

# Three new records of copepods (Siphonostomatoida) parasitic on marine fishes of Iraq, including the relegation of two species of *Lernanthropinus* to *Lernanthropinus temminckii* (von Nordmann, 1864)

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## Abstract

Three parasitic copepods (Siphonostomatoida) belonging to three different genera were recovered from marine fishes of Iraq, and are listed here as new records. The sea lice *Caligus epinepheli* Yamaguti, 1936 (Caligidae) was collected from the Japanese threadfin bream, *Nemipterus japonicus* (Bloch). It had been frequently reported from teleost fishes around the world. The second record, comprising male and female, was another caligid, rarely caught from fishes – *Hermilius longicornis* Bassett-Smith, 1898, collected from the giant catfish, *Netuma thalassina* (Rüppell). This paper features the first description of the male of the latter species. The third record was the lernanthropid, *Lernanthropinus temminckii* (von Nordmann, 1864) (Lernanthropidae), redescribed based on the specimens collected from the greater lizard fish, *Saurida tumbil* (Bloch) (Synodontidae). In order to clarify its taxonomic status, our specimen was compared with the holotype of *L. gibbosus* (Pillai, 1964) from the collections of Zoological Survey of India, Kolkata, and the syntypes of *L. sauridae* Do in Ho and Do, 1985 and *L. temminckii* from the collections of the Smithsonian Institution, Washington D.C. We found similarities in the morphology of the body, mouthparts, and legs 1–4 in three above-mentioned species. The prominent feature, the setation pattern of legs 1 and 2 was similar in all the female specimens examined. In the light of this, we formally relegate *L. gibbosus* and *L. sauridae* to synonymy with *L. temminckii*. Another important similarity is that *Lernanthropinus gibbosus*, *L. sauridae*, and *L. temminckii* have exclusively been parasitic on lizardfishes (Synodontidae). The attachment site of all three copepods reported from Iraq were the gill filaments.

## Keywords

fish, wild, parasite, copepod, caligid, lernanthropid, Asia, middle-east, Iraq

## Introduction

Parasitic copepods are common on cultured and wild marine fishes (Ho and Lin 2004; Johnson *et al.* 2004) and freshwater as well (Piasecki *et al.* 2004). However, some copepods like caligids, lernaepodids, hatschekids, and lernanthropids are dominant among the parasitic copepods of fishes (Boxshall and Halsey 2004; Ho and Lin 2004; Johnson *et al.* 2004; Moon and Kim 2013). In Asia, parasitic copepods are well studied in several countries such as Japan, Taiwan,

India, and Korea (Pillai 1985; Kim 1998; Ho and Lin 2004; Venmathi Maran *et al.* 2009; Moon and Kim 2012, 2013), but only a limited number of parasitic copepods was described or recorded from the middle east countries like Kuwait and Egypt (Ho and Sey 1996; Ho and Kim 2000; Boxshall and El-Rashidy 2009; El-Rashidy and Boxshall 2010). In this study, three parasitic copepods belonging to three different genera including two species from the family Caligidae Burmeister, 1835 and one from the Lernanthropidae Kabata, 1979 are reported. The genus *Caligus* Müller,

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1785 is one of the major genera of the Caligidae parasitic on teleost fishes around the world. There are currently more than 250 valid species of *Caligus* (Dojiri and Ho 2013), in contrast, *Hermilius* Heller, 1865, another genus from the same family has so far been reported with just 8 species (Boxshall and Halsey 2004; Dojiri and Ho 2013). In this study, we report a species from both *Caligus* and *Hermilius* and the male of latter species is also described.

The Lernanthropidae is a large family that comprises more than 150 species that are exclusively parasitic on gill filaments of marine teleosts using their prehensile antennae and maxillipeds (Boxshall and Halsey 2004). In female, leg 3 is modified as large, folded lamellae for clinging to the gill filaments (Ho *et al.* 2011). The genus *Lernanthropinus* Do in Ho et Do 1985 (Lernanthropidae) was adopted based on two lateral plates (Ho and Do 1985). Following this feature, eight species of *Lernanthropus* de Blainville, 1822 were transferred to *Lernanthropinus* (see Ho and Do 1985; Ho *et al.* 2008, 2011) including the one here, we report and redescribe as *Lernanthropinus temminckii* (von Nordmann, 1864). In this study, we relegate two other species of *Lernanthropinus* collected from the same host of India and Japan to *L. temminckii* (Pillai 1964, 1985; Cressey and Cressey 1979; Ho and Do 1985), which reduces the number of valid species of *Lernanthropinus* to six.

In the presently reported study from Iraq, three parasitic copepods were recovered from three different marine fish hosts such as the Japanese threadfin bream, *Nemipterus japonicus* (Bloch, 1791) (Perciformes: Nemipteridae); the giant catfish *Netuma thalassina* (Rüppell, 1837) (Siluriformes: Ariidae); and the greater lizard fish, *Saurida tumbil* (Bloch, 1795) (Aulopiformes: Synodontidae). This is also the first report of occurrence on these three parasitic copepods from Iraq.

## Materials and Methods

Copepod specimens were carefully removed from the gills of the host fish collected from the fishing port of Al-Faw City, Basrah Province, Iraq (29°46'N; 48°49'E) using fine forceps and observed under a dissecting microscope. The collected copepods were preserved in 70% ethanol. Preserved copepods were cleared in a drop of 85% lactic acid or lactophenol prior to examination using an Olympus BX51 differential phase contrast microscope. Selected specimens were measured intact using an ocular micrometer and/or dissected and examined according to the wooden slide procedure (Humes and Gooding 1964). Measurements given in millimeter (mm) are in the range followed by the mean in parentheses. Specimens from collections of Zoological Survey of India (ZSI), Kolkata, and United States National Museum for Natural History (USNMNH), Smithsonian Institution, Washington D.C., USA were also studied for the comparisons. Morphological terminology follows Ho and Lin (2004) and

Huys and Boxshall (1991) and fish names conform to Fish-Base (Froese and Pauly 2013). Voucher specimens are deposited at the National Institute of Biological Resources (NIBR), Incheon, Korea.

## Results and Discussion

Order Siphonostomatoida Thorell, 1859  
 Family Caligidae Burmeister, 1835  
 Genus *Caligus* Müller, 1785  
*Caligus epinepheli* Yamaguti, 1936  
 (Fig. 1A)

*Caligus epinepheli* Yamaguti, 1936: 4; Shiino 1952: 80; Yamaguti 1963: 53; Kirtisinghe 1964: 57; Kabata 1965: 112; Leong 1984: 166; Pillai 1985: 287; Ho and Sey 1996: 64; Ho *et al.* 2000: 164; Ho and Lin 2004: 175; Boxshall and El-Rashidy 2009: 26.

*Caligus annularis* Yamaguti, 1954: 375  
*C. chiloscyllii* Pillai, 1967: 1556.  
*C. cossackii* Rangnekar et Murti, 1959: 78.  
*C. minutus* Pillai, 1963: 655.  
*C. paxillifer* Yamaguti, 1954: 375  
*C. sciaenae* Gnanamuthu, 1947: 43

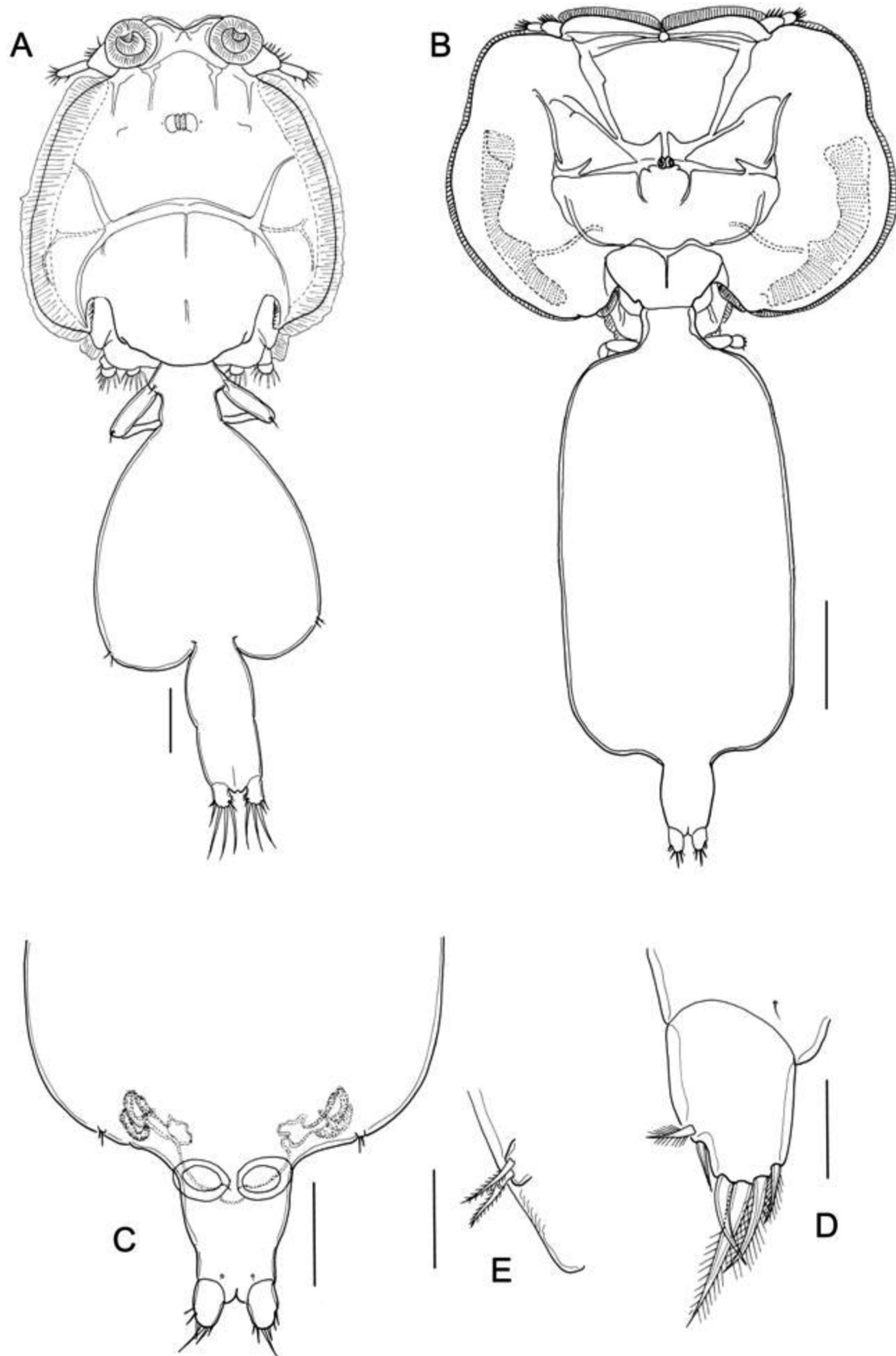
**Material examined.** 5♀♀ (NIBRIV0000276263) from gill filaments of Japanese threadfin bream, *Nemipterus japonicus* (Bloch); Fishing Port, Al-Faw City, Basrah Province, Iraq, 4 June 2011.

**Systematic accounts of adult female.** Body (Fig. 1A) 2.58 (2.38–2.91,  $n = 5$ ) mm long, excluding setae on caudal rami. Cephalothoracic shield 1.16 (1.06–1.26) mm long and 1.13 (1.01–1.25) mm wide, excluding lateral hyaline membranes. Genital complex 0.89 (0.86–0.92) mm long and 0.83 (0.80–0.86) mm wide. Abdomen longer than wide, 0.41 (0.39–0.43) × 0.26 (0.24–0.28) mm. Caudal ramus longer than wide (86 × 68 μm), armed with 3 long and 3 short setae.

	Exopod	Endopod
Leg 1	1-0; III, I, 3	(vestigial)
Leg 2	I-1; I-1; I, II, 5	0-1; 0-2; 6
Leg 3	I-0; 1-1; 7	0-1; 6
Leg 4	I-0; I, III	(missing)

**Male.** Unknown from Iraq (this study) and Taiwan (Ho and Lin 2003), but reported from Japan (Shiino 1952), India (Pillai 1985), and Malaysia (Leong 1984).

**Remarks.** The diagnostic feature of *C. epinepheli* is the absence of three plumose setae, which are commonly found on the posterior margin of the terminal segment of the exopod of leg 1. Although over 250 species of *Caligus* are reported



**Fig.1.** *Caligus epinepheli* Yamaguti, 1936, female. **A** – habitus, dorsal; *Hermilius longicornis* Bassett-Smith, 1898, female. **B** – habitus, dorsal; **C** – abdomen, ventral; **D** – caudal ramus, ventral; **E** – leg 5. Scale bars: A = 200  $\mu$ m, B = 400  $\mu$ m; C, D, E = 50  $\mu$ m

(Dojiri and Ho 2013), this character is shared by 8 of its congeners, i.e., *C. affinis* Heller, 1866; *C. ariocolus* Wilson, 1928; *C. (Subcaligus) bocki* Heegaard, 1943; *C. enormis* Wilson, 1913; *C. lagocephali* Pillai, 1961; *C. mauritanicus* Brian, 1924; *C. mirabilis* Leigh-Sharpe, 1934; and *C. productus* Dana, 1852 (Dojiri and Ho 2013). Some of these species can be easily distinguished from *C. epinepheli* (cf. Ho and Lin 2003; Dojiri and Ho 2013).

**Distribution.** It is widely distributed (Boxshall and El-Rashidy 2009), but predominantly occurs in Asian countries such as Japan (Yamaguti 1936, 1963), India (Pillai 1963; Rangnekar and Murti 1963), Sri Lanka (Kirtisinghe 1964), Malaysia (Leong 1984), Kuwait (Ho and Sey 1996), and Tai-

wan (Ho and Lin 2003). It has also been recorded from Australia (Kabata 1965) and the Caribbean Sea (Cressey 1991).

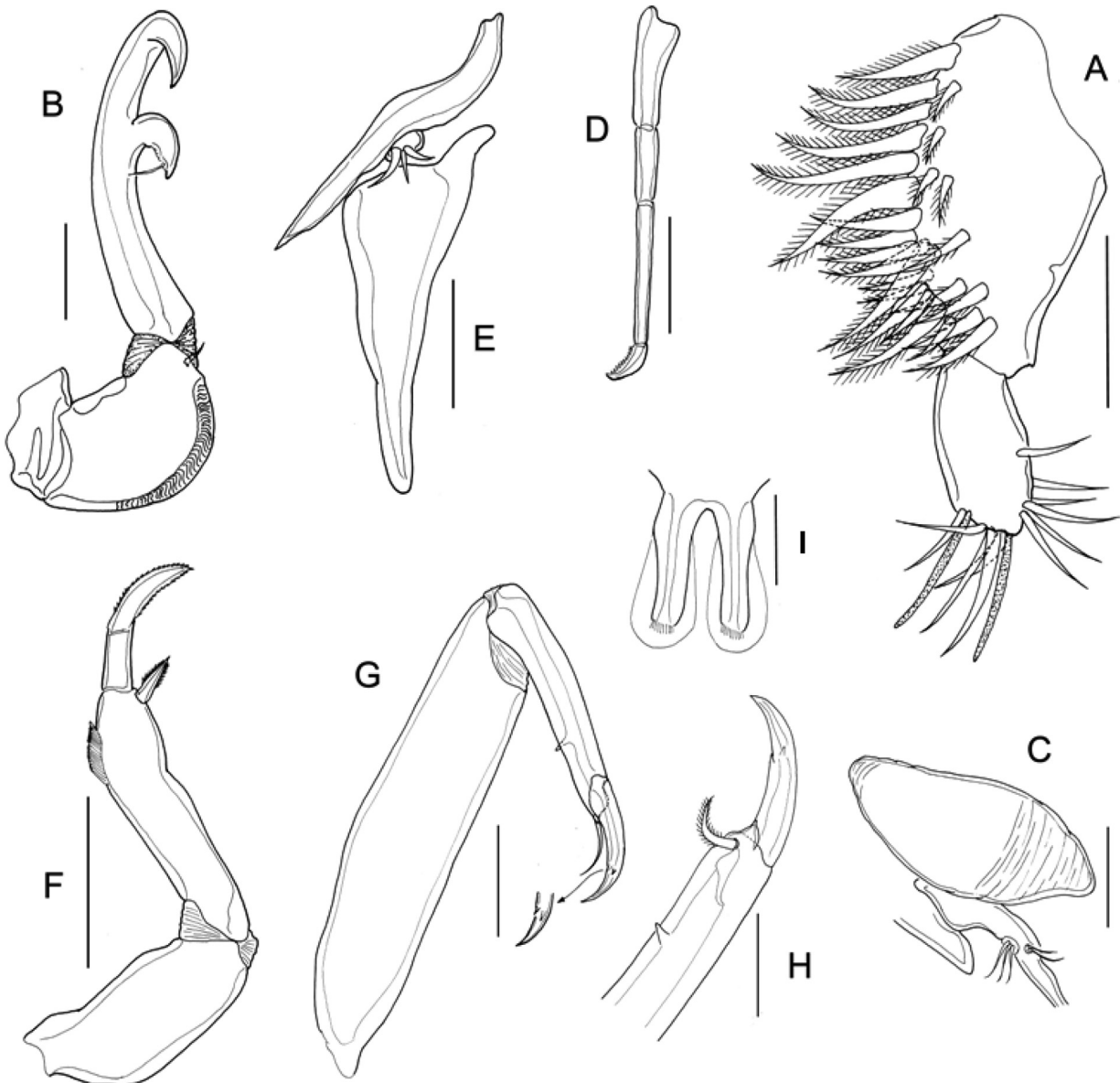
Genus *Hermilius* Heller, 1865

*Hermilius longicornis* Bassett-Smith, 1898

(Figs. 1B-4)

*Hermilius longicornis* Bassett-Smith, 1898: 80; Rangekar 1963: 80; Pillai 1963: 183; Yamaguti 1963: 83; Kirtisinghe 1964: 76; Pillai 1985: 416; Ho and Kim 2000: 86. *H. pyriventris* Pillai, 1961: 123.

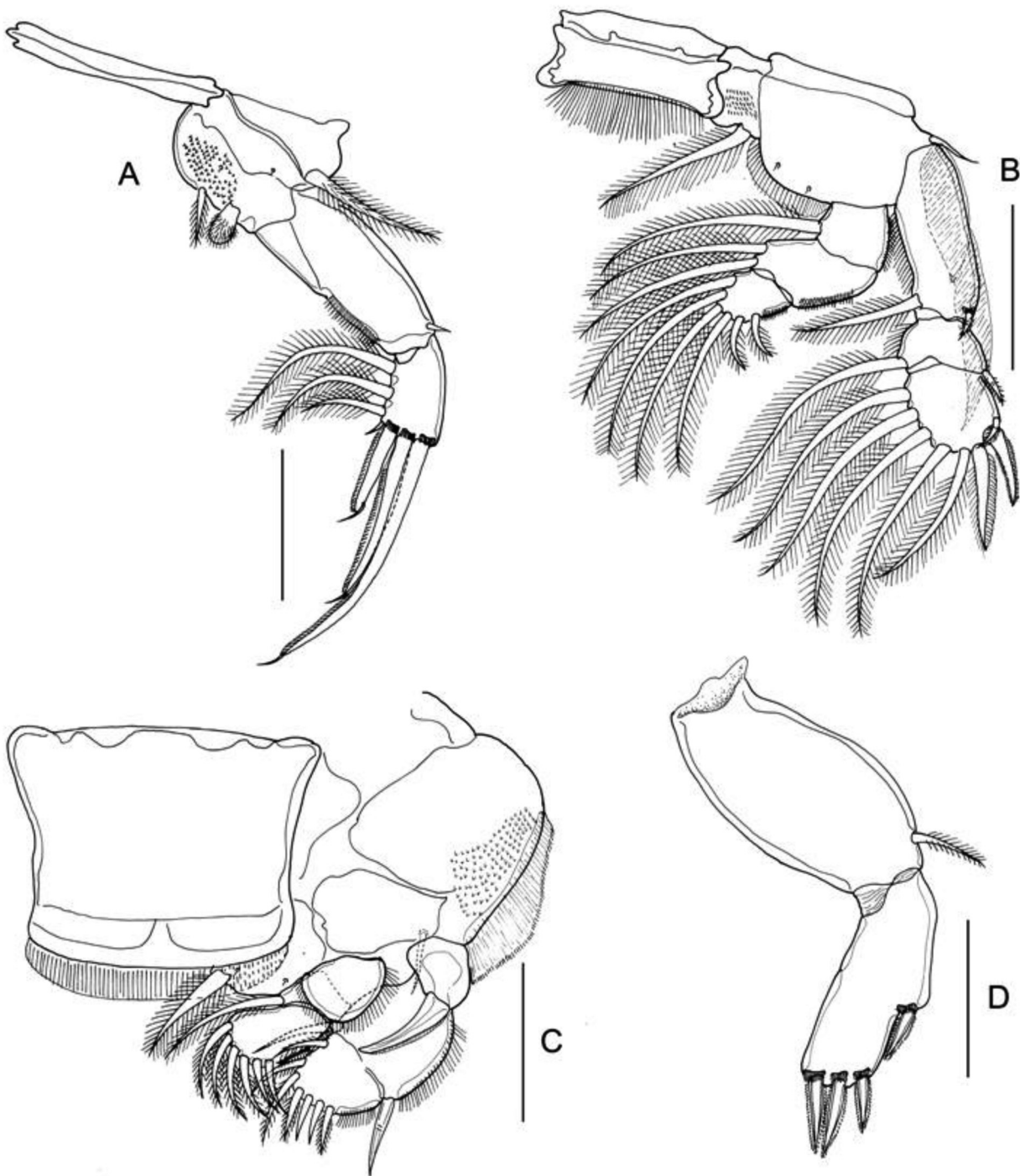
**Material Examined.** 4♀ (NIBRIV0000276264) and 1♂ (NIBRIV0000276265) from gills of giant catfish, *Netuma*



**Fig. 2.** *Hermilius longicornis* Bassett-Smith, 1898, female. A – antennule; B – antenna; C – postantennary process; D – mandible; E – maxillule; F – maxilla; G – maxilliped; H – tip of maxilliped; I – sternal furca. Scale bars: A, C–E, H = 50  $\mu$ m; B, F, G, I = 100  $\mu$ m

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**Fig. 3.** *Hermilius longicornis* Bassett-Smith, 1898, female. **A** – leg 1; **B** – leg 2; **C** – leg 3; **D** – leg 4. Scales bars: A–D = 50  $\mu$ m

*thalassina* (Rüppell), Fishing Port, Al-Faw City, Basrah Province, Iraq, 25 October 2011.

**Adult Female.** Body (Fig. 1B) 3.41 (3.26–3.55,  $n = 4$ ) mm long excluding setae on caudal rami. Cephalothorax  $1.27 \times 1.83$ , wider than long with deep notches anteromedially and folded ventrally; Genital complex large ( $1.75 \times 0.96$ ), longer than wide and longer than cephalothorax, broadened distally

with flat sides, bearing pair of spermatophores (Fig. 1C). Abdomen (Fig. 1C) short ( $260 \times 217 \mu\text{m}$ ), unsegmented, slightly longer than wide. Caudal ramus (Fig. 1D) about 1.5 times ( $96 \times 64 \mu\text{m}$ ) longer than wide armed with 3 long and 3 short plumose setae.

Antennule (Fig. 2A) 2-segmented; proximal segment with 27 setae on anterodistal surface; distal segment with 1 sub-terminal seta on posterior margin and 11 setae plus 2 aes-

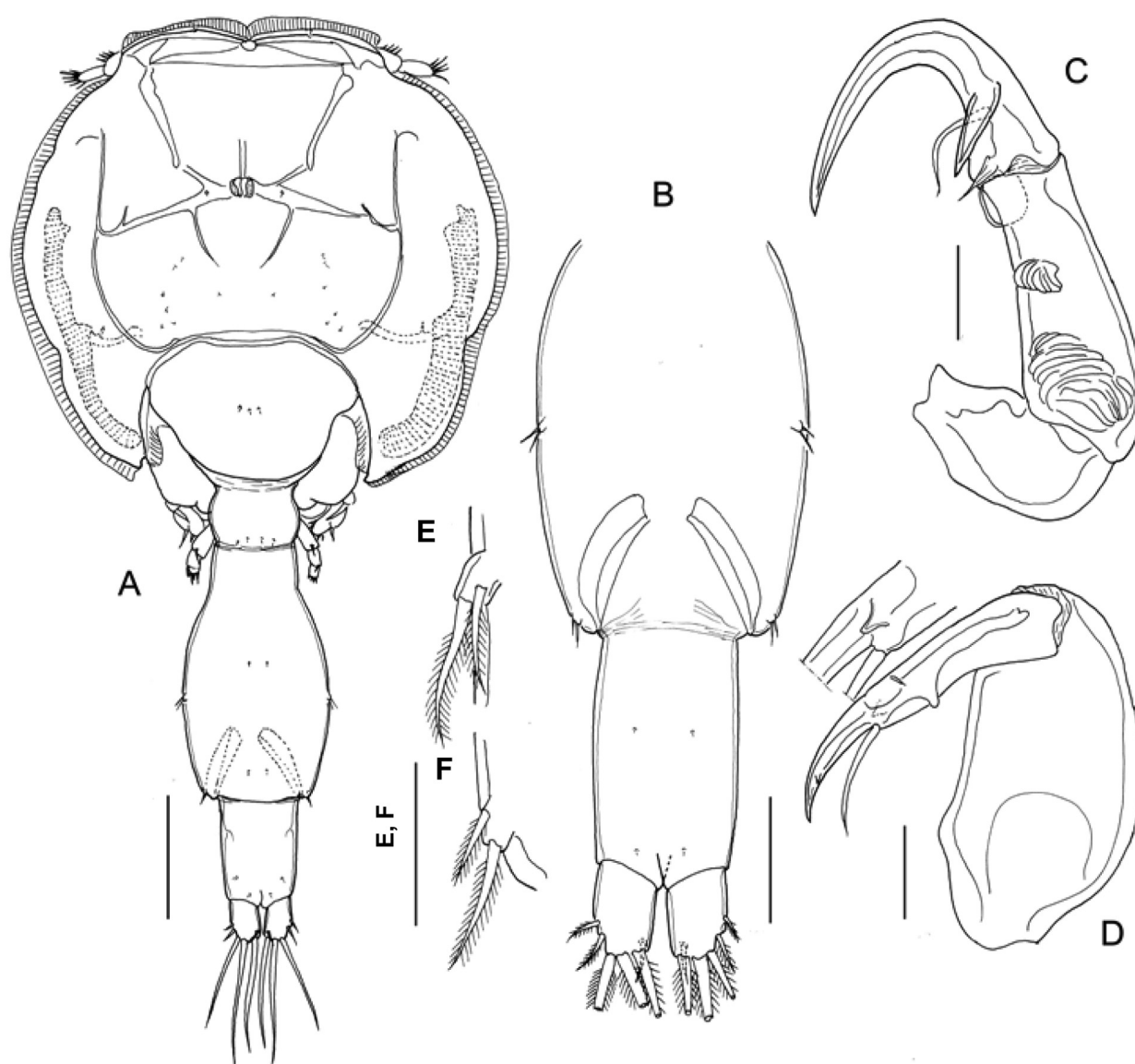
thetasc distally. Antenna (Fig. 2B) 3-segmented; proximal segment smallest; middle segment swollen, with a small distal seta; distal segment a long recurved, sharply pointed, strong claw, sharp auxiliary process in terminal region with 1 subterminal seta. Postantennal process (Fig. 2C) represented by large fleshy lobe. Mandible (Fig. 2D) as typical in *Hermilius* comprised with 12 teeth distally. Maxillule (Fig. 2E) comprising papilla bearing 3 setae, long dentiform process. Maxilla (Fig. 2F) 2-segmented; proximal segment large and unarmed; distal segment slender with subterminal hyaline membrane on outer edge and 2 unequal elements terminally, terminal calamus small armed with spinules on both sides. Maxilliped (Fig. 2G) more than slender, indistinctly 3-segmented; proximal segment largest but unarmed; middle segment small; terminal segment long with sharp claw

terminally bearing basal seta and small subterminal tine (Fig. 2H). Sternal furca (Fig. 2I) broad, tines with broad spatulated membranes.

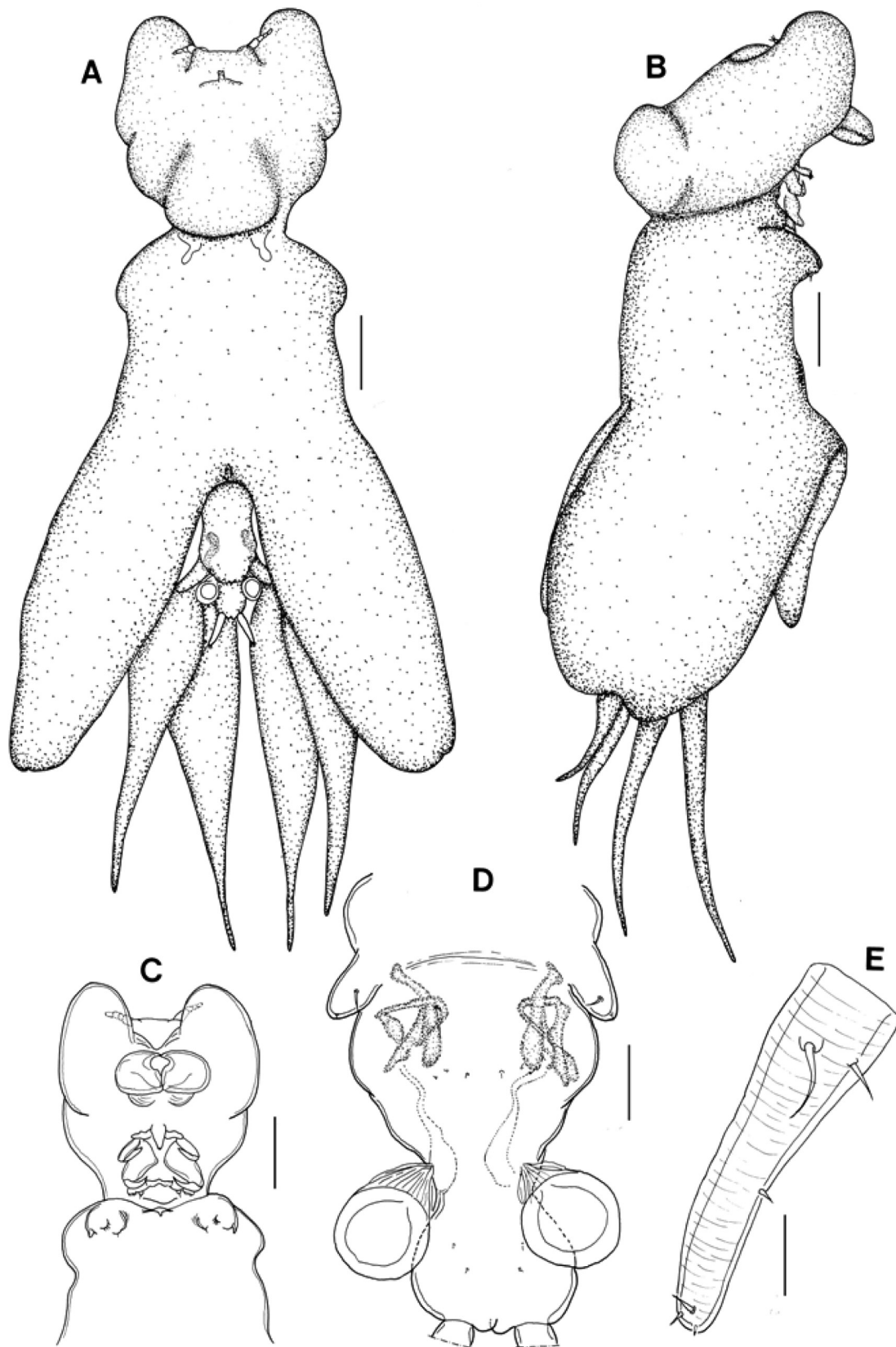
Armature on rami of legs 1–4 as follows (Roman numerals indicating spines and Arabic numerals indicating setae):

	Exopod	Endopod
Leg 1	I-0; III, I, 3	(vestigial)
Leg 2	I-1; I-1; I, II, 5	0-1; 0-2; 6
Leg 3	I-0; I-1; 7	0-1; 6
Leg 4	I-0; III	(missing)

Leg 1 (Fig. 3A) protopod with large, plumose outer seta and another small, inner seta in addition to spinules on ventral surface; vestigial endopod as knob covered with setules; proximal seg-



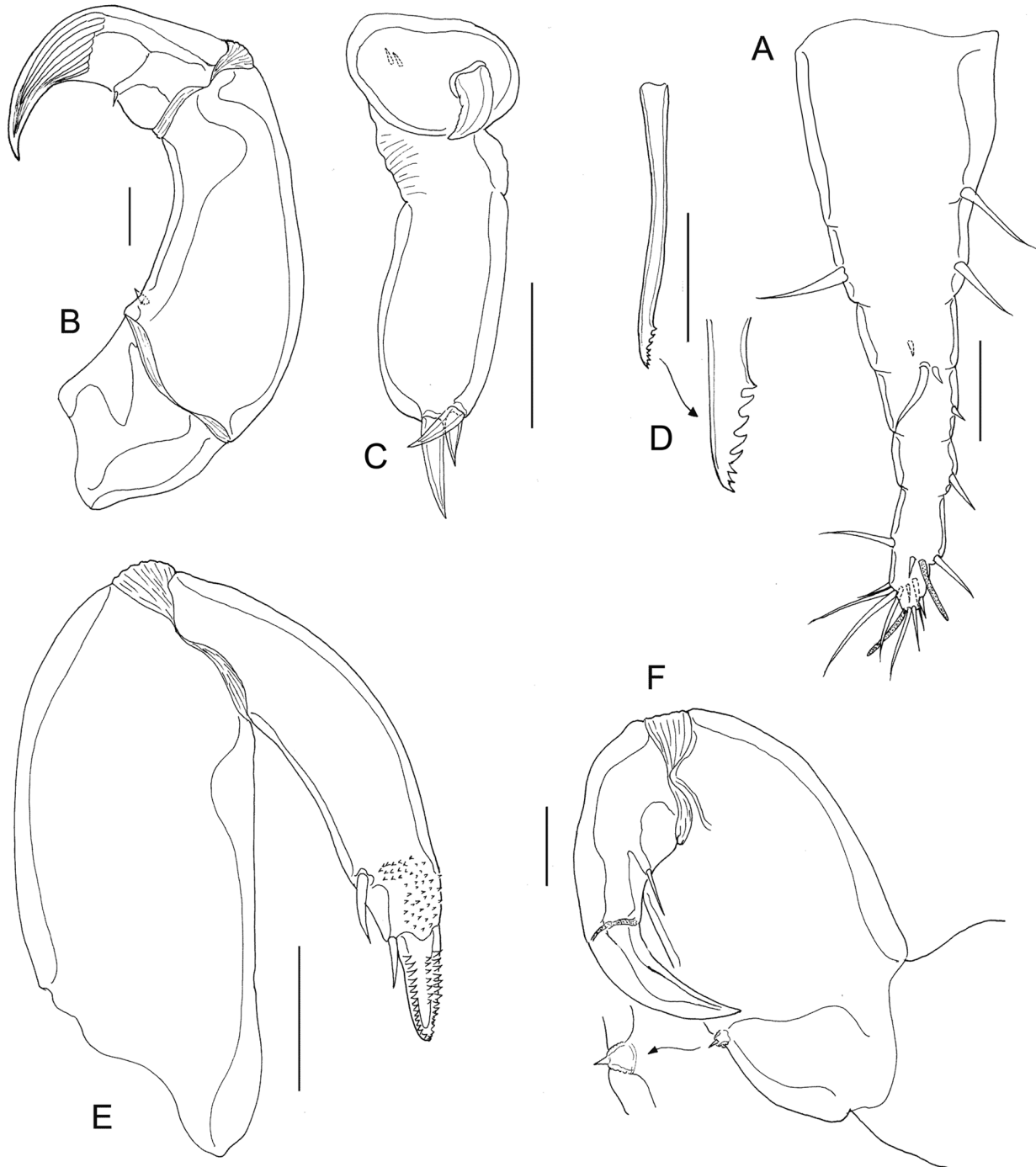
**Fig. 4.** *Hermilius longicornis* Bassett-Smith, 1898, male. **A** – habitus, dorsal; **B** – abdomen, ventral; **C** – antenna; **D** – maxilliped; **E** – leg 5; **F** – leg 6. Scale bars: **A** = 200  $\mu$ m; **B**, 100  $\mu$ m; **C** = 50  $\mu$ m; **E**, **F** = 25  $\mu$ m



**Fig. 5.** *Lernanthropinus temminckii* (von Nordmann, 1864), female. **A** – habitus, dorsal; **B** – habitus, lateral; **C** – head, ventral; **D** – abdomen, ventral; **E** – caudal rami, ventral. Scale bars: A, B = 500  $\mu$ m; C, E = 50  $\mu$ m; D = 100  $\mu$ m..

ment of exopod with row of setules on inner margin and short spiniform seta at outer distal corner; outer terminal element on last segment of exopod longer than inner 2 elements; pecten at base of all 3 outer terminal elements. Leg 2 (Fig. 3B) coxa small with large plumose inner seta posteriorly; basis with small outer simple seta, small marginal inner setules in addition to inner marginal membrane; with strong outer spines on proximal and middle segments of exopod. Leg 3 (Fig. 3C) protopod with small

outer and large inner plumose seta, membrane on outer edge and patch of spinules in outer portion of ventral surface; outer flange on spine and swelling of first segment of exopod with stronger outer spine on middle segment of exopod. Leg 4 (Fig. 3D) protopod large with plumose outer seta; pectens on both exopodal segments at insertion of each of 4 outer shorter spines. Leg 5 (Fig. 1E) represented by papilla bearing 2 small setae located at posterolateral corner of genital complex anterior to genital pore.



**Fig. 6.** *Lernanthropinus temminckii* (von Nordmann, 1864), female. A – antennule; B – antenna; C – maxillule; D – mandible; E – maxilla; F – maxilliped. Scales bars: A–F = 50  $\mu$ m



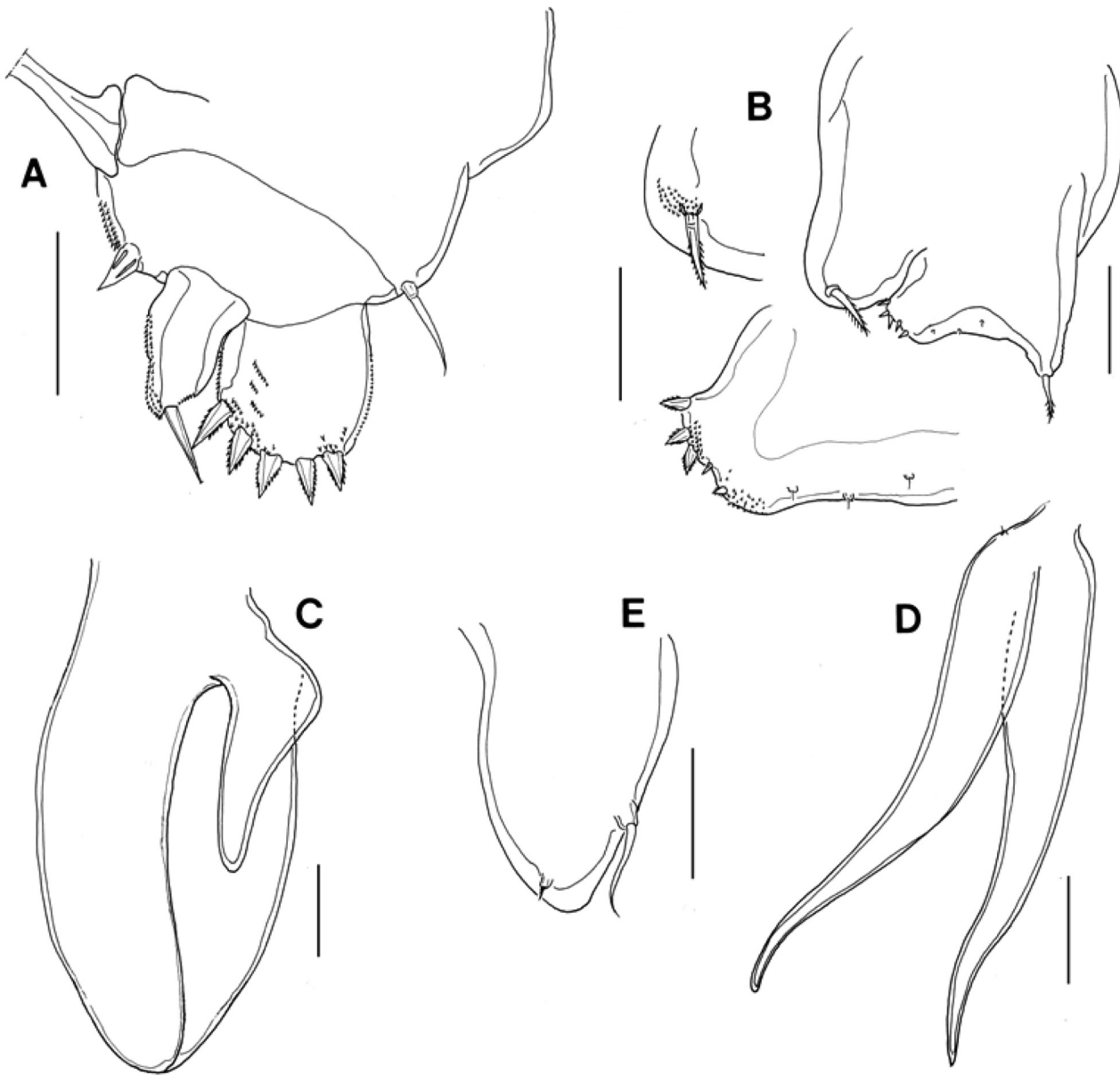


Fig. 7. *Lernanthropinus temminckii* (von Nordmann, 1864), female. A – leg 1; B – leg 2; C – leg 3; D – leg 4; E – leg 5. Scales bars: A–E=50  $\mu$ m

**Adult Male.** Body (Fig. 4A) 1.61 (n = 1) mm long excluding setae on caudal rami. Cephalothorax  $0.79 \times 0.84$  mm, wider than long with deep notches and folding. Fourth pediger, convex-shaped, wider than long. Genital complex (Fig. 4B)  $0.35 \times 0.29$  mm, longer than wide and swollen midlaterally, narrowed anteriorly, broadened posteriorly. Abdomen (Fig. 4B) short ( $0.21 \times 0.13$   $\mu$ m), 1-segmented, slightly longer than wide. Caudal ramus (Fig. 4B) ( $83 \times 56$   $\mu$ m) longer than wide armed with 3 long and 3 short plumose setae. Antennule as in female. Antenna (Fig. 4C) 3-segmented; proximal segment transversed; middle segment slender, projected with corrugated pads; distal segment strongly falcated with sharp claw; sharp auxiliary process in terminal region with spine-like seta at base of auxiliary process and small seta inwardly near process.

Postantennal process, Mandible, Maxillule and Maxilla as in female. Maxilliped (Fig. 4D) large, indistinctly 3-segmented; proximal segment largest but unarmed; middle segment small; terminal segment long with sharp claw bearing long basal seta and small subterminal seta. Sternal furca as in female.

Legs 1–4 as in female. Leg 5 (Fig. 4E) represented by papilla bearing 2 setae located at midlateral portion of genital somite and leg 6 (Fig. 4F) tipped with 2 setae posteriorly.

**Remarks.** The structure and armature on the exopod of leg 4 are characteristic to the species of the genus *Hermilius*. The diagnostic features of female *H. longicornis* are: 1) 1-segmented abdomen; 2) 3-segmented antenna; 3) 1-segmented exopod of leg 4, spine III is longer; 4) presence of 6 plumose

setae on the caudal ramus. It closely resembles *H. alatus* Hameed, 1981; *H. ariodi* Prabha et Pillai, 1986 and *H. youngi* Kabata, 1964. It differs mainly in the exopod spines of leg 4, in which, the terminal spine is shorter than middle spine (vs. terminal spine is longer in other 3 species). Male is comparatively smaller than female, possess some prominent diagnostic features: 1) antenna is provided with falcated claw in the distal segment, corrugated pads in the middle segment and sharp auxiliary process in the middle region; 2) maxilliped is larger than female, provided with sharp claw terminally. It differs with the male of *H. ariodi* and *H. pyriventris* Heller, 1865, in the following features: 1) sterna furca is broad, tines with spatulated membranes and without lateral sclerotized processes (vs. very broad flanges, with lateral sclerotized processes above sterna furca in *H. ariodi*; apically acute and diverged tines without processes in *H. pyriventris*); 2) terminal segment of maxilliped is having sharp claw long basal seta and small subterminal seta (vs. absence of subterminal seta in *H. ariodi* and *H. pyriventris*); 3) terminal region of antenna is with spine-like seta at the base of auxiliary process, in addition a small seta is located inwardly near process (vs. absence of small seta inwardly near process in *H. ariodi* and *H. pyriventris*).

*H. longicornis* was described by various authors (Bassett-Smith 1898; Pillai 1961, 1963, 1985; Rangnekar 1963; Leong 1985; Ho and Kim 2000). Although, the complete redescription of female was provided by Ho and Kim (2000), we have illustrated all features on female to show its conspecific characters to male and also to compare its features with its congeners. We also found few minor differences on the habitus provided by Ho and Kim (2000). The outer cephalothorax is broad in our study, but, not broader in Ho and Kim (2000) and outer layers might be folded. The maxilliped is shown with minute setae in our study (see: Fig. 2G, H), which are overlooked in Ho and Kim (2000). The complete description of male is also provided in this study. This is only the third species of the genus with a male description after *H. ariodi* and *H. pyriventris*. *Hermilius* is host specific to marine catfishes (Ariidae). All 8 species such as, *H. alatus*, *H. ariodi*, *H. longicaudus* Ho et Kim, 2000, *H. longicornis*, *H. pseudari* Hameed, 1987, *H. pyriventris*, *H. tachysuri* Pillai et Natarajan, 1980 and *H. youngi* have been reported from cat fishes around the world (Ho and Kim 2000). This is the first report on this genus from Iraq. However, Ho and Kim (2000) reported three species *H. pyriventris*, *H. longicaudus*, and *H. longicornis* from the giant marine catfish, *Arius thalassinus* Rüppel, from Kuwait, a neighboring country of Iraq.

**Distribution.** It is so far reported from India (Pillai 1963), Kuwait (Ho and Kim 2000), Malaysia (Leong 1985) and Sri Lanka (Bassett-Smith 1898; Kirtisinghe 1964).

Family Lernanthropidae Kabata, 1979  
*Lernanthropinus* Do in Ho et Do, 1985  
*Lernanthropinus temminckii* (von Nordmann, 1864)  
 (Figs. 5–7)

*Lernanthropus temminckii* von Nordmann, 1864: 501, Cressey and Cressey 1979: 20.

*Lernanthropus gibbosus* Pillai, 1964: 46; Pillai 1985: 536.

*Lernanthropinus sauridae* Do in Ho and Do, 1985: 55.

**Material examined.** 1♀ (NIBRIV0000276266) from gill filaments of greater lizard fish *Saurida tumbil* (Bloch), Fishing Port, Al-Faw City, Basrah Province, Iraq, 03 November 2011.

**Other material examined.** *Lernanthropus gibbosus* Pillai, 1964: Holotype ♀ (Reg. No. C4447/1, Trivandrum, India) from collections of Zoological Survey of India, Calcutta; *Lernanthropinus sauridae* Do in Ho and Do, 1985. Syntypes: 1♀ and 1♂ (Reg. No. 190646. Kojima Bay, Japan) from collections of Smithsonian Institution, Washington D.C., USA; *Lernanthropus temminckii* von Nordmann, 1864 (= *L. temmenckii*): Syntypes: 8♀♀ specimens (Reg. No. 180570, Trivandrum, India), 1♂ (Reg. No. 180567, Thailand); 1♀ (Reg. No. 180568, Unknown locality), 1♀ (Reg. No. 180569, off Somalia); 1♀ (Reg. No. 180571, the Philippines), all from collections of Smithsonian Institution, Washington D.C., USA.

**Adult female.** Body (Fig. 5A, B) 6.64 mm long, typical appearance of lernanthropid. Head 1.64 × 1.48 mm, bearing large fleshy fold on either side anterior to oral region (see Fig. 5A, C) and at posterior margin, formed as bulged ridge (see Fig. 5B). Trunk protruded laterally at anterior end. All pedigerous somites fused (Fig. 5C) and not demarcated except leg 3. Urosome well exposed to both dorsal (Fig. 5A) and ventral sides. Genital complex narrowed posteriorly, pair of spermatophores seen attached (Fig. 5D). Abdomen (Fig. 5D) 0.75 × 0.41 mm, wider than long. Caudal ramus (Fig. 5E) 0.27 × 0.07 mm longer than wide, armed anteriorly with 2 slender setae and posteriorly with 4 small spiniform setae.

Antennule (Fig. 6A) indistinctly 6-segmented; armed with setal formula of 1, 2, 3, 1, 1 and 12+2 aesthetascs. Antenna (Fig. 6B) indistinctly 3-segmented; proximal segment stout and small; middle segment stout and larger than other 2 segments, having small spiniform seta posterolaterally; distal segment forming as curved claw bearing spiniform seta mid laterally. Maxillule (Fig. 6C) bilobed, outer lobe bearing 1 larger seta and 2 spiniform setae; inner lobe longer bearing 3 setae terminally. Mandible (Fig. 6D) moderately long, bearing 8 teeth distally. Maxilla (Fig. 6E) 2-segmented; with lacertus, larger and brachium bearing subterminally 1 seta on medial surface; terminal claw armed with rows of denticles on medial surface in addition to 1 basal seta. Maxilliped (Fig. 6F) indistinctly 3-segmented; corpus robust bearing small papilla on myxal surface; subchela with seta-bearing papilla on medial surface of shaft; terminally striated claw bearing 1 spiniform basal seta.

Leg 1 (Fig. 7A) with inconspicuous protopod having 1 slender outer seta and 1 spiniform inner element with rows of denticles; exopod 1-segmented and bearing 5 robust spines articulated with spinules, medial surface having rows of den-

**Table 1:** Hosts and localities of six valid species of *Lernanthropinus* Do (Crustacea: Copepoda: Siphonostomatoidea) after relegation of *L. gibbosus* (Pillai) and *L. sauridae* Do to *L. temminckii* (von Nordmann)

<i>Lernanthropinus</i> spp.	Host: Common Name	Host order: Family	Locality	Reference
<i>Lernanthropinus decapteri</i> (Pillai, 1964)	<i>Decapterus russelli</i> (Rüppel, 1830): Indian Scad	Perciformes: Carangidae	Trivandrum, Bay of Bengal, India	Pillai (1964, 1985)
<i>Lernanthropinus forficatus</i> (Redkar, Rangnekar et Murti, 1949)	<i>Trichurus lepturus</i> Linnaeus, 1758 (= <i>T. haumela</i> ): Largehead hairtail	Perciformes: Trichiuridae	Mumbai (=Bombay), Maharashtra, India	Redkar <i>et al.</i> (1949)
<i>Lernanthropinus nemastitii</i> Deetz et Benz, 1988	<i>Lepturacanthus savala</i> (Cuvier, 1829) (= <i>Trichurus savala</i> ): Savalai hairtail	Trichiuridae	Kerala, West Coast of India	Pillai (1967, 1985)
<i>Lernanthropinus sphyraenae</i> (Yamaguti and Yamasu, 1959)	<i>Nemastitius pectoralis</i> Gill, 1862: Roosterfish	Perciformes: Nemastitidae	Punta Arena de la Ventana, Baja California Sur, Mexico	Deetz and Benz (1988)
<i>Lernanthropinus temminckii</i> (von Nordmann, 1864) [= <i>L. gibbosus</i> (Pillai, 1964)]	<i>Mene maculata</i> (Bloch & Schneider, 1801): Moonfish	Perciformes: Menidae	Sagami Bay, Japan Chiayi County, Taiwan	Yamaguti and Yamasu (1959) Ho <i>et al.</i> (2011)
	<i>Synodus saurus</i> (Linnaeus, 1758) (= <i>Saurus lacerta</i> ): Atlantic lizardfish	Aulopiformes Synodontidae	East Indies	(von Nordmann, 1864)
	<i>Saurida tumbil</i> (Bloch, 1795): Greater lizardfish	Synodontidae	Trivandrum, Bay of Bengal, India	Pillai (1964, 1985)
	<i>Saurida undosquamis</i> (Richardson, 1848): Brushtooth lizardfish	Synodontidae:	Trivandrum, Bay of Bengal, India	Cressey and Cressey (1979)
[= <i>L. sauridae</i> Do in Ho and Do, 1985]	<i>Saurida elongata</i> (Temminck & Schlegel, 1846): Slender lizardfish	Synodontidae	the Philippines, Gulf of Thailand <b>Al-Faw City, Iraq</b>	<b>Present study</b> Cressey and Cressey (1979)
<i>Lernanthropinus trachuri</i> (Brian, 1903)	<i>Trachurus trachurus</i> (Linnaeus, 1758): Atlantic horse mackerel	Perciformes: Carangidae	Off Somalia Kojima Bay, Okayama Prefecture, Japan	Do in Ho and Do (1985)
	<i>Campogramma glyacos</i> (Lacepède, 1801) (= <i>Lichia vadigo</i> ): Vadigo		Nice, France	Brian (1903) Delamare-Deboutteville and Nunes-Ruivo (1954) Brian (1903)
	<i>Trachurus mediterraneus</i> (Steindachner, 1868): Mediterranean horse mackerel	Carangidae	The Bosphorous, Turkey	Öketer and Trilles (2004)
	<i>Cynoscion striatus</i> (Cuvier, 1829): Striped weakfish	Sciaenidae	Argentina	Timi and Eichegoin (1996)

ticles; endopod small tipped with 1 seta, lateral region having row of denticles. Leg 2 (Fig. 7B) slightly reduced than leg 1; exopod armed with 5 spines smaller than leg 1; endopod bearing 1 seta as like leg 1. Leg 3 (Fig. 7C), not fused, modified as 2 fleshy lamellae for exopod and endopod, both unarmed. Leg 4 (Fig. 7D) represented by pair of bilobate process, long, fleshy, having identical blunt tips. Leg 5 (Fig. 7E) represented by 2 papillae having 1 plumose seta midlaterally and 1 spiniform seta posteriorly.

**Male.** Unknown from Iraq (present study), but reported from Trivandrum, India (Pillai 1964, 1985), the Andaman Sea, Gulf of Thailand (Cressey and Cressey 1979) and Kojima Bay, Japan (Ho and Do 1985).

**Remarks.** The diagnostic features of the genus *Lernanthropinus* are: 1) the presence of posterolateral plate-like structures on the trunk, 2) the absence of dorsal and ventral plates on the trunk, and 3) both leg 4 and the urosome are visible in dorsal and ventral views (see Ho and Do 1985). According to Walter (2013), *Lernanthropinus* contains the following eight species: *L. decapteri* (Pillai, 1964); *L. forficatus* (Redkar, Rangnekar et Murti, 1949); *L. gibbosus* (Pillai, 1964); *L. nematistii* Deets et Benz, 1988; *L. sauridae* Do in Ho and Do, 1985; *L. sphyraenae* (Yamaguti and Yamasu, 1959); *L. temminckii* (von Nordmann, 1864) and *L. trachuri* (Brian, 1903). The female and male are known for all species, except *L. decapteri* and, until now, *L. temminckii* as well.

Among the eight species of *Lernanthropinus*, *L. gibbosus*, *L. sauridae* and *L. temminckii* have been reported exclusively from lizardfishes (Synodontidae). Von Nordmann (1864) described *L. temminckii* based on a female collected from the Atlantic lizardfish *Synodus saurus* (Linnaeus) from the East Indies (Table 1). Cressey and Cressey (1979) later incompletely redescribed the female of the same species based on specimens collected from the Greater lizardfish *Saurida tumbil* (Bloch) off India and in the Bay of Bengal and from the brushtooth lizardfish *Saurida undosquamis* (Richardson) from off Somalia. The descriptions of *L. gibbosus* provided by Pillai (1964, 1985) were based on specimens of both sexes collected from the gills of *S. tumbil* from India. The description of *L. sauridae* provided by Do in Ho and Do (1985) was based on females and males collected from the gills of the slender lizardfish *Saurida elongata* (Temminck and Schlegel) from Kojima Bay, Okayama Prefecture, Japan.

*Lernanthropinus gibbosus*, *L. sauridae* and *L. temminckii* share many features in common. The only apparent differences between these three species are the maxillule, the maxilliped and the setation pattern of legs 1 and 2 in the female. Nevertheless, Pillai (1985) considered the possibility that *L. gibbosus* is synonymous with *L. temminckii*. In order to clarify this issue, we compared our specimens from Iraq with the holotype (Reg. No. C4447/1) of *L. gibbosus* deposited at the Zoological Survey of India, Calcutta, India, a syntype of *L. sauridae* (Reg. No. 190646) and *L. temminckii* (Reg. Nos.

180567, 180568, 180569, 180570, 180571) accessioned at the Smithsonian Institution, Washington D.C., USA. We found that all three species have similar morphologies of the body, mouthparts and legs 1–4. More importantly, the maxillule, the maxilliped and the setation pattern of legs 1 and 2 are similar between all the female specimens examined. In the light of this, we formally relegate *L. gibbosus* and *L. sauridae* as junior synonyms of *L. temminckii*.

Ho *et al.* (2008) recognized two groups in the genus *Lernanthropinus* based on whether or not the endopods of leg 3 are fused along their medial margin to form a “false ventral plate.” *Lernanthropinus temminckii*, along with *L. forficatus* and *L. nematistii*, are in the group with unfused leg 3 endopods.

The congener *L. forficatus* was first reported from large-head hairtail *Trichurus lepturus* Linnaeus, 1758 (= *T. haumela*) from Mumbai, India (Redkar *et al.* 1949) with incomplete descriptions (Pillai 1985). But, later it was re-described by Pillai (1985) from *Trichurus savala* Cuvier, 1829 along the west coast of India. Hence, we compare with Pillai’s (1985) redescription. *Lernanthropinus temminckii* differs from its congener *L. forficatus* in the following features: 1) head is formed as a bulged ridge posteriorly (vs. absence of bulged ridge in *L. forficatus*); 2) antennule is 6-segmented (vs. 7-segmented in *L. forficatus*); 3) maxillule possesses 2 spiniform setae in the outer lobe (vs. absent in *L. forficatus*); 4) endopod of legs 1 and 2 is armed with 1 seta (vs. absent in *L. forficatus*); 5) exopod of leg 2 is armed with 5 small spines (vs. 4 small spines in *L. forficatus*) (see: Pillai 1967, 1985).

Another congener *L. nematistii* was parasitic on rooster fish *Nematistius pectoralis* Gill, 1862, reported from Mexico by Deetz and Benz (1988) (Table 1). *Lernanthropinus temminckii* differs from *L. nematistii* in the following features: 1) antennule is 6-segmented (vs. 7-segmented in *L. nematistii*); 2) maxilla is having a subterminal seta in the brachium (vs. bifid process in the branchium of maxilla of *L. nematistii*); 3) mandible with 8 teeth (vs. 6 teeth in *L. nematistii*); 4) simple seta in the endopod of leg 1 (vs. denticulated seta in the endopod of leg 1 of *L. nematistii*); 5) leg 5 is having 2 setae (vs. 1 seta in the leg 5 of *L. nematistii*).

The zoogeography of lernanthropids showed that majority of them occurs in the tropical waters of Taiwan, India, Japan and UK. India has been recorded with most number of lernanthropids. It has 6 genera including 44 species (Pillai 1985). However, Taiwan contains 7 genera including 20 species (Ho *et al.* 2008), Japan with 5 genera including 9 species (Ho and Do 1985; Ho *et al.* 2008) and the UK with 5 genera including 5 species (Kabata 1979; Boxshall and Halsey 2004).

**Distribution.** Occurs on Indo-West Pacific lizardfishes (see: Table 1).

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## References

- Bassett-Smith P.W. 1898. Further new parasitic copepods found on fish in the Indo-tropical region. *The Annals and Magazine of Natural History Series*, 7, 2, 77–98.
- Boxshall G.A., El-Rashidy H.H. 2009. A review of the *Caligus productus* species group, with the description of a new species, new synonymies and supplementary descriptions. *Zootaxa*, 2271, 1–26. DOI:10.1.1.192.7978
- Boxshall G.A., Halsey S.H. 2004. An Introduction to Copepod Diversity. London, The Ray Society, 940 pp.
- Brian A. 1903. Sui copepodi parassiti di pesci marini dell' Isola D'Elba. 4 nota. *At ti del. Society Ligustica*, 14, 77–84.
- Cressey R.F. 1991. Parasitic copepods from the Gulf of Mexico and Caribbean Sea. III: *Caligus*. *Smithsonian Contributions of Zoology*, 497, 1–53.
- Cressey R.F., Cressey H.B. 1979. The parasitic copepods of Indo-West Pacific lizardfishes (Synodontidae). *Smithsonian Contributions of Zoology*, 296, 1–80.
- Delamare-Deboutteville C., Nunes-Ruivo L. 1954. Parasites de poissons de mer ouest africains récoltés par M. J. Cadenat II. Copépole (1er. note). Genres *Lernanthropus*, *Sagum*, *Paeon*, *Pennella*. Bulletin Institute français d' Afrique noire, t. XVI, (1) série A, 139–166.
- Deetz G.B., Benz G.W. 1988. *Lernanthropinus nematistii* sp.nov. (Lernanthropidae) and *Caligus tenuifurcatus* Wilson, 1937 (Caligidae), siphonostomatoid copepod parasites of roosterfish (*Nematistius pectoralis* Gill, 1864) from the Sea of Cortez. *Canadian Journal of Zoology*, 66, 866–874. DOI:10.1139/z88-128
- Dojiri M., Ho J-S. 2013. Systematics of the Caligidae, Copepods Parasitic on Marine Fishes. *Crustaceana Monograph Series*, 18, 448 pp. DOI: 10.1163/9789004204256
- El-Rashidy H.H., Boxshall G.A. 2010. Parasitic copepods on immigrant and native clupeid fishes caught in Egyptian coastal waters off Alexandria. *Systematic Parasitology*, 76, 19–38. DOI: 10.1007/s11230-010-9230-6.
- Froese R., Pauly D. (Eds.). 2013. FishBase. World Wide Web electronic publication. <http://www.fishbase.org>, version (9/2013).
- Gnanamuthu C.P. 1947. *Caligus sciaenae* n. sp. parasitic on *Sciaena glauca* from Madras. *Proceedings of the Indian Academy of Sciences, Section B*, 25, 43–49.
- Ho J-S., Do T.T. 1985. Copepods of the family Lernanthropidae parasitic on Japanese marine fishes, with a phylogenetic analysis of the lernanthropid genera. *Reports of the Sado Marine Biological Station Niigata University*, 15, 31–76.
- Ho J-S., Kim I-H. 2000. Copepods of the genus *Hermilius* (Caligidae) parasitic on marine catfish of Kuwait, with a key to the species of *Hermilius*. *Pakistan Journal of Marine Sciences*, 9, 79–90.
- Ho J-S., Lin C.L. 2003. Solution to the taxonomic confusion surrounding *Caligus epinepheli* Yamaguti, a caligid copepod (Siphonostomatoida) parasitic on marine fishes. *Zoological Studies*, 42, 256–271.
- Ho J-S., Lin C.L. 2004. Sea Lice of Taiwan (Copepoda: Siphonostomatoida: Caligidae). The Sueichan Press, Keelung, 388 pp.
- Ho J-S., Liu W.C., Lin C.L. 2008. Six species of lernanthropid copepods (Siphonostomatoida) parasitic on marine fishes of Taiwan. *Journal of Fisheries Society of Taiwan*, 35, 251–280.
- Ho J-S., Liu W.C., Lin C.L. 2011. Six species of the Lernanthropidae (Crustacea: Copepoda) parasitic on marine fishes of Taiwan, with a key to 18 species of the family known from Taiwan. *Zoological Studies*, 50, 611–635.
- Ho J-S., Sey O. 1996. Parasitic Copepoda of marine fishes from Kuwait: A preliminary report. *Kuwait Journal of Science and Engineering*, 23, 61–69.
- Humes A.G., Gooding R.U. 1964. A method for studying the external anatomy of copepods. *Crustaceana*, 6, 238–240.
- Huys R., Boxshall G.A. 1991. Copepod Evolution. The Ray Society, London, UK, 468 pp.
- Johnson S.C., Treasurer J.W., Bravo S., Nagasawa K., Kabata Z. 2004. A review of the impact of parasitic copepods on marine aquaculture. *Zoological Studies* 43, 2, 229–243.
- Kabata Z. 1965. Copepoda parasitic on Australian fishes. IV. Genus *Caligus* (Caligidae). *Annal Magazine of Natural History Series*, 13, 8, 109–126.
- Kabata Z. 1979. Parasitic Copepoda of British Fishes. The Ray Society, London, 468 pp.
- Kim I-H. 1998. Cirripedia, Symbiotic Copepoda, Pycnogonida. Illustrated Encyclopedia of Fauna and Flora of Korea, Ministry of Education, Seoul 38, 1038 pp. [In Korean]
- Kirtisinghe P. 1964. A review of the parasitic copepods of fish recorded from Ceylon, with description of additional forms. *Bulletin of Fisheries Research Station Ceylon*, 17, 45–132.
- Leong T.S. 1984. Copepoda of the genus *Caligus* (Caligidae) parasitic on Malaysian fishes. *Tropical Biomedicine*, 1, 163–174.
- Leong T.S. 1985. Copepoda of the genera of *Parapetalus*, *Synestius* and *Hermilius* (Caligidae) parasitic on Malaysian fishes. *Malayan Natural Journal*, 19, 41–56.
- Moon S.Y., Kim I-H. 2012. Sea lice (Copepoda, Siphonostomatoida, Caligidae) new to Korea, including three new species. *Journal of Species Research*, 1, 175–217.
- Moon S.Y., Kim I-H. 2013. Copepods of Hatschekiidae (Copepoda, Siphonostomatoida) new to Korean fauna, with description of a new species. *Ocean Science Journal*, 48, 19–34. DOI:10.1007/s12601-013-0002-5
- Öketener A., Trilles J-P. 2004. Three new parasitic copepod species for the parasite fauna of marine fish of Turkey. *Journal of Black Sea/Mediterranean Environment*, 10, 71–80.
- Piasecki W., Goodwin A.E., Eiras J.C., Nowak B.F. 2004. Importance of Copepoda in freshwater aquaculture. *Zoological Studies* 43, 2, 193–205.
- Pillai N.K. 1961. Copepods parasitic on south Indian fishes. Pt.1. Caligidae. *Bulletin of Central Research Institute of University, Kerala (C)*, 8, 87–130.
- Pillai N.K. 1963. Copepods parasitic on South Indian fishes. Family Anthosomidae-1. *Journal of Bombay Natural History Society*, 60, 655–570.
- Pillai N.K. 1964. Copepods parasitic on South Indian fishes. Family Anthosomidae-2. *Journal of Bombay Natural History Society*, 61, 46–59.
- Pillai N.K. 1967. Copepods parasitic on Indian marine fishes. A review. *Proceedings of Symposium on Crustacea, Cochin*, 5, 1556–1680.
- Pillai N.K. 1985. The Fauna of India—Parasitic copepods of marine fishes, Zoological Survey of India, Calcutta, India, 900 pp.
- Rangnekar M.P. 1963. Redescription of *Hermilius longicornis* Bassett-Smith: a copepod parasitic on a fish of Bombay coast. *Journal of University of Bombay*, 31, 80–83.
- Rangnekar P.G., Murti N.N. 1959. *Caligus cossackii* Bassett-Smith, a copepod parasitic on a marine fish at Bombay *Journal of University of Bombay*, 28, 78–81.

- Rangnekar P.G., Murti N.N. 1963. *Bomolochus decapteri* Yamaguti and *Caligus epinepheli* Yamaguti: copepods parasitic on fishes of Bombay. *Journal of University of Bombay*, 31, 84–90.
- Redkar M.V., Rangnekar P.G., Murti N.N. 1949. Four new species of parasitic copepods from the marine fishes of Bombay. *Journal of University of Bombay*, 18, 36–50.
- Shiino S.M. 1952. Copepods parasitic on Japanese fishes. 1. On the species of *Caligus* and *Lepeophtheirus*. *Reports of Faculty of Fisheries Prefectural University of Mie*, 1, 79–113.
- Timi J.T., Etchegoin J.A. 1996. A new species of *Lernanthropus* (Copepoda: Lernanthropidae) parasite of *Cynoscion striatus* (Pisces: Sciaenidae) from Argentinean waters, and new records of *Lernanthropus trachuri*. *Folia Parasitologica*, 43, 71–74. doi:10.1111/j.1095-8649.2005.00867.x
- Venmathi Maran B.A., Leong T.S., Ohtsuka S., Nagasawa K. 2009. Records of *Caligus* (Crustacea: Copepoda: Caligidae) from Marine Fish Cultured in Floating Cages in Malaysia with a redescription of the male of *Caligus longipedis* Bassett-Smith, 1898. *Zoological Studies*, 46, 797–807.
- von Nordmann A. 1864. Neue Beitrage zur Kenntniss Parasitischer Copepoden. *Bulletin de la Societe Impériale des Naturalistes de Moscou*, 27, 461–520.
- Walter T. C. (2013). *Lernanthropinus* Ho & Do, 1985. In: (Eds. T.C. Walter and G.A. Boxshall). World of Copepods database. Accessed through: World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=347401> on 2013-09-10
- Yamaguti S. 1936. Parasitic copepods from fishes of Japan. Part 2. Caligoida I: 1–22. (Published by the author, Japan).
- Yamaguti S. 1954. Parasitic copepods from fishes of Celebes and Borneo. *Publications of Seto Marine Biological Laboratory*, 3, 375–398.
- Yamaguti S., Yamasu T. 1959. Parasitic copepods from fishes of Japan with descriptions of 26 new species and remarks on two known species. *Biology Journal of Okayama University*, 5, 89–165.
- Yamaguti S. 1963. Parasitic Copepoda and Branchiura of Fishes. New York (U.S.A.): Interscience Publishers. 1104 pp.

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