

***Doridicola indistinctus* n. sp. (Copepoda: Poecilostomatoida: Rhynchomolgidae) associated with the soft coral *Gersemia fruticosa* Sars (Octocorallia: Alcyonacea: Nephtheidae) from the White Sea**

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Abstract A new species of poecilostomatoid copepod, *Doridicola indistinctus* n. sp. (Rhynchomolgidae), is described from specimens found in association with the soft coral *Gersemia fruticosa* Sars (Alcyonacea: Nephtheidae), collected from the White Sea. The new species is distinguished from its congeners by the combination of the following features in the female: (i) antenna tipped, with two subequal large claws which are about as long as the segment bearing them; (ii) two naked, extremely unequal setae on the middle segment of the maxilliped, the short, medial seta less than half-length of the outer seta; and (iii) free segment of leg 5 bears the basal swelling and is ornamented with spinules on the outer surface. This is the first report of a copepod occurring in symbiosis with nephtheid corals from the Arctic Zone. It also constitutes the northernmost record for a species of *Doridicola* Leydig, 1853, which is the largest genus of the Rhynchomolgidae Burmeister, 1835 comprising 52 species, including the present new species.

Introduction

Rhynchomolgidae is the largest family of poecilostomatoid copepods comprising over 250 species living in association with marine invertebrates, including cnidarians, molluscs, and echinoderms (Ho & Kim 2001; Boxshall & Halsey 2004). According to Walter & Boxshall (2012), there are 44 genera in the Rhynchomolgidae and *Doridicola* is the largest genus of the family comprising 51 species. As far as we are aware, these 51 species of *Doridicola* are from either tropical or temperate regions of the world. Examination of specimens of *Doridicola* occurring in association with the soft coral *Gersemia fruticosa* Sars in the Arctic Region (White Sea) revealed that these represent an unknown species.

This paper provides a description of the new species and discusses its relationships with the alcyonacean associated congeners.

Materials and methods

Colonies of the soft coral *Gersemia fruticosa* from the Kandalaksha Bay, White Sea, near the Marine Station of the Moscow State University, were isolated in plastic bags underwater by SCUBA diver. At the surface ethanol was added to each bag and the fluid was filtered through a 20 µm mesh net. In the laboratory copepods were cleared and dissected in lactic acid following in general the method of Humes

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& Gooding (1964), stained with chlorazol black E, and examined in glycerin with bright-field or differential interference contrast optics. Drawings were made using camera lucida. Terminology of the parts on appendages follows Humes & Boxshall (1996).

Doridicola indistinctus n. sp.

Type-host: *Gersemia fruticosa* Sars (soft coral) (Nephtheidae Gray).

Type-locality: Kandalaksha Bay (near the marine station of Moscow State University at 66°30′27.29″N, 33°31′35.30″E) at 24 m depth.

Site: Surface of colony.

Material studied: 27 ♀♀ and 23 ♂♂ obtained on 22 July 2001 from the washings of soft coral.

Type-material: Holotype (ZMMU Me-1204), allotype (ZMMU Me-1205) and 1 paratype male (ZMMU Me-1206) are deposited in the Zoological Museum of Moscow State University (ZMMU). Additional specimens are retained in the collection of VNI.

Etymology: The species name *indistinctus* is a Latin word meaning “obscure.” It alludes to the presence of an incompletely developed rostrum in the female of this species (see Fig. 2A).

Description (Figs. 1, 2, 3).

Female. Body (Fig. 1A) 1.61 mm long (excluding setae on caudal rami) and 0.66 mm wide (greatest width of cephalothorax). First pediger well separated from cephalosome. Free thoracic somites progressively decreasing in size from anterior to posterior. Fifth pediger distinctly wider than long (Fig. 1B). Genital-double somite 0.22 mm long and 0.18 mm wide (Fig. 1B), with lateral bulge on both sides housing egg-sac attachment area (Fig. 1C). Three free abdominal somites (Fig. 1B) wider than long. Caudal ramus (Fig. 1B) $108 \times 43 \mu\text{m}$ (length/width ratio 2.51 : 1), bears 6 setae in terminal area. Egg-sac (Fig. 1A) oval shaped, small, not reaching beyond anal somite.

Rostrum (Fig. 2A) indistinct. Antennule (Fig. 1D) 7-segmented, with armature formula: 4, 13, 6, 3, 4 + 1 aesthetasc, 2 + 1 aesthetasc, and 7 + 1 aesthetasc. Antenna (Fig. 1E) 4-segmented, comprising coxobasis and 3-segmented endopod; with armature formula: 1, 1, 3, and 5 + 2 large claws. Labrum (Fig. 2A) plate-like with deep central incision. Mandible (Fig. 1F)

with proximal notch on concave margin followed by row of long spinules; convex margin with protruded scale-like area beyond proximal notch bearing row of short spinules and hyaline, serrated fringe; terminal lash long, bilaterally spinulated. Maxillule (Fig. 2B) armed with 4 unequal setae, 3 terminal and 1 subterminal. Maxilla (Fig. 2C) 2-segmented; proximal segment (syncoxa) inflated and unarmed; distal segment (basis) carrying small outer setule (seta I) at base, simple seta (seta II) on posterior surface, and larger seta (seta III) armed with long spinules; terminal lash armed along one side with long spinules. Maxilliped (Fig. 2D) 3-segmented; proximal segment (syncoxa) largest but unarmed; middle segment (basis) carrying two extremely unequal, naked setae; distal segment (endopod) terminating in simple attenuated process and carrying long spiniform outer seta and short, simple, medial seta at base.

Legs 1–4 (Figs. 2E, F; 3A, B) biramous, with 3-segmented rami except 2-segmented endopod of leg 4. Leg armature formula (spines indicated by Roman numerals; setae indicated by Arabic numerals) as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 1, 4
Leg 2	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 2
Leg 4	0-1	1-0	I-0; I-1; II, I, 5	0-1; 0, II, 0

Leg 5 (Fig. 3C) consists of outer basal seta, arising from dorsolateral surface of fifth pediger and free segment (exopod). Latter arched with prominent basal swelling and armed with spinules on outer surface; 2 terminal naked setae. Leg 6 (Fig. 1C) on posterodorsal surface of genital double somite, composed of two small setae.

Male. Body (Fig. 3D) 1.28 mm long, with 6-segmented urosome. Genital somite squarish, about as long as wide, containing mature spermatophore (Fig. 3E). Caudal ramus $68 \times 27 \mu\text{m}$ (length/width ratio 2.52 : 1). Maxilliped (Fig. 3F) 4-segmented; first segment (syncoxa) unarmed; second segment (basis) largest, armed with rows of spinules and 2 inner setae; third segment (endopod) smallest and unarmed; terminal claw longer than three segments combined,

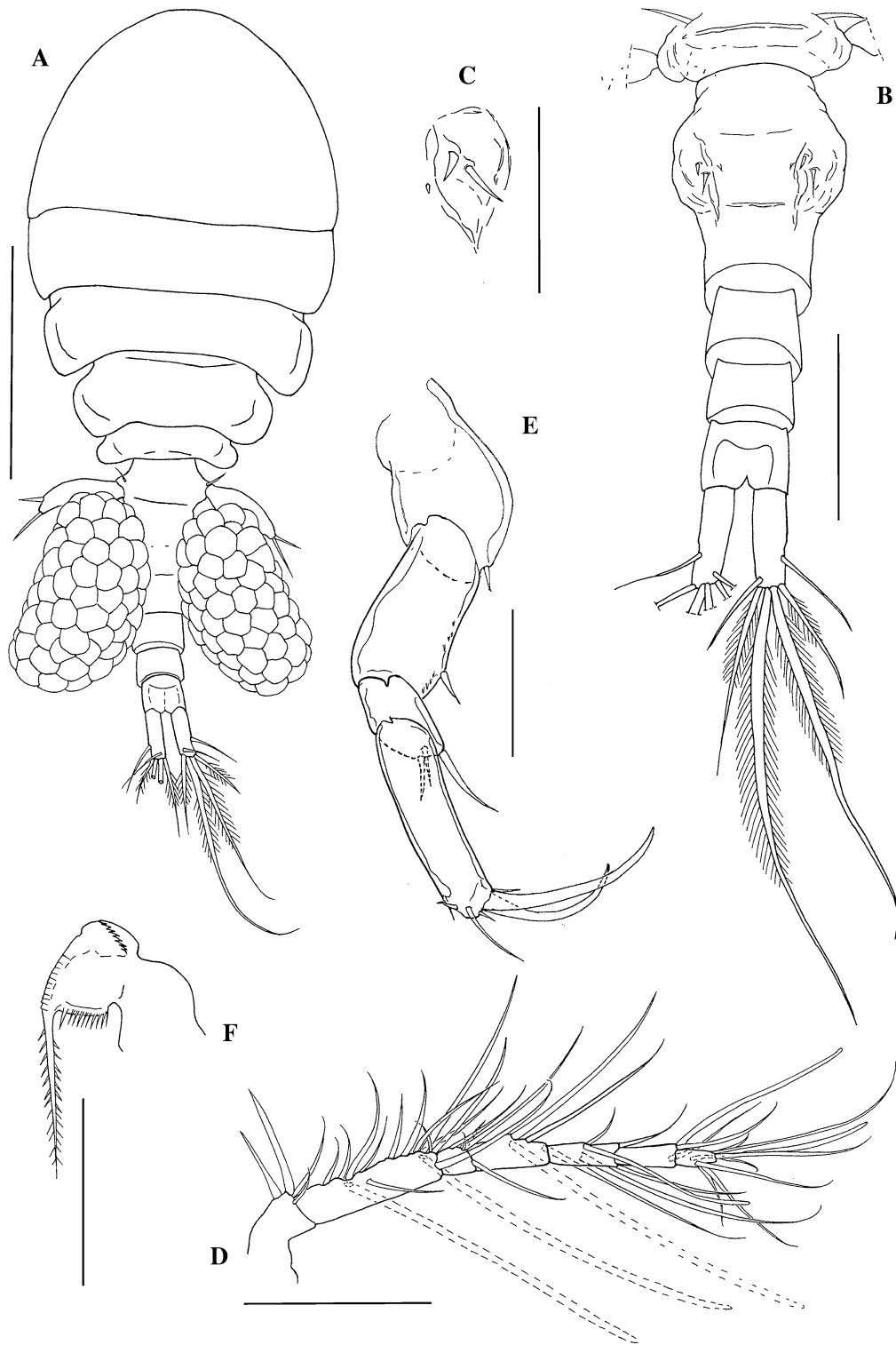


Fig. 1 *Doridicola indistinctus* n. sp. Female. A, habitus, dorsal view; B, urosome, dorsal view; C, egg-sac attachment area and leg 6, dorsal view; D, antennule (broken lines indicate aesthetascs in male); E, antenna; F, mandible. Scale-bars: A, 0.5 mm; B, D, 0.2 mm; C, E, F, 0.1 mm

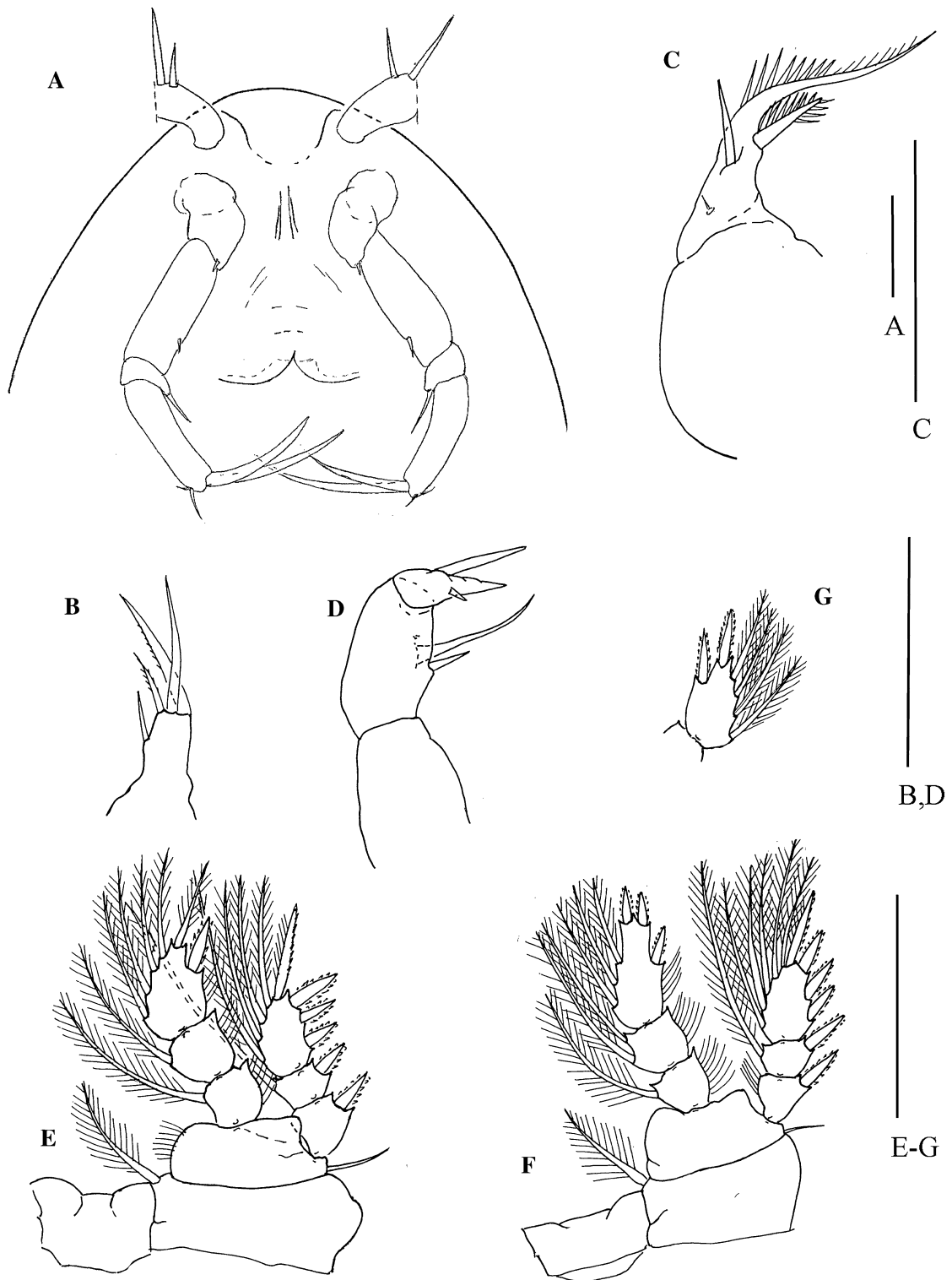


Fig. 2 *Doridicola indistinctus* n. sp. Female (A–F): A, anterior part of cephalosome, ventral view; B, maxillule; C, maxilla; D, maxilliped; E, leg 1; F, leg 2. Male: G, distal segment of endopod. Scale-bars: A–D, 0.1 mm; E–G, 0.2 mm

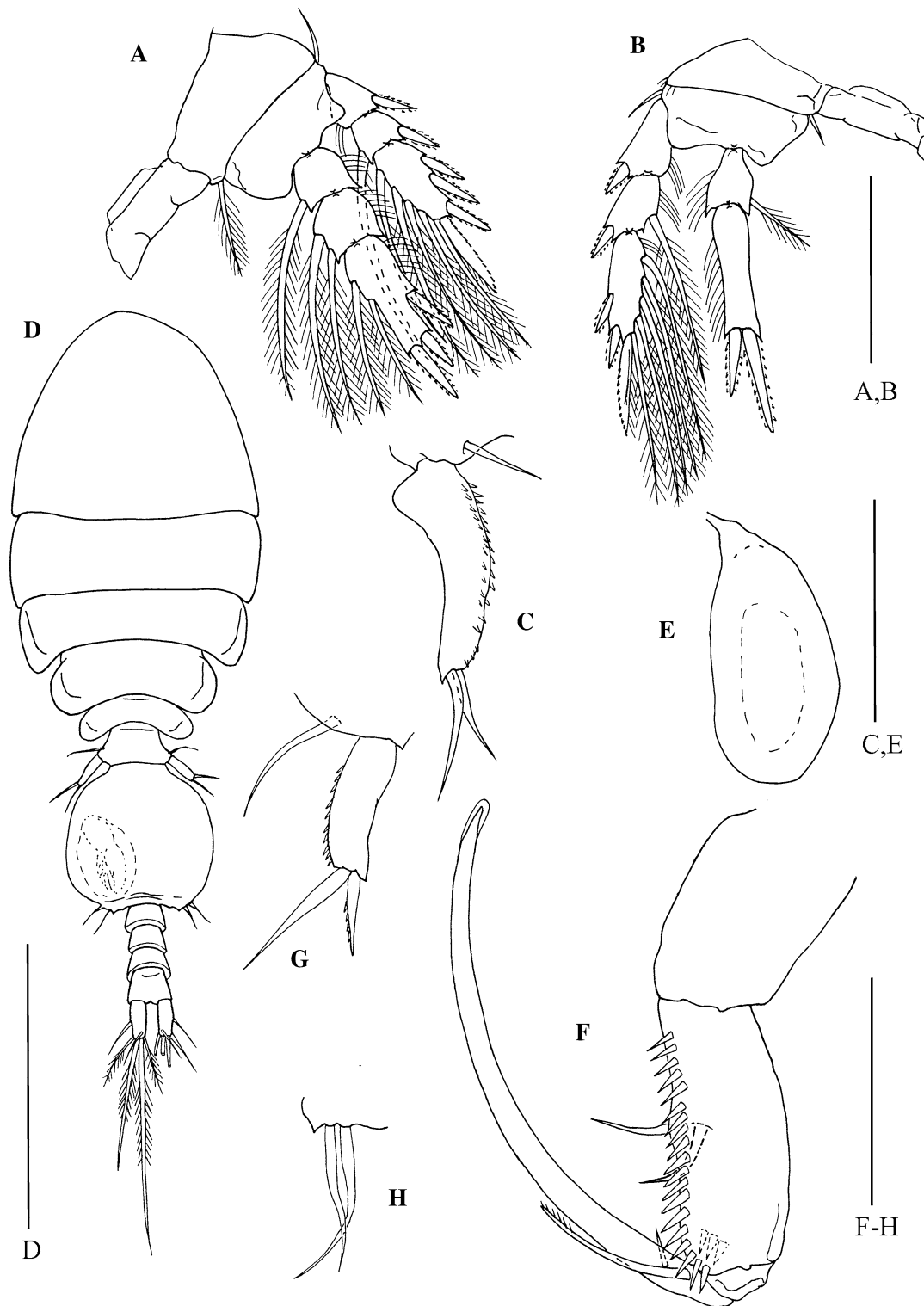


Fig. 3 *Doridicola indistinctus* n. sp. Female (A–C). A, leg 3; B, leg 4; C, leg 5. Male (D–H): D, habitus, dorsal view; E, spermatophore; F, maxilliped; G, leg 5; H, leg 6. Scale-bars: A, B, 0.2 mm; C, E–H, 0.1 mm; D, 0.5 mm

bearing 2 very unequal setae in basal region. Leg 2 (Fig. 2G): formula of distal endopodal segment I, I + 1, 3. Free segment of leg 5 (Fig. 3G) small, $61 \times 23 \mu\text{m}$ (length/width ratio 2.74 : 1), bearing row of spinules on outer margin and tipped with two unequal, spiniform setae; inner terminal seta denticulate on outer side. Leg 6 (Fig. 3H) composed of 2 naked setae located at posterolateral corner of genital somite.

Discussion

In a cladistic analysis of the genus *Doridicola* Ho & Kim (2001) excluded, due to being insufficiently known, the following four species: *D. brevifurcatus* (Ummerkutty, 1962), *D. congoensis* (T. Scott, 1894), *D. hirsutipes* (T. Scott, 1893) and *D. simplex* (Thompson & A. Scott, 1903). Accordingly, these four species of *Doridicola* are considered *species incertae sedis* and excluded in the following discussion.

The female of the new species described above is characteristic in having leg 5 composed of a free segment bearing the basal swelling (or conical protrusion), armed with rows of spinules on the outer margin, and tipped with two naked setae. This structure of leg 5 is shared with only 14 of the 51 congeners, namely *D. aculeatus* (Humes & Ho, 1968); *D. botulosus* (Stock & Kleeton, 1963); *D. cincinnatus* (Humes, 1975); *D. comai* Conradi, Megina & López-González, 2004; *D. commodus* (Humes, 1964); *D. inflatseta* (Humes & Stock, 1973); *D. lumarius* (Humes, 1980); *D. mimicus* (Humes, 1975); *D. parvicaudatus* Kim, 2003; *D. sensilis* (Humes, 1964); *D. singularipes* (Humes & Ho, 1968); *D. spinulifer* (Humes & Frost, 1964); *D. virgatus* Kim, 2007; and *D. vulcanius* Humes, 1990.

Another unusual feature of the new species is found on its antenna. This pair of anchoring appendages in *D. indistinctus* n. sp. is peculiar in being tipped with two long claws (instead of two short claws), which are as long as the segment (last segment of the endopod) bearing them. Only four of the above listed 14 species show this special feature: *D. aculeatus*, *D. botulosus*, *D. lumarius*, and *D. parvicaudatus*. Comparison with the works of Humes & Ho (1968), Stock & Kleeton (1963), and Conradi et al. (2004), reveals that the female of the new species is distinguishable from *D. aculeatus* and *D. botulosus* in the structure of the urosome (being longer), the armature on the third segment of the antenna (with 3 setae instead of 2+I),

and in the armature of the maxilliped (with naked, instead of spinulate setae on the middle segment). *Doridicola indistinctus* can be distinguished from *D. lumarius* as described by Humes (1980), by having an indistinct rostrum, longer abdominal somites, naked (instead of spinulated) setae on the middle segment of the maxilliped, and the proximal expansion of the free segment of leg 5 being globular (instead of thorn-shaped). Kim's (2003) description of *D. parvicaudatus* shows that it differs from *D. indistinctus* in having a set of longer abdominal somites, longer caudal rami, and a pair of naked (instead of spinulated) setae on the middle segment of the maxilliped. Accordingly, *D. indistinctus* is considered a new species.

As far as we are aware, about 20 species of symbiotic copepods have been reported from the invertebrates of the White Sea. They have been found in symbiosis with various species of Demospongiae (see Ivanenko, 1997, 2000); Polychaeta (see Marchenkov, 1997, 2002); Crustacea (see Marchenkov, 1997); Bryozoa (see Ivanenko & Smurov, 1997; Ivanenko & Ferrari, 2003; Ferrari & Ivanenko, 2005; Ivanenko et al. 2008a, b); Asteroidea (see Ivanenko et al., 2001); and Ascidiacea (see Schimkevitch, 1889; Marchenkov, 1994, 1997, 1998; Marchenkov & Boxshall, 1995, 2003); but no copepod symbiont has been found in association with representatives of Alcyonacea. *D. indistinctus* n. sp. thus represents the first copepod symbiont to be found on White Sea soft coral.

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