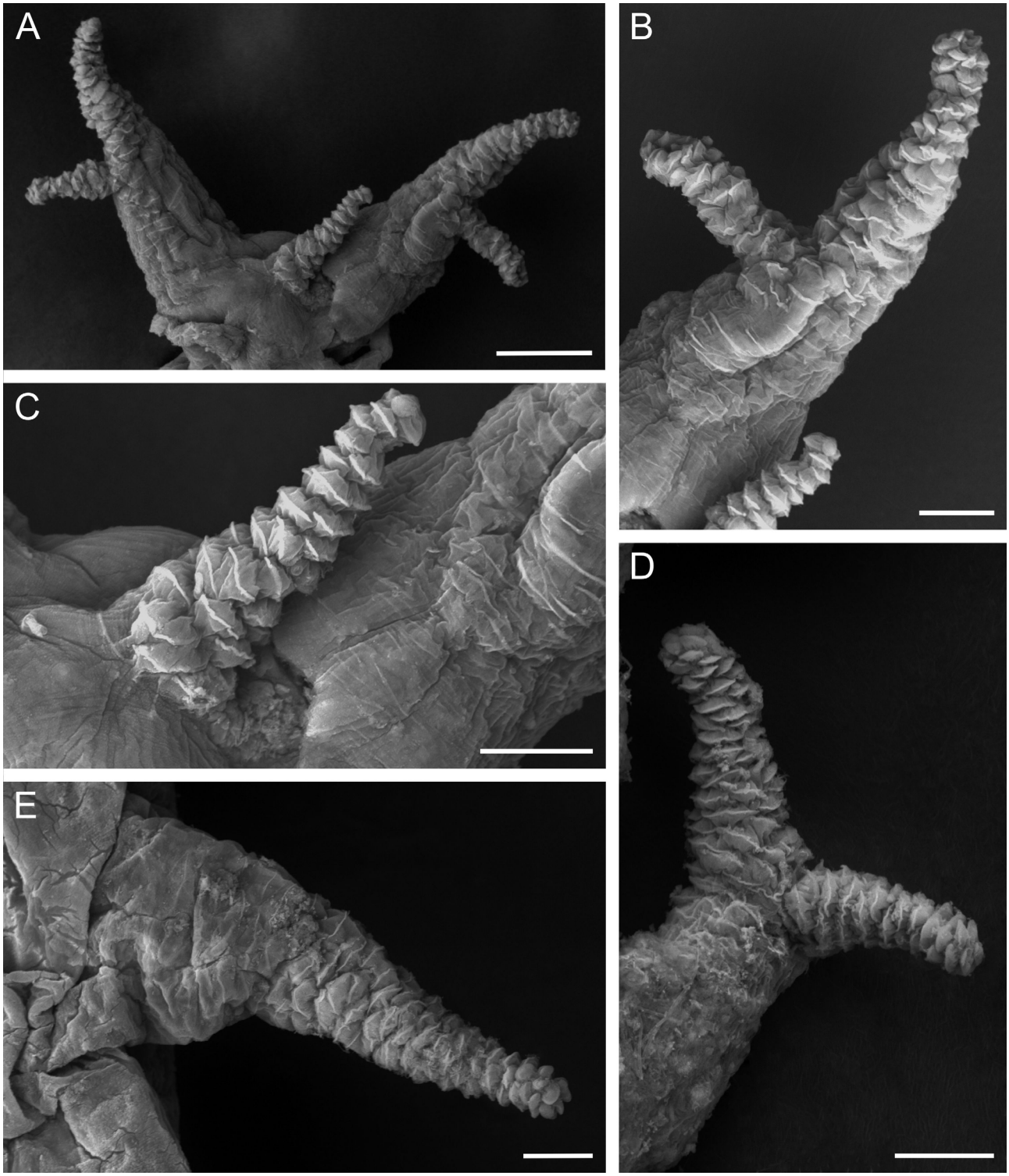

FIGURE 2. *Colobomatus kimi* **sp. nov.** (female, ventral view). A, cephalic processes; B, detail of lateral cephalic process; C, detail of midventral cephalic process; D, detail of thoracic process; E, detail of genital process. Scale bars: A = 50μm; B–E = 20μm.

Discussion

The genus *Colobomatus* is the most speciose one in the family Philichthyidae, currently encompassing 71 valid species (Walter & Boxshall 2015). The majority of the species utilize a wide range of perciform teleosts, but some species are also associated with Anguilliformes, Myctophiformes, Characiformes, Beloniformes, Scorpaeniformes and lamniform elasmobranchs (Table 1) (Grabda & Linkowski 1978; West 1992; Madinabeitia *et al.* 2013; Walter & Boxshall 2015). Although members of this genus are highly modified, they can readily be characterized by the following combination of characters: (a) body elongate, comprising cephalosome, fused thoracic somites, abdomen and caudal rami, (b) the presence of at least two pairs of divergent lateral processes in the thoracic region, arranged in the shape of the letter 'X', and (c) leg 4 being reduced to a single seta or completely absent (West 1992; Boxshall & Halsey 2004; Pereira *et al.* 2012).

According to Grabda & Linkowski (1978) and Grabda (1991) *Colobomatus* species display a very narrow host specificity, typically utilizing a single host species, or rarely two. Other authors have suggested that the evidence is perhaps now sufficient to conclude that many or most species are specific to host families or genera (Hayward 1996) or even suborders (Castro Romero & Muñoz 2011), rather than to single host species (Table 1). These levels of specificity might be associated with the spatial overlap of host populations displaying a similar anatomy of the attachment site (subcutaneous spaces) (West 1992; Hayward 1996).

There are no previous records of *Colobomatus* species associated with members of the genus *Upeneus*, however, four species of this genus have been reported to be associated with mullid fishes, *i.e.*, *C. mulli* Essafi, Raibaut & Boudaoud-Krissat, 1983 and *C. steenstrupi* (Richardi, 1876) from two species of *Mullus* (*M. barbatus* Linnaeus and *M. surmuletus* Linnaeus) in the western Mediterranean (Essafi *et al.* 1983), *C. pupa* Izawa, 1974 from three species of *Parupeneus* (*P. spilurus* (Bleeker), *P. ciliatus* (Lacépède) and *P. multifasciatus* (Quoy & Gaimard)) off the Ryukyu Islands, Japan (Madinabeitia *et al.* 2013), and *C. sudatlanticus* from *Mullus argentinae* along the eastern coast of South America (Pereira *et al.* 2012).

The presence of one midventral simple cephalic process and two lateral cephalic processes in *C. kimi* **sp. nov.** is shared by another 18 species of *Colobomatus* (Table 2). Among these congeners, the new species resembles *C. mulli* and *C. steenstrupi* by the shared presence of lateral cephalic processes that are apically forked and end in rounded tips, but differs by the forked caudal rami which are simple in the other two species (Essafi *et al.* 1983). Furthermore *C. mulli* and *C. steenstrupi* are readily distinguished from the new species by the midventral cephalic process being larger than or similar in length to, the lateral cephalic processes, respectively, while in the new species it is shorter (Essafi *et al.* 1983; Pereira *et al.* 2012).

Another species of *Colobomatus* that displays apically forked lateral cephalic processes with rounded tips is *C. sieboldi* (Richiardi, 1877). According to Essafi *et al.* (1983) information on the presence of the midventral cephalic process in this species is lacking, leading some authors to consider that it belongs to the group displaying paired processes on the cephalosome (Kim & Moon 2013). However, the absence of paired genital processes in *C. sieboldi* separates this species from the other species that share the apically forked lateral cephalic processes with rounded tips, including *C. kimi* **sp. nov.** (Yamaguti 1963; Essafi *et al.* 1983).

Species of the family Philichthyidae are readily recognizable by the number and form of body processes in the female (Kim & Moon 2013). Nevertheless some descriptions of *Colobomatus* species are incomplete, missing important details such as the arrangement of the legs, the number of segments in the antennule, size of somites and the buccal area (Boxshall & Halsey 2004; Paschoal *et al.* 2016). Records of philichthyid copepods from the Neotropics are scarce, *i.e.* of 72 known species of *Colobomatus* (including *C. kimi* **sp. nov.**), only four have been reported from the Atlantic seaboard of South America (Paschoal *et al.* 2016). One of the reasons for the understimated diversity of *Colobomatus* could be their sites of infestation (subcutaneous spaces, sensory canals and lateral line) which are usually not examined during fish dissections (West 1992). According to Madinabeitia & Iwasaki (2013), this family remains a poorly understood group of parasitic copepods and might be more abundant than previously thought. It is conceivable that future studies will reveal the real diversity of this group in the Neotropical Region, providing new insights in its morphological diversity and its host specificity which, at least in mullid fish hosts, appears to be restricted to genus level.

TABLE 1. Host specificity and biogeographic marine realm (Spalding *et al*. 2007) of the species of *Colobomatus*.

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. absens Madinabeitia, Tang & Nagasawa, 2013	Caesionidae	Species	Central Indo-Pacific	Madinabeitia *et al.* (2013), Madinabeitia & Iwasaki (2013)
C. acanthuri Madinabeitia, Tang & Nagasawa, 2013	Acanthuridae	Species	Central Indo-Pacific	Madinabeitia *et al.* (2013), Madinabeitia & Iwasaki (2013)
C. agassizi (Richiardi, 1877)	Sparidae	Species	Temperate Northern Atlantic	Richiardi (1877b), Essafi *et al*. (1984), Raibaut *et al*. (1998)
C. arabicus Hayward, 1996	Sillaginidae	Genus	Western Indo-Pacific	Hayward (1996)
C. asiaticus Hayward, 1996	Sillaginidae	Genus	Central Indo-Pacific; Western Indo-Pacific	Hayward (1996)
C. baraldii (Richiardi, 1877)	Sparidae	Species	Temperate Northern Atlantic	Delamare-Deboutteville (1962), Raibaut *et al*. (1998)
C. belizensis Cressey & Schotte, 1983	Haemulidae	Family	Temperate Northern Atlantic; Tropical Atlantic; Temperate South America	Cressey & Schotte (1983), Luque & Tavares (2007), Paschoal *et al*. (2015)
C. benazzii Delamare Deboutteville & Nunes, 1952	Sparidae	Species	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952), Raibaut *et al*. (1998)
C. bergyltae Hesse, 1873	Labridae	Species	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. canthari Delamare Deboutteville & Nunes, 1952	Sparidae	Species	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952), Raibaut *et al.* (1998)
C. caribbei Cressey & Schotte, 1983	Haemulidae	Species	Tropical Atlantic	Cressey & Schotte (1983), Paschoal *et al.* (2015)
C. charleah Hayward, 1996	Sillaginidae	Family	Temperate Australasia	Hayward (1996), Hayward (1997)
C. collettei Cressey, 1977	Hemiramphidae	Genus	Tropical Northern Pacific	Cressey (1977), Madinabeitia *et al.* (2013)
C. creeveyae West, 1992	Carangidae	Species	Temperate Australasia	West (1992)
C. cresseyi West, 1992	Hemiramphidae	Family	Central Indo-Pacific; Temperate Australasia	West (1992)
C. cribbi West, 1992	Nemipteridae	Species	Central Indo-Pacific	West (1992)
C. deltotus West, 1985	Mugilidae	Family	Central Indo-Pacific	West (1985)
C. denticis (Richiardi, 1877)	Sparidae	Species	Temperate Northern Atlantic	Richiardi (1877a), Essafi *et al.* (1984), Raibaut *et al.* (1998)
C. doderleini (Richiardi, 1883)	Labridae	Genus	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952), Raibaut *et al.* (1998)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. edwardsi (Richiardi, 1876)	Serranidae	Genus	Temperate Northern Atlantic	Richiardi (1876b), Essafi *et al.* (1984), Raibaut *et al.* (1998)
C. embiotocae Noble, Collard & Wilkes, 1969	Embiotocidae	Family	Temperate Northern Pacific; Tropical Eastern Pacific	Noble *et al.* (1969), Arai *et al.* (1988)
C. exilis Izawa, 1974	Anthiinae	Species	Temperate Northern Pacific	Izawa (1974)
C. fiatolae (Richiardi, 1880)	Stromateidae	Species	Temperate Northern Atlantic	Richiardi (1880), Delamare Deboutteville & Nunes-Ruivo (1952), Raibaut *et al.* (1998)
C. floridus Kim & Moon, 2013	Hapalogenyidae	Species	Temperate Northern Pacific	Kim & Moon (2013)
C. fulloonae Hayward, 1996	Sillaginidae	Genus	Central Indo-Pacific; Temperate Australasia	Hayward (1996)
C. fusiformis Izawa, 1974	Chaetodontidae	Species	Central Indo-Pacific	Izawa (1974)
C. gietzelae West, 1992	Gerreidae	Species	Central Indo-Pacific	West (1992)
C. goodingi Cressey & Collette, 1970	Belonidae	Family	Tropical Atlantic; Central Indo-Pacific; Tropical Eastern Pacific; Temperate Northern Atlantic; Temperate Southern Africa; Western Indo-Pacific; Eastern Indo-Pacific	Cressey & Collette (1970)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. grubeii (Richiardi, 1877)	Sparidae	Genus	Temperate Northern Atlantic	Essafi *et al*. (1982), Raibaut *et al*. (1998)
C. gymnocranii Madinabeitia, Tang & Nagasawa, 2013	Lethrinidae	Species	Central Indo-Pacific	Madinabeitia *et al*. (2013)
C. gymnoscopeli Grabda & Linkowski, 1978	Myctophidae	Species	Southern Ocean	Grabda & Linkowski (1978)
C. haeckeli (Richiardi, 1877)	Bramidae	Species	Temperate Northern Atlantic	Richiardi (1877b), Delamare-Deboutteville (1962), Raibaut *et al*. (1998)
C. hispidus West, 1992	Haemulidae	Species	Central Indo-Pacific	West (1992)
C. icopaius West, 1989	Lethrinidae	Species	Central Indo-Pacific	West (1989)
C. kimi **sp. nov.**	Mullidae	Species	Tropical Atlantic	This study
C. labracis Delamare Deboutteville & Nunes, 1952	Moronidae	Species	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952), Raibaut *et al*. (1979), Raibaut *et al*. (1998)
C. lamnae Hesse, 1873	Lamnidae	Species	Temperate Northern Atlantic	Hesse (1873), Delamare-Deboutteville (1962)
C. lesteri West, 1992	Gerreidae	Species	Temperate Australasia	West (1992)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. lichiae (Richiardi, 1877)	Carangidae	Genus	Temperate Northern Atlantic	Richiardi (1877a), Delamare-Deboutteville (1962), Raibaut *et al.* (1998)
C. mackayi West, 1992	Haemulidae	Species	Western Indo-Pacific	West (1992)
C. minimus (Richiardi, 1877)	Serranidae	Species	Temperate Northern Atlantic	Richiardi (1877b), Delamare-Deboutteville (1962), Raibaut *et al.* (1998)
C. miniprocessus Castro Romero & Muñoz, 2011	Haemulidae	Species	Temperate South America	Castro Romero & Muñoz (2011)
C. mugilis Raibaut, Caillet & Ben Hassine, 1978	Mugilidae	Family	Temperate Northern Atlantic	Raibaut *et al.* (1978), Raibaut *et al.* (1998), Dzikowski *et al.* (2003)
C. mulli Essafi, Raibaut & Boudaoud-Krissat, 1983	Mullidae	Genus	Temperate Northern Atlantic	Essafi *et al.* (1983), Raibaut *et al.* (1998)
C. muraenae (Richiardi, 1877	Muraenidae	Species	Temperate Northern Atlantic	Richiardi (1877b), Delamare-Deboutteville (1962), Raibaut *et al.* (1998)
C. mylionus Fukui, 1965	Sparidae	Family	Temperate Northern Pacific; Temperate Australasia; Central Indo-Pacific	Byrnes & Cressey (1986), West (1992), Roubal (1990)
C. nanus West, 1992	Terapontidae	Species	Temperate Australasia	West (1992)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. oblatae Delamare Deboutteville & Nunes, 1952	Sparidae	Family	Temperate Northern Atlantic	Delamare Deboutteville & Nunes-Ruivo (1952), Essafi *et al*. (1984), Raibaut *et al*. (1998)
C. orientalis Kim & Moon, 2013	Sciaenidae	Species	Temperate Northern Pacific	Kim & Moon (2013)
C. ornatus West, 1992	Nemipteridae	Species	Central Indo-Pacific	West (1992)
C. pagelli (Richiardi, 1877)	Sparidae	Family	Temperate Northern Atlantic	Richiardi (1877a), Essafi *et al*. (1984), Raibaut *et al*. (1998)
C. pagri (Richiardi, 1877)	Sparidae	Family	Temperate Northern Atlantic	Richiardi (1877a), Essafi *et al*. (1984), Raibaut *et al*. (1998)
C. pteroisi Madinabeitia, Tang & Nagasawa, 2013	Scorpaenidae	Species	Central Indo-Pacific	Madinabeitia *et al.* (2013)
C. pupa Izawa, 1974	Mullidae	Genus	Central Indo-Pacific; Temperate Northern Pacific	Izawa (1974), Madinabeitia *et al.* (2013)
C. quadrifarius Cressey & Schotte, 1983	Haemulidae	Family	Temperate Northern Pacific; Tropical Eastern Pacific	Cressey & Schotte (1983), Paschoal *et al*. (2015)
C. recticaudatus Kim & Moon, 2013	Labridae	Species	Temperate Northern Pacific	Kim & Moon (2013)
C. richiardii (Valle, 1881)	Sparidae	Species	Temperate Northern Atlantic	Delamare-Deboutteville (1962), Raibaut *et al*. (1998)
C. rothae West, 1992	Platycephalidae	Species	Temperate Australasia	West (1992)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. sciaenae (Richiardi, 1876)	Sciaenidae	Family	Temperate Northern Atlantic	Richiardi (1876a), Delamare-Deboutteville (1962), Raibaut *et al.* (1998)
C. sewelli West, 1992	Polynemidae	Species	Temperate Australasia	West (1992)
C. sieboldi (Richiardi, 1877)	Sparidae	Species	Temperate Northern Atlantic	Richiardi (1877b), Delamare-Deboutteville (1962), Raibaut *et al.* (1998)
C. sillaginis West, 1983	Sillaginidae	Family	Central Indo-Pacific; Western Indo-Pacific; Temperate Australasia	West (1983), Hayward (1996)
C. similis Kim, 1995	Embiotocidae	Species	Temperate Northern Pacific	Kim (1995)
C. sparsi Essafi, 1982	Sparidae	Species	Temperate Northern Atlantic	Essafi (1982), Raibaut *et al.* (1998)
C. springeri Cressey, 1977	Labrisomidae	Species	Temperate Northern Pacific	Cressey (1977)
C. steenstrupi (Richiardi, 1876)	Mullidae	Genus	Temperate Northern Atlantic	Richiardi (1876b), Essafi *et al.* (1983), Raibaut *et al.* (1998)
C. stelliferi Pombo, Turra, Paschoal & Luque, 2015	Sciaenidae	Genus	Temperate South America	Pombo *et al.* (2015)

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TABLE 1. (Continued)

Species	Host Family	Host specificity (levels)	Marine realm	Reference
C. sudatlanticus Pereira, Timi, Lanfranchi & Luque, 2012	Mullidae	Species	Temperate South America; Tropical Atlantic	Pereira *et al.* (2012), Luque *et al.* (2014)
C. tenuis Castro Romero & Muñoz, 2011	Blenniidae, Labrisomidae	Suborder	Temperate South America	Castro Romero & Muñoz (2011)
C. unimanus Kim & Moon, 2013	Labridae	Species	Temperate Northern Pacific	Kim & Moon (2013)
C. vallei Essafi, Cabral & Raibaut, 1984	Sparidae	Species	Temperate Northern Atlantic	Essafi *et al.* (1984), Raibaut *et al*. (1998)
C. westi Hayward, 1996	Sillaginidae	Genus	Central Indo-Pacific; Temperate Northern Pacific	Hayward (1996)

TABLE 2. Characteristics of the midventral and lateral cephalic processes in species of *Colobomatus*.

Species	Midventral cephalic process	Lateral cephalic processes	Reference
C. baraldii	simple, sharp tip	apically forked, sharp tips	Essafi *et al.* (1983)
C. benazzii	simple, rounded tip	basally forked, sharp tips	Essafi *et al.* (1983)
C. canthari	simple, minute, sharp tip	simple, sharp tips	Essafi *et al.* (1983)
C. charleah	simple, minute, rounded tip	simple, rounded tips	Hayward (1996)
C. denticis	simple, spinulose, sharp tip	apically forked, sharp tips	Essafi *et al.* (1984)
C. fulloonae	simple, short, rounded tip	simple, rounded tips	Hayward (1996)
C. kimi **sp. nov.**	simple, spinulose, rounded tip	apically forked, rounded tips	this study
C. minimus	simple, sharp tip	simple, sharp tips	Essafi *et al.* (1983)
C. mulli	simple, bulged tip	apically forked, rounded tips	Essafi *et al.* (1983)
C. mylionus	simple, sharp tip	simple, sharp tips	Byrnes & Cressey (1986)
C. pagelli	simple, minute, sharp tip	simple, sharp tips	Essafi *et al.* (1983)
C. pagri	simple, spinulose, sharp tip	apically forked, sharp tips	Essafi *et al.* (1984)
C. sciaenae	simple, sharp tip	simple, sharp tips	Essafi *et al.* (1983)
C. sewelli	simple, sharp tip	simple, sharp tips	West (1992)
C. sieboldi	unknown	apically forked, rounded tips	Essafi *et al.* (1983)
C. similis	simple, spinulose, rounded tip	simple, rounded tips	Kim (1995)
C. steenstrupi	simple, bulged tip	apically forked, rounded tips	Essafi *et al.* (1983)
C. sudatlanticus	simple, spinulose, rounded tip	simple, rounded tips	Pereira *et al.* (2012)
C. tenuis	simple, rounded tips	simple, rounded tips	Castro Romero & Muñoz (2011)

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