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Redescription of *Elthusa sinuata* (Koelbel, 1879) Comb.Nov. (Isopoda, Cymothoidae) Parasitizing the Red Bandfish in Turkey

Ahmet Öktener¹ · Jean Paul Trilles² · Engin Kocabaş¹ · Haşim İnceoğlu¹ · Ali Alaş³

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Abstract

Livoneca sinuata Koelbel, 1879 (Isopoda, Cymothoidae) is known from the Mediterranean Sea. In this study, this species is redescribed and transferred to the genus *Elthusa* according to the current status of this: body weakly twisted, antennula shorter than antenna, posterior margin of cephalon not trilobed, pleonite 1 slightly narrower than pleonite 2, maxilliped with oostegital lobe and pleopods all lamellar, without lobes or folds. This species was collected on the red bandfish, *Cepola macrophthalma*, and reported for the first time in the Sea of Marmara, Turkey. The species is also photographed for the first time on the host.

Keywords Cymothoidae · *Elthusa* · *Livoneca* · Isopoda · Red bandfish · Turkey

Introduction

The Cymothoidae (Crustacea, Isopoda) are usually parasitic on marine, brackish or freshwater teleost fish. They are blood-feeding. Some species settle in the buccal cavity, other attach in the branchial cavity, several on the external surface and other in a cavity hollowed in the body. Most cymothoids are highly host and site specific (Williams and Williams Jr 1998; Ramdane and Trilles 2007; Nagler and Haug 2016).

Six genera, *Ceratothoa*, *Nerocila*, *Emetha*, *Mothocya*, *Anilocra* and *Livoneca*, belonging to the Cymothoidae family are known from Turkish waters (Öktener and Trilles 2004; Trilles and Öktener 2004) and seven species, *Anilocra physodes* (Linnaeus, 1758), *Ceratothoa italica* Schiödte and Meinert, 1883, *Ceratothoa oestroides* (Risso, 1816), *Ceratothoa parallela* (Otto, 1828), *Emetha audouini* (H. Milne Edwards, 1840), *Mothocya taurica* (Czerniavsky,

1868), and *Nerocila bivittata* (Risso, 1816) were until now reported from the Sea of Marmara (Öktener and Trilles 2004).

Twenty one species first listed in the genus *Livoneca* were later transferred to *Elthusa* by Bruce (1990). Twenty eight nominal species were accepted by Smit et al. (2014). Hadfield et al. (2016) proposed *Elthusa nierstraszi* as the new replacement name for the junior secondary homonym *Elthusa parva*. Saito and Yamauchi (2016) described *Elthusa moritakii* on *Ereunias grallator* from East China Sea. Hadfield et al. (2017a) described *Elthusa winstoni* on *Ctenochaetus strigosus* from Hawaii. These last two records increase the number of *Elthusa* species until now identified (Hadfield et al. 2017b).

The *Elthusa* genus has a wide distribution in the world. It has been reported from the Pacific Ocean (Trilles and Justine 2004; Trilles and Justine 2006, 2010; Hadfield et al. 2017a), the Indian Ocean (Bruce 1990; Trilles 1994), the Atlantic Ocean (Rocha-Ramírez et al. 2005). They were reported from the gills of the host fish (Bruce 1990).

Livoneca sinuata Koelbel 1879 was collected on the red bandfish, *Cepola macrophthalma*, and is reported for the first time in the Sea of Marmara, Turkey. In this study, this species is redescribed and transferred to the genus *Elthusa* Schiödte and Meinert 1884. This recombination is based on the current status of the genus *Elthusa* proposed by Bruce (1990), Trilles and Randall (2011), Hadfield et al. (2017a): body weakly twisted, antennula shorter than antenna, posterior margin of cephalon not trilobed, pleonite 1 slightly narrower than pleonite 2, pleopods all lamellar, without lobes or folds.

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The present study contributes also to the knowledge of the geographical distribution of the genus *Elthusa* and particularly of the species *Elthusa sinuata*.

Materials and Methods

The red bandfish, *Cepola macrophthalma* (Linnaeus) (Perciformes, Cepolidae) were collected by beam trawling during a stock assessment monitoring project of the deep water pink shrimp from the Sea of Marmara, Turkey (40° 30' 32"N; 28° 19' 33"E; 40° 28' 53"N; 28° 25' 24"E; Fig. 1) in 2015. Isopods were preserved in vials containing 70% ethanol. Identifications of parasites were performed mainly according to Trilles (1976a), Kussakin (1979), Brusca (1981), Trilles and Randall (2011), Hadfield et al. (2017a). Mouthparts and appendages were dissected using Wild M5 stereo microscope. Dissected parts were mounted on slides in the glycerin-gelatine mounting medium. Pleopods were stained with methylene blue. Measurements (in micrometers) were obtained using a micrometric program (Pro-way). The appendages were drawn with the aid of a camera lucida (Olympus BH-DA). Drawings were transferred to digital media via scanner. The photos were performed using a Canon EOS 1100D camera attached to a microscope. Parasite (MNHN-IU-2014-12,866, MNHN-IU-2017-318) was deposited in the collections of the Museum National d'Histoire Naturelle (MNHN), Paris, France.

Results

Order Isopoda Latreille, 1817.

Suborder Cymothoidea Wägele, 1989.

Superfamily Cymothooidea Leach, 1814.

Family Cymothoidae Leach, 1814.

Elthusa Schioedte and Meinert 1884.

Elthusa sinuata (Koelbel 1879) comb.nov. (Figs. 2, 3, 4, 5, 6 and 7).

Synonyms:

Livoneca mediterranea Heller 1868: 146, fig. 16.— Koelbel 1879: 407.— Schioedte and Meinert 1884: 358–360, XIV, Fig.13–14.—Brian 1912: 99.—Montalenti 1948: 62.

Livoneca sinuata Koelbel 1879: 406–407, tag. I(fig.5a-d).— Schioedte and Meinert 1884: 378–381, Tab. XVI (fig.7–9).—Carus 1885: 444.—Gerstaecker 1901: 257.—Richardson 1910: 24.—Nierstrasz 1915: 99.—Galati-Mosella 1920: 1–10,Tab. I, fig.1–9.—Brian 1921: 20–24.—Penso 1939: 1.—Montalenti 1948: 62–75.—Vasiliiu and Carausu 1948: 175.—Trilles 1962: 102.—Trilles 1968: 136–139, phot.38–39.—Trilles 1968: 19.—Boscolo 1970: 72.

Livoneca sinuata: Brian 1912: 97–99, fig.1–4.—Monod 1924: 434, Fig. A-B (p.433) and fig.3 (p.435).—Vasiliiu 1932: 177–180, Fig.8, taf. I (fig.1–2), taf. II(fig.3–4), taf.III(fig.5–7).—Borcea 1933: 500–501.—Trilles 1976a: 793.

Lironeca sinuata: Brian and Darteville 1949: 176.—Trilles and Raibaut 1973: 278, 280.—Trilles 1976b: 806–808,

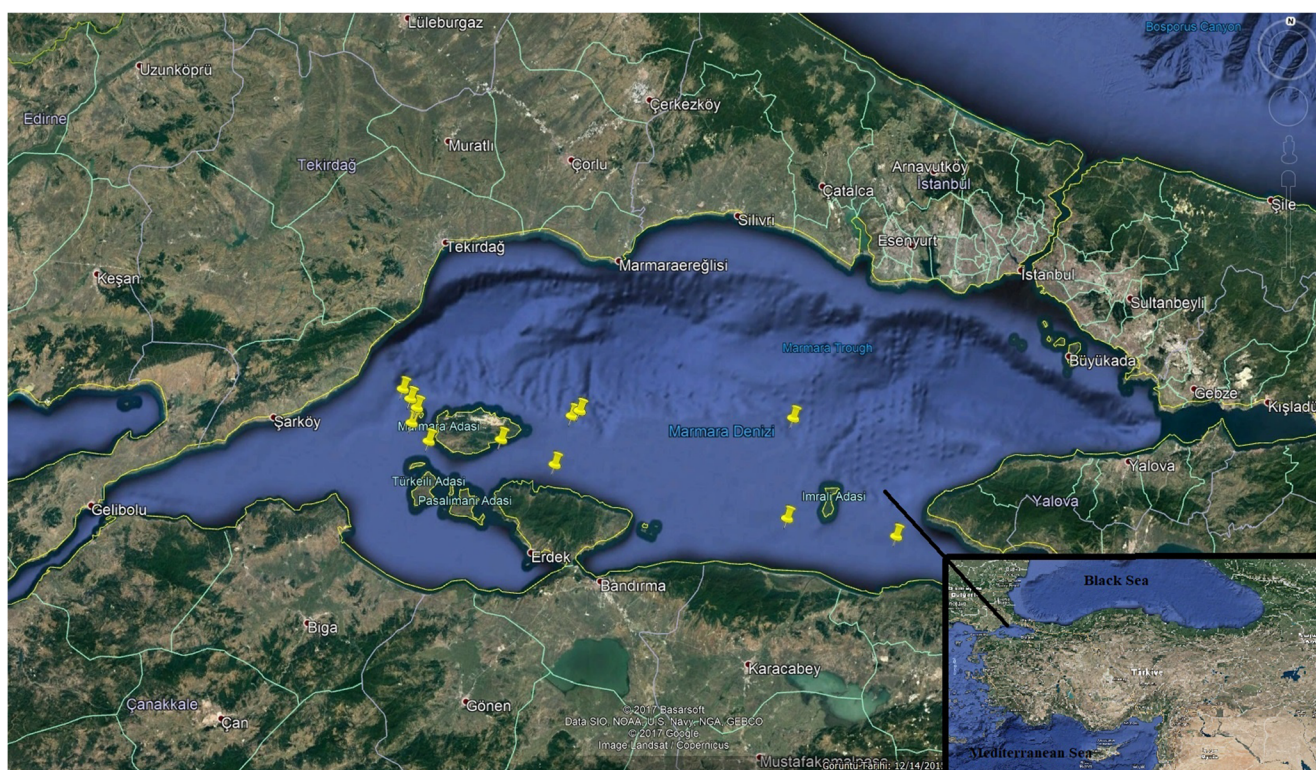


Fig. 1 Satellite image of sampling area in Sea of Marmara (Google Earth)

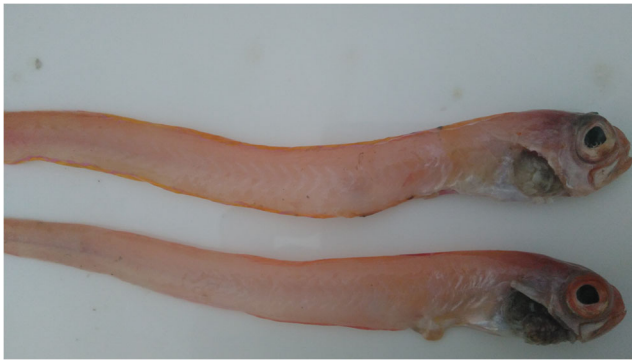


Fig. 2 *Elthusa sinuata* comb.nov. (Ovigerous female) on the right gill chamber of the red bandfish

Fig.62–93, pl. I, 2–3.—Dollfus and Trilles 1976: 827, 829.—Trilles 1977: 16.—Rokicki 1984: 1–220, fig.1–68.—Rokicki 1985: 95–122.—Trilles et al. 1989: 279–306, Fig.13.

All parasites were attached to the right gill cavity of the host. The dorsal surface of parasites were turned to inward of the gill cavity (Fig. 2). The prevalence of parasites was 13.3% (12 infected of 90 red bandfish). Total parasite number and dissected parasite number were 12 females and 4 females, respectively.

Description of ovigerous female (Figs. 3, 4, 5, 6 and 7): Body length varies from 0.81 to 1.42 cm. Body width varies from 0.41 to 0.74 cm. Body weakly twisted. Cephalon 0.6 times longer than wide, visible from dorsal view, immersed in pereonite 1. Body 2 times as long as greatest width, dorsal surfaces smooth and polished in appearance, widest at pereonite 5, most narrow at pereonite 1. Pereonite 1 longest, 2–4 progressively increasing in length, 5–7 progressively



Fig. 3 *Elthusa sinuata* comb.nov. (Ovigerous female)

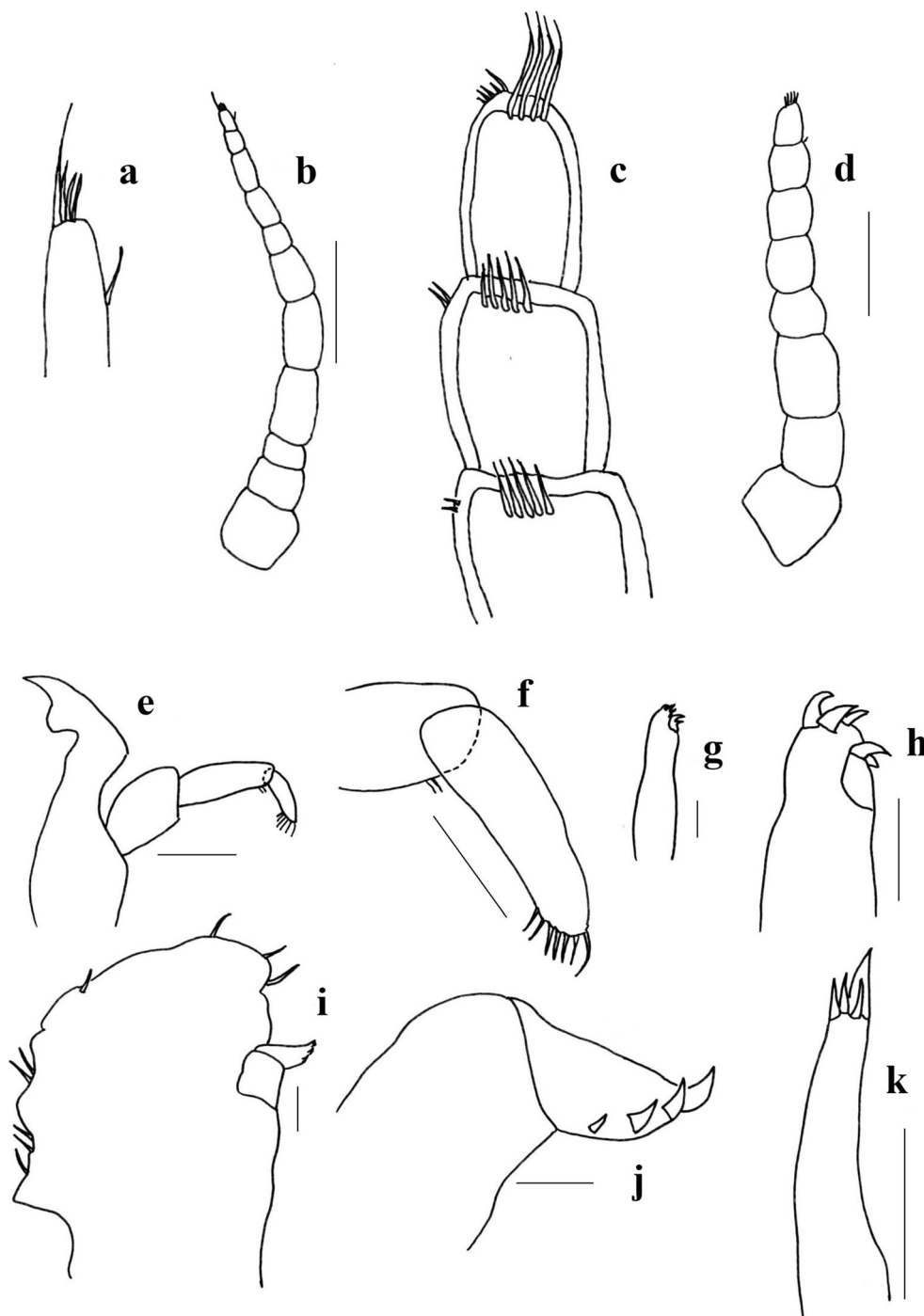
decreasing towards posterior in length. Posterior margin of pereonite 7 deeply curved. Frontal margin apex subacute. Eyes trapezoid (well-developed), 0.3–0.35 times width of head. Coxal plates of pereonites 2–7 visible in dorsal view. Coxae 1–2 posteroventral margins rounded; 3–7 posteroventral margins acute. All pleonites similar length, visible in dorsal view; pleonites 2–5 similar in width; first pleonite distinctly narrow than other. Pleonite 1 overlapped by pereonite 7. Pleotelson 0.62–0.68 times as long as anterior width, dorsal surface with 2 sub-medial depressions, lateral margins and posterior margin rounded. Pleotelson not wider than seven pleonite.

Antenna (Fig. 4a, b) comprised of 11 articles, extending to anterior margin of pereon 1. Antennula (Fig. 4c, d) comprised of 8 articles; extending to posterior margin of eye. The medial part of every article of antennula with 4–5 setae. Labrum lateral margins concave, anterior margin rounded. Mandibular (Fig. 4e, f) process without simple setae, mandible palp article 2 with 2 setae, article 3 with 7 setae. Maxillula (Fig. 4k) simple, with 4 terminal robust setae, one long and three short. Maxilla (Fig. 4g, h) mesial lobe with 2 recurved robust setae, lateral lobe with 3 recurved setae. Maxilliped (Fig. 4i, j) comprised of 3 articles, with lamellar oostegite lobe, palp article 2 without simple setae, article 3 with 3–4 recurved robust setae.

Pereopods (Fig. 5a–g) gradually increasing in length. Pereopods 1–3 slightly smaller than 4–7. The carpus of sixth and seventh pereopod (Fig. 7) with one chitinous protrusion. The basis of 4–7 pereopods longer than 1–3 pereopods. Pereopod 1 basis 1.16 times as long as greatest width; ischium 0.6 times as long as basis; merus proximal margin with bulbous protrusion; carpus with straight proximal margin; propodus 1.2 times as long as wide; dactylus slender, 1.4 times as long as propodus, 1.08 times as long as basal width. Pereopod 7 basis 2 times as long as greatest width; ischium 1.8 as long as basis, without protrusions; merus proximal margin with slight bulbous protrusion, merus 0.3 as long as ischium, 0.6 times as long as wide; carpus 0.38 as long as ischium, 0.7 times as long as wide; propodus 0.5 as long as ischium, 1.1 times as long as wide; dactylus slender, 1.5 as long as propodus.

Pleopods (Fig. 6a–e) gradually decreasing in length. Peduncles of pleopods 1–4 with 4–9 coupling hooks irregularly. Endopod of pleopods 2–5 with proximomedial lobe, pleopod 1 without it. Pleopod 1 exopod 1.2 times as long as wide, lateral margin strongly convex, distally broadly rounded, mesial margin straight; endopod 1.4 times as long as wide, lateral margin convex, distally broadly rounded, mesial margin straight; peduncle 3.5 times as wide as long, without retinaculae. Pleopods 2–5 similar to pleopod 1. Uropods (Fig. 5h, i) slightly beyond the margin of pleotelson. Exopod slightly larger than endopod. Uropod peduncle lateral margin without spines. Exopod terminal with two setae.

Fig. 4 *Elthusa sinuata* comb.nov. **a** Tip of antenna, **b** Antenna (0.46 mm), **c** Tip of antennula, **d** Antennula (0.29 mm), **e** Mandible (0.31 mm), **f** Tip of mandible (0.08 mm), **g** Tip of maxilla, **h** Maxilla (0.13 mm), **i** Maxilliped (0.14 mm), **j** Tip of maxilliped (0.05 mm), **k** Maxillula (0.32 mm)

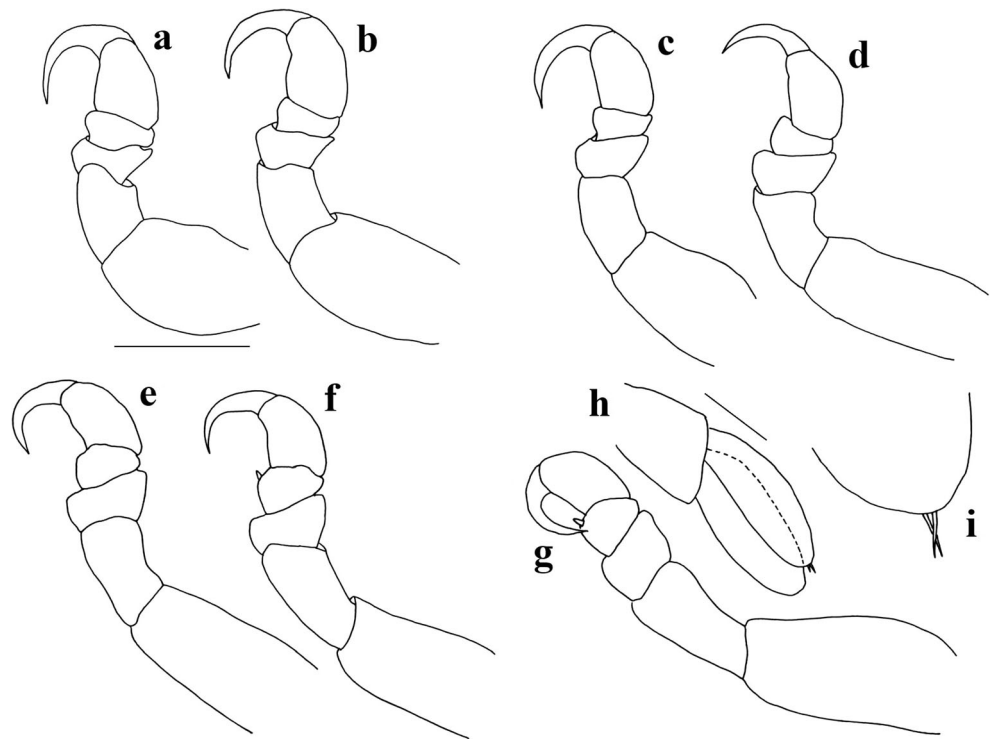


Discussion

Elthusa sinuata comb.nov. was first collected by Koelbel in 1879. It was reported from the Mediterranean Coasts (Koelbel 1879; Schioedte and Meinert 1884; Carus 1885; Gourret 1891; Gerstaecker 1901; Galati-Mosella 1920; Brian 1921; Trilles 1968; Trilles and Raibaut 1973; Dollfus and Trilles 1976; Trilles 1977; Rokicki 1984; Trilles et al. 1989; Trilles and Öktener 2004; Trilles 2008; Öktener et al. 2009).

Elthusa sinuata comb.nov. has been collected on hosts from several fish species as *Cepola macrophthalmia* (Koelbel 1879; Carus 1885; Galati-Mosella 1920; Brian 1921; Trilles 1968; Trilles and Raibaut 1973; Rokicki 1985; Trilles et al. 1989); *Pleuronectes* sp. (Monod 1924); *Raja miraletus* (Pisces; Rajidae) (Trilles and Raibaut 1973; Rokicki 1985); *Boops boops* (Pisces; Sparidae) and *Gobius* sp. (Pisces; Gobidae) (Dollfus and Trilles 1976); *Brama brama* (Pisces; Bramidae), (Rokicki

Fig. 5 *Elthusa sinuata* comb.nov. (Ovigerous female) (**a–g**) Pereopods 1–7 (0.74 mm), (**h**) Uropod (0.44 mm), **i** Apex of exopod

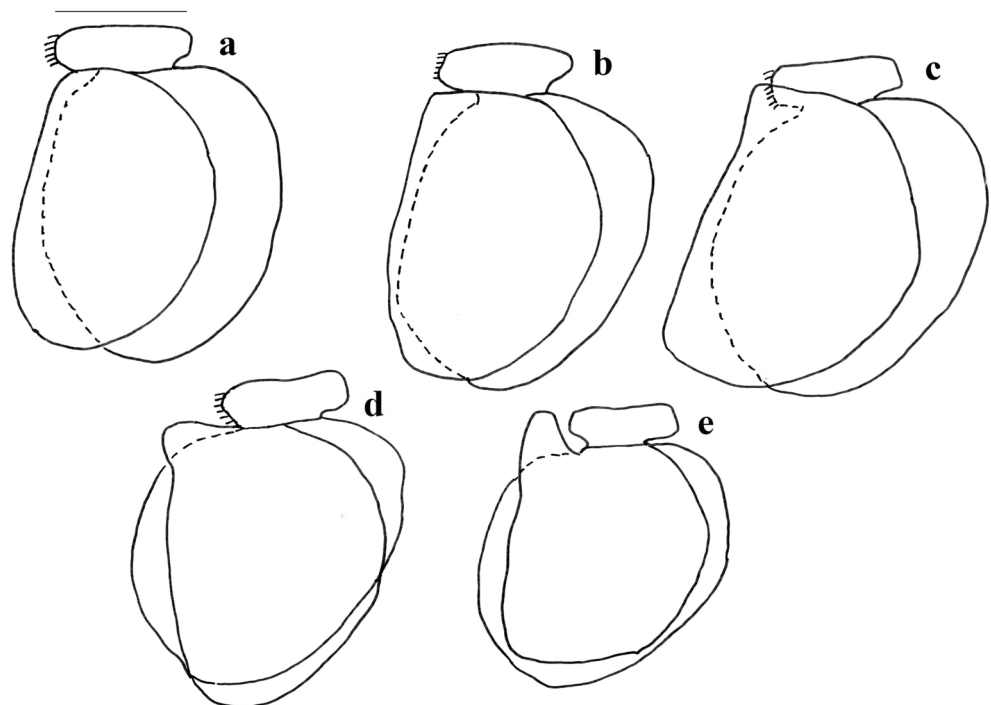


1985; Bello and Mariniello 1998); *Lepidopus caudatus* (Pisces; Trichiuridae) and *Trichiurus lepturus* (Pisces; Trichiuridae) (Bello and Mariniello 1998); *Raja clavata* (Pisces; Rajidae), *Argentina sphyraena* (Pisces; Argentinidae) (Öktener et al. 2009). It has been reported from two cephalopod species *Sepiolo ligulata* (Cephalopoda; Sepiolidae) from Adriatic Sea (Bello and

Mariniello 1998); *Loligo vulgaris* (Cephalopoda; Loliginidae) from Aegean Coasts of Turkey (Trilles and Öktener 2004).

There are limited studies on the morphology including mouthparts, pleopods, and pereopods of *Elthusa sinuata* comb.nov. (Schioedte and Meinert 1884; Kussakin 1979; Trilles 1976a). Especially, the taxonomic characters found

Fig. 6 *Elthusa sinuata* comb.nov. (Ovigerous female) (**a–e**) Pleopods 1–5 (1.02 mm)



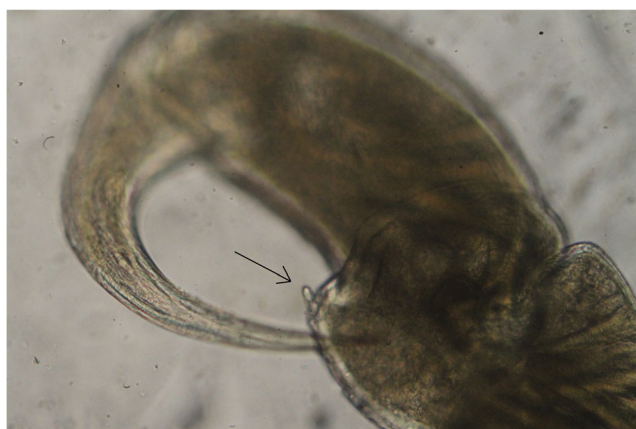


Fig. 7 One chitinous protrusion at carpus of seventh pereopods of *Elthusa sinuata* comb.nov.

the specimens have been compared to all characters of species described by Trilles (1976a).

Table 1 Comparison of some characters differentiating *Elthusa* (syn. *Livoneca*) *sinuata* from *Elthusa atlantniroi* and *Elthusa vulgaris*

	<i>Elthusa atlantniroi</i> (Kononenko 1988)	<i>Elthusa vulgaris</i> (Stimpson, 1857) described by Brusca (1981)	<i>Elthusa</i> (syn. <i>Livoneca</i>) <i>sinuata</i> (Koelbel 1879)
Antennula	6–8 articles	8 articles	8 articles
Antenna	11–13 articles	10–11 articles	11 articles
Mandible palp article 3 and 2	5 setae	4–2	7–2 setae
Spine number on medial/lateral lobe of maxilla	2/2	2–4/2–4	2/3
Spine number on maxillula	3	4 (not clear)	4
Spine number on maxilliped article 3	2	2–4	3–4
Setae on carpus of sixth and seventh pereopod	Not present	Not present	present
Presence of setae on uropod terminal	Not present	Not present	Two setae
Exopod/endopod		subequal	exopod longer than endopod
Coupling hook number on medial peduncle margin of pleopods		4	4–9
Presence of proximomedial lobe on endopods of pleopod		Present on all	Present on 2–5

Although *Elthusa atlantniroi* (Kononenko 1988) and *Elthusa vulgaris* (Stimpson, 1857) are two species reported from very distant regions and other very different hosts, they are most similar to *Elthusa sinuata* comb.nov., morphologically (Table 1).

The record of *Elthusa sinuata* comb.nov. in Turkish waters brings the total number of the valid genus of cymothoids recorded in that region to seven.

Acknowledgements The samples identified in this study were obtained in the sampling area of study for TAGEM/HAYSUD/2011/A11/P-02/2 Project carried by Sheep Research Institute and supported by Ministry of Food, Agriculture and Livestock of Türkiye. The authors gratefully acknowledge the following individuals for technical and facility support: Dr.Kerry Hadfield Malherbe verified *Elthusa* genus; Dr. Alessandro Ceregato, Rita Mascolo, Giovanni Maffei for obtain scanned literature. First author dedicates this paper to the memory of Professor Murat Sezgin, who passed away in the traffic accident.

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