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Morphological Characters of Two Cymothoid Isopods: *Ceratothoa oestroides* (Risso, 1816) and *Ceratothoa parallela* (Otto, 1828) from Turkey

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Abstract: This paper aims to present morphological characters of two species of cymothoid isopods, *Ceratothoa oestroides* and *Ceratothoa parallela* from Turkey. Although *Ceratothoa* species were previously reported by Turkish researchers, in particular, it is necessary to indicate to refer to the mouthparts and other body extremities of Turkish *Ceratothoa* species with photos and drawings. In addition, the pleopods 1 to 5 having peduncle medial margin with four hooks in *Ceratothoa* species which are found for the first time in this study as distinct from other studies. The detailed description of the morphological features of these two parasite species are given in the present article.

Keywords: Turkey, *Ceratothoa*, Isopoda, Cymothoidae, Morphology.

Introduction

The Cymothoidae is a family of ectoparasitic isopods found on body, fins, or inside the buccal or branchial cavities of numerous freshwater and marine fish species. They are protandrous hermaphrodites (Bariche & Trilles, 2005). Several studies were carried out to determine the effect of the cymothoids on host fishes in aquaculture (Mladineo, 2002; Horton & Okamura, 2003; Çolak et al., 2017). Mladineo (2002) found a significant decrease in weight of sea bass infested with *C. oestroides*. Horton & Okamura (2003) searched the blood parameters of cultured sea bass which was infected with *C. oestroides* in Turkey. They indicated that the infested fishes by this parasite had low erythrocyte counts, haematocrit and haemoglobin with high leucocyte counts. Çolak et al. (2017) examined the effects of *C. oestroides* on cultured meagre in the Adriatic Sea and they found the parasite causing the deformation of infested fishes.

Thirty species of *Ceratothoa* were enlisted by The World Register of Marine Species (WoRMS, 2018). Five species of this genus (*C. capri*, *C. italica*, *C. oestroides*, *C. parallela* and *C. steindachneri*) were reported from Turkish waters, but limited descriptions were included (Kırkı, 1998; Öktener & Trilles, 2004).

The present paper reports the morphological characters of *C. oestroides* and *C. parallela* from Turkish waters.

Material and Methods

Thirty-six *Pagellus erythrinus* (Linnaeus, 1758), 38 *Spicara maena* (Linnaeus, 1758), 12 *Lithognathus mormyrus* (Linnaeus, 1758) and 78 *Boops boops* (Linnaeus, 1758) were collected by local gears from the Aegean Sea and the Sea of Marmara of Turkey during 2014. The collected parasites were fixed in 70% ethanol. Mouthparts and pleopods were dissected out by using Wild M5 stereo microscope. Dissected parts were mounted on slides in

glycerine-gelatine mounting medium. The pleopods of isopods were stained with methylene blue. The drawings of appendages were carried out with the aid of a camera Lucida (Olympus BH-DA). The photos were taken with the aid of Canon EOS 1100D camera attached to a microscope. The measurements were taken in millimeters (mm), with a micrometric programme (Pro-way). The scientific names and synonyms of both parasites and hosts were checked with WoRMS (2018) and Froese & Pauly (2018), respectively. Identifications and comparisons of parasites were performed according to Schioedte & Meinert (1883), Montalenti (1948), Trilles (1968, 1972), Kırkım (1998), Horton (2000) and Hadfield et al. (2016).

Results and Discussion

In this parasitological study, two species of cymothoid isopods (*C. oestroides* and *C. parallela*) from Turkey waters were identified.

Ceratothoa oestroides (Risso, 1816) (Figures 1-7)



Figure 1: *Ceratothoa oestroides* (♀).

Hosts: *Pagellus erythrinus* and *Spicara maena*.

Infestation site: Mouth cavity.

Locality: Edremit Bay and Bandırma Bay.

Museum number: MNHN-IU-2013-18752.

Prevalence: 11.1% on *P. erythrinus* and %15.7 on *S. maena*.

Female: Body length varies from 20 to 28 mm. Cephalon two times as wide as long. Body long and oval, about 2.7-3 times as long as wide, longest at pereonites 1-4, shortest at 6-7 pereonites. Body width increasing step by step from first to fourth, later decreasing. Pereon

widest at pereonite 5, most narrow at pereonite 1. All pleonites visible, first pleonite distinctly narrow, 3-5 pleonites slightly wider. Pleonites equal in length. Pleonite 1 overlapped by pereonite 7. Pleotelson wider than long. Pleotelson 0.6 times as long as wide, posterior margin broadly rounded. Pleotelson not wider than seven pleonites. Coxal plates of pereonites 1-4 inconspicuous, those of 5-7 visible in dorsal view.

Antennule extending to middle of eye, composed of seven articles. Antenna extending to posterior margin of eye, composed of nine articles. Mandible palp third article distinctly shorter than others, with setae on lateral margin of it. Maxillula with four terminal spines, one long and three short. Maxilla with double row spines. Maxilla medial lobe with 4-7 spines, lateral lobe with 6-12 spines. Maxilliped of ovigerous female with oostegial lobe and distal palp with three apical recurved spines on article 3; three apical recurved spines on article 3 of non-ovigerous female.

Pereopods gradually increasing in length, all without spines; pereopods 1-3 slightly smaller than pereopods 4-7. Merus expansions on 1-3 pereopods distinct than 4-7. Pleopods gradually decreasing in length. Pleopods peduncle with four irregular hooks, but pleopod 3 generally least one hook. Uropods extending to, or slightly beyond margin of pleotelson. Exopod and endopod ramus subequal in length.

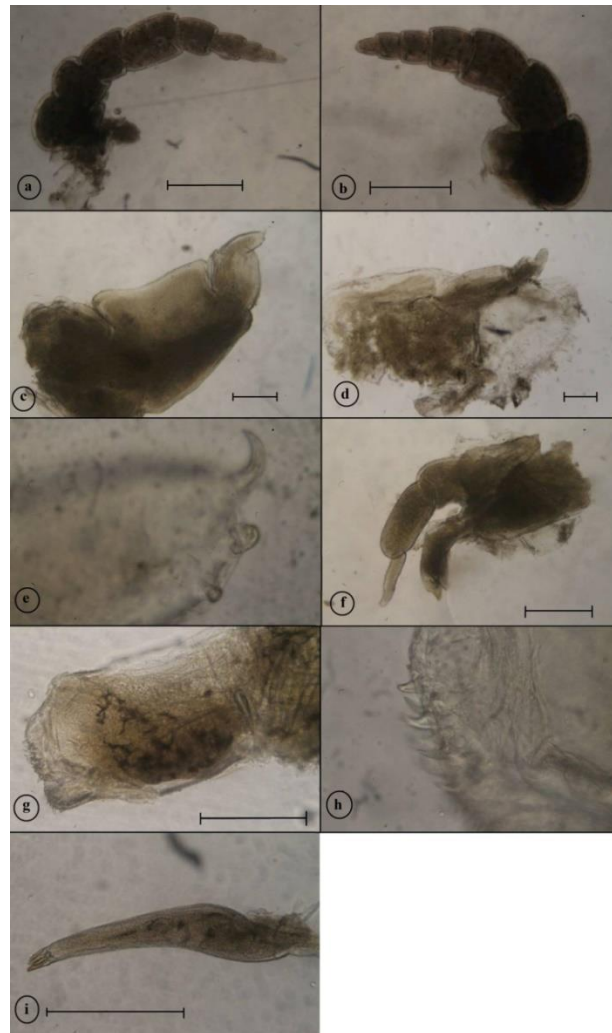


Figure 2: *Ceratothoa oestroides* (♀): (a) Antenna (0.50 mm); (b) antennule (0.50 mm); (c) non-ovigerous maxilliped (0.21 mm); (d) ovigerous maxilliped (0.25 mm); (e) distal part of maxilliped; (f) mandible (0.54 mm); (g) maxilla (0.50 mm); (h) distal part of maxilla; (i) maxillula (0.45 mm).

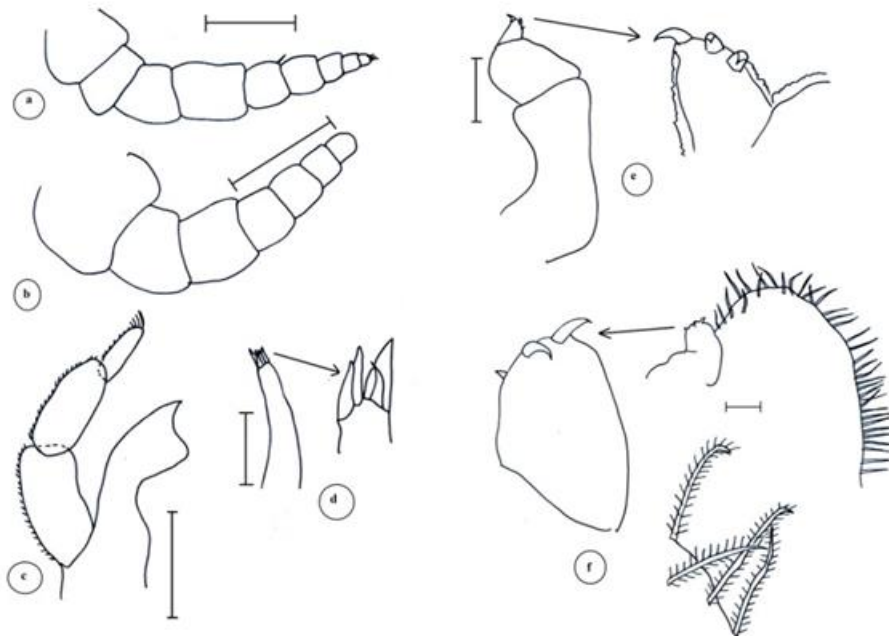


Figure 3: *Ceratothoa oestroides* (♀): (a) Antenna (0.50 mm); (b) antennule (0.50 mm); (c) mandible (0.53 mm); (d) maxillula (0.45 mm); (e) non-ovigerous maxilliped (0.29 mm); (f) ovigerous maxilliped (0.25 mm).

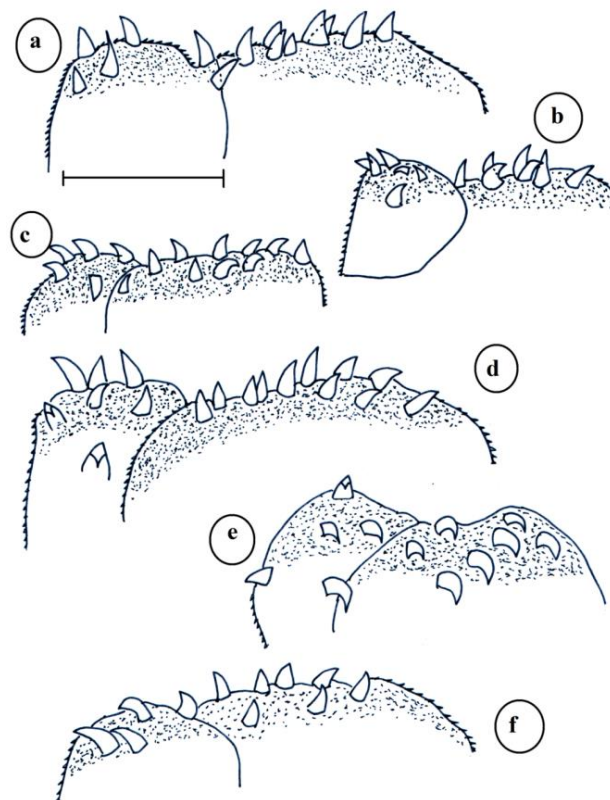


Figure 4: *Ceratothoa oestroides* (♀): (a-f) Spines on lateral and medial lobes of maxilla (0.13 mm).

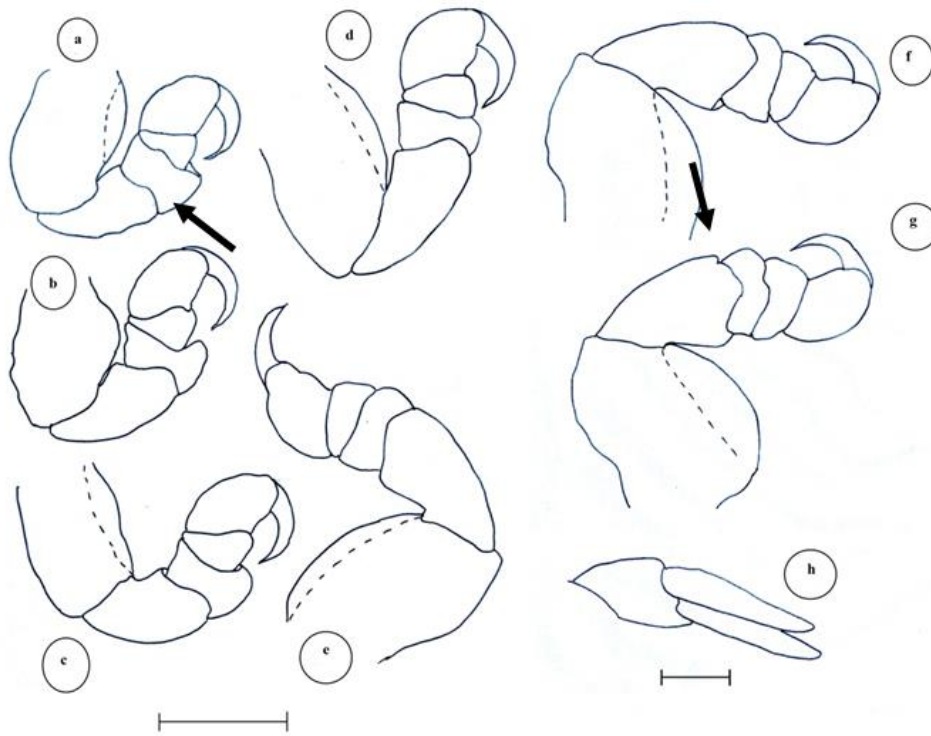


Figure 5: *Ceratothoa oestroides* (♀): (a-g) Pereopods I-VII (1.5 mm); (h) uropod (0.88 mm).

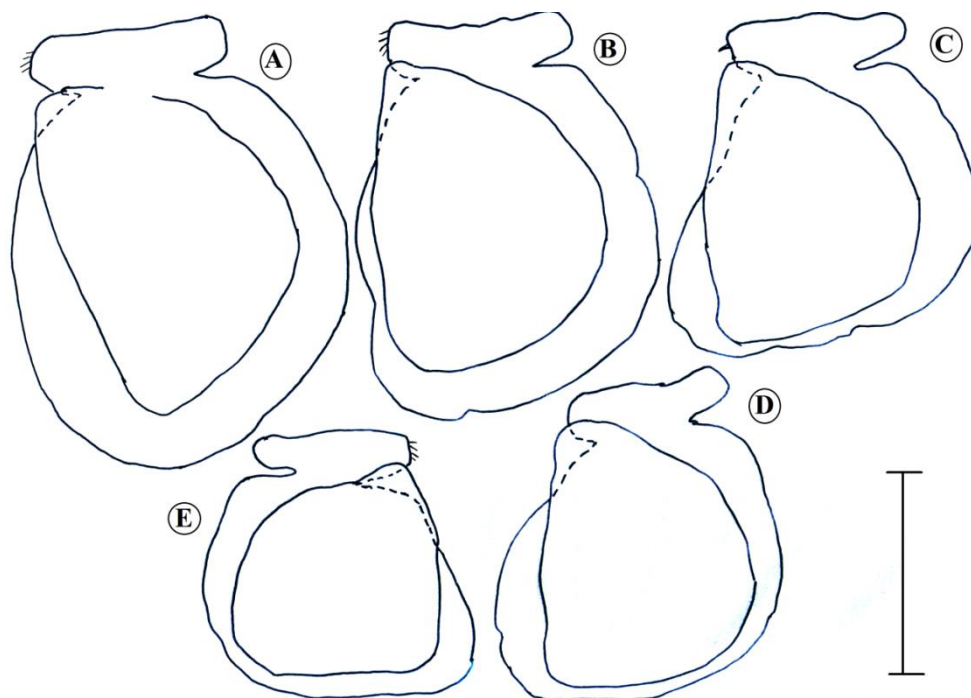


Figure 6: *Ceratothoa oestroides* (♀): (a-e) Pleopods I-V (1.8 mm).

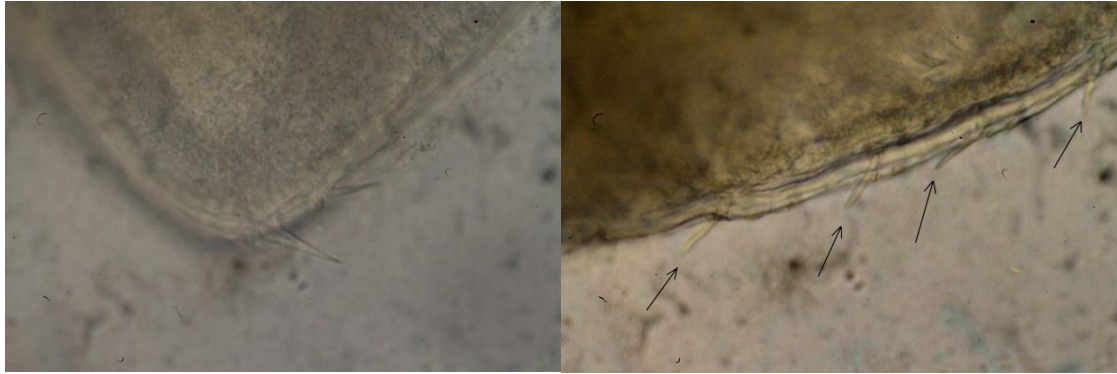


Figure 7: *Ceratothoa oestroides* (♀): Hooks on medial of pleopod peduncle.

Distribution: North Atlantic Ocean, Mediterranean Sea (Trilles, 1994; Hadfield et al., 2016).

Hosts: This species was reported on many host species of Sparidae and Centranchidae. It was also rarely collected from different fish families such as Scorpaenidae, Carangidae, Mullidae, Clupeidae, Mugilidae, Sebastidae, Moronidae, Pomacentridae, Zeidae, Scombridae, Uranoscopidae, Trachinidae, Rajidae, Pomatomidae, Phycidae and Labridae (Trilles, 1994; Horton, 2000; Hadfield et al., 2016).

Hosts: Among the marine fish species which are known to be parasitized by *C. oestroides*, only previous records of its hosts (which are reported in the present investigation) will be mentioned here in order to economise space and references. Previously, this isopod was reported from *Pagellus erythrinus* by Trilles et al. (1989) and from *Spicara maena* by Gourret (1891), Montalenti (1948), Berner (1969), Charfi-Cheikhrouha et al. (2000), Öktener & Trilles (2004) and Kırkım et al. (2008).

Remarks: *C. oestroides* was reported from the Mediterranean Sea, the Aegean Sea and the Sea of Marmara coasts of Turkey from *S. maena*. However, *P. erythrinus* is considered in the present article as a new host for this species in Turkey.

The antennule with seven articles and antenna with nine articles, are found in this study. Antennule with seven articles and antenna with nine articles were previously reported by Schioedte & Meinert (1883), Montalenti (1948) and Hadfield et al. (2016). However, antennule with seven articles and antenna with eight articles were demonstrated by Trilles (1968, 1972) and Kırkım (1998). The maxillula with four terminal spines, found in the present study, is compatible with Montalenti (1948) and Trilles (1968, 1972). The medial lobe with 4-7 spines and lateral lobe with 6-12 spines of maxilla are found in this study, while medial lobe with two spines and lateral lobe with four spines were found by Montalenti (1948), medial lobe with seven spines and lateral lobe with eight spines was demonstrated by Trilles (1968) and medial lobe with three spines and lateral lobe with five spines were demonstrated by Trilles (1972). The third article with setae on lateral margin of mandible palp, found in this study, is compatible with Montalenti (1948) and Trilles (1968, 1972). Three spines on article 3 of maxilliped of ovigerous and non-ovigerous females are found in this study, while two spines on article 3 of maxilliped of non-ovigerous females were found by Montalenti (1948) and four spines on article 3 of female maxilliped were found by Trilles (1968). Morphological characters of *C. oestroides* were given in a key to the *Ceratothoa* which was prepared by Horton (2000) as "Pleotelson wider than long but not as wide as pereonite VII. Very prominent expansions of the merus on pereopods I-III, not significant on pereopods IV-VII. Body oval, widest as pereonite V." So, the morphological characters of the present investigation are compatible with Horton (2000). The hooks were determined on medial part of pleopod peduncle (Figure 7).

***Ceratothoa parallela* (Otto, 1828) (Figures 8-14)**Figure 8: *Ceratothoa parallela* (♀).

Hosts: *Lithognathus mormyrus* and *Boops boops*.

Infestation site: Mouth cavity.

Locality: Edremit Bay and Bandırma Bay.

Museum number: MNHN-IU-2013-18753.

Prevalence: 33% on *L. mormyrus* and 25.6% on *B. boops*.

Female: Body length varies from 18 to 27 mm. Body elongated and parallel sided, about 3.5-4 times as long as wide. Eyes distinct but often hidden by antennule and antenna. Pereon widest at pereonite 4, most narrow at pereonite 1. Sixth and seventh pereonites shortest, 1-5. pereonites subequal in length. All pleonites visible, first pleonite distinctly narrow, second pleonite slightly more wide than first. 3-5 pleonites distinctly wider than 1-2. Pleonites almost equal in length. Pleotelson wider than long, 2.8-3 times as long as wide, posterior margin broadly rounded.

Antennule extending to anterior of pereonite 1, composed of seven articles. Antenna extending to anterior of pereonite 1, composed of nine articles. Mandible palp third article distinctly shorter than others, third article with setae on its apex. Maxillula with four terminal spines, one long and three short. Maxilla with single row of spines. Maxilla medial lobe with 4-6 spines, lateral lobe with 4-9 spines. Maxilliped with oostegial lobe and distal palp with 5-7 apical recurved spines on article 3.

Pereopods slightly increasing in length, all without spines; pereopods 1-5 subequal in length. Sixth and seventh pereopods slightly longer than others. Basis expansions on upper and lower edges of sixth and seventh pereopods distinct than in pereopods 1-5. Pleopods gradually decreasing in length. Pleopods peduncle with four irregular hooks, but rarely with six hooks. Uropods extending to, or slightly beyond margin of pleotelson. Exopod ramus longer than endopod ramus.

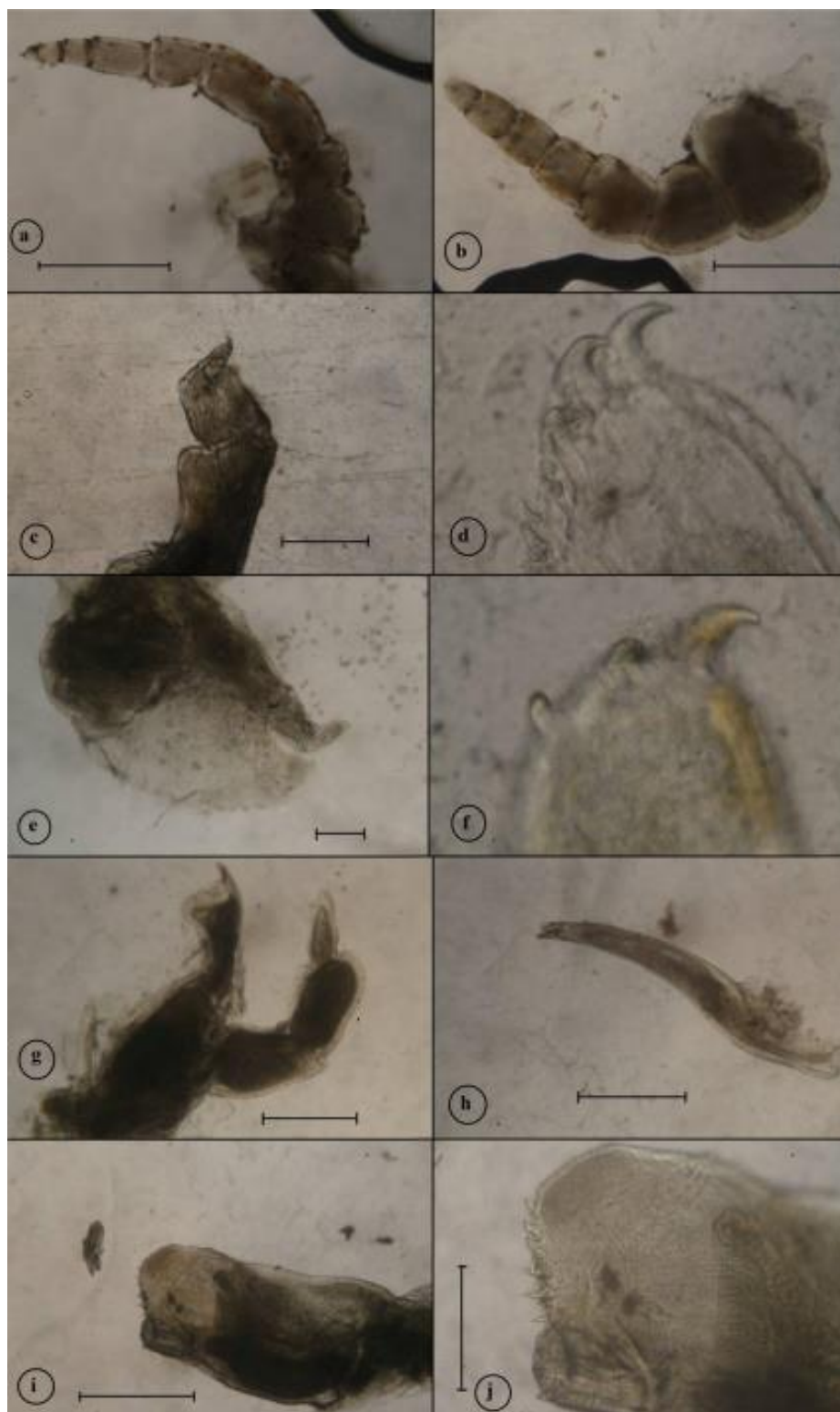


Figure 9: *Ceratothoa parallela* (♀): (a) Antenna (0.81 mm); (b) antennule (0.50 mm); (c) non-ovigerous maxilliped (0.65 mm); (d) distal of maxilliped; (e) ovigerous maxilliped (0.46 mm); (f) distal part of maxilliped; (g) mandible (0.65 mm); (h) maxillula (0.58 mm); (i) maxilla (0.54 mm); (j) distal part of maxilla (0.27 mm).

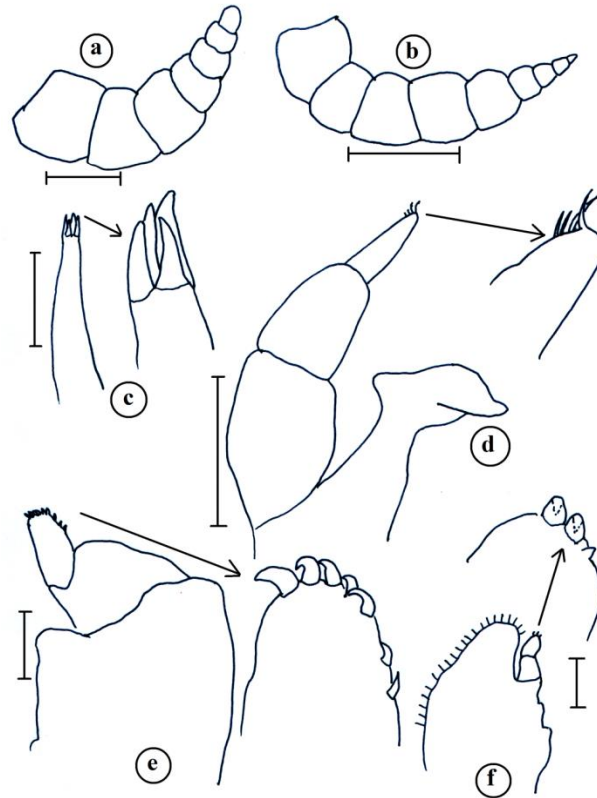


Figure 10: *Ceratothoa parallela* (♀): (a) Antennule (0.50 mm); (b) antenna (0.81 mm); (c) maxillula (0.58 mm); (d) mandible (0.65 mm); (e) non-ovigerous maxilliped (0.65 mm); (f) ovigerous maxilliped (0.46 mm).

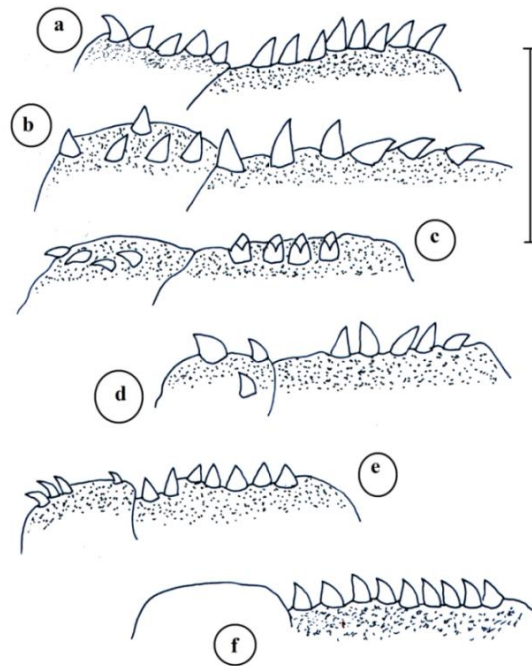


Figure 11: *Ceratothoa parallela* (♀): (a-f) Spines on lateral and medial lobes of maxilla (0.27 mm).

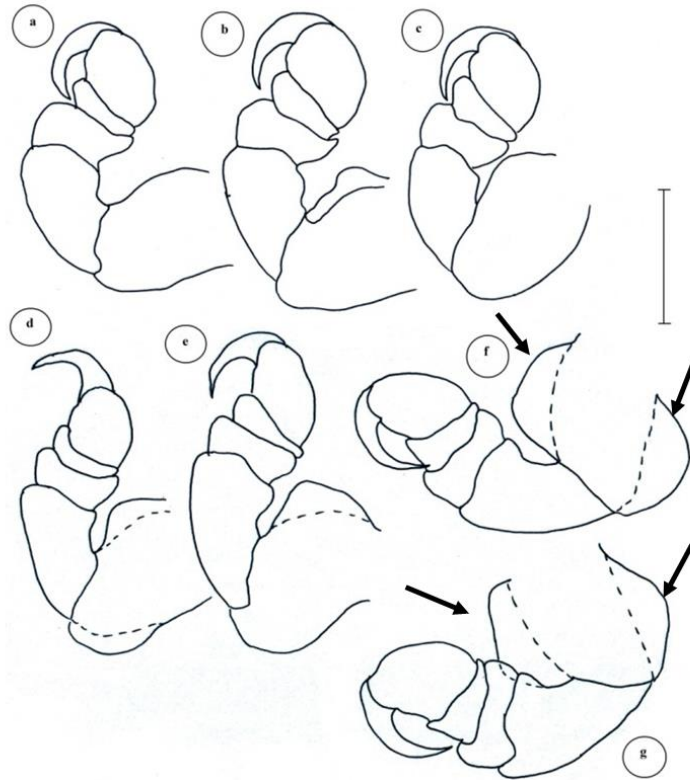


Figure 12: *Ceratothoa parallela* (♀): (a-g) Pereopods I-VII (1.33 mm).

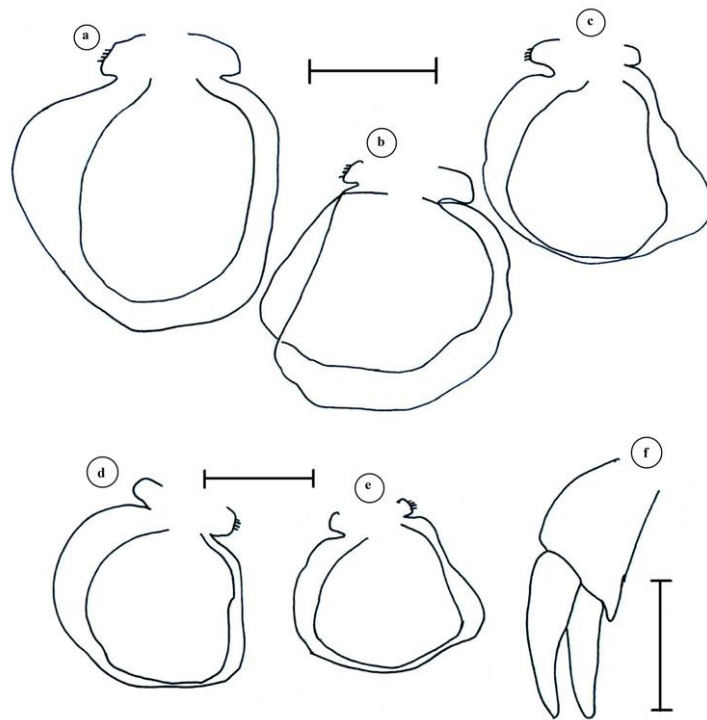


Figure 13: *Ceratothoa parallela* (♀): (a-e) Pleopods I-V (1.45 mm); (f). Uropod (1.70 mm).

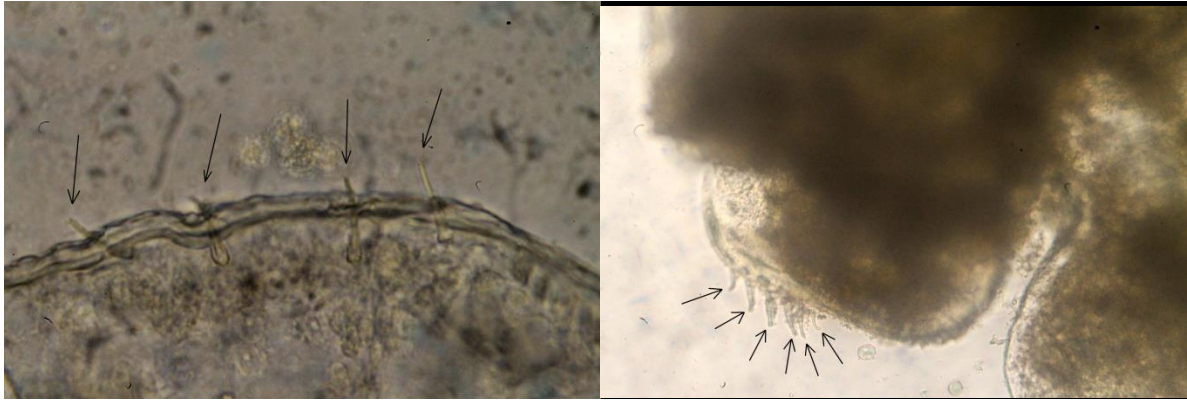


Figure 14: *Ceratothoa parallela* (♀): Hooks on medial of pleopod peduncle.

Distribution: Atlantic Ocean and Mediterranean Sea (Trilles, 1994).

Hosts: *C. parallela* was reported on many host species of Sparidae. It was also rarely collected from different fish families such as Merlucciidae, Rajidae, Centranchidae, Mullidae, Scorpaenidae, Gadidae, Carangidae, Zeidae and Triglidae (Trilles, 1994; Horton, 2000; Hadfield et al., 2016).

Remarks: *L. mormyrus* is considered now as a new host for *C. parallela* in Turkey.

The antennule, with seven articles and antenna with nine articles, are found in the present study, while antennule with seven articles and antenna with nine articles were found by Trilles (1968, 1972) and Kırkım (1998). Antennule with seven articles and antenna with eight articles were found by Schioedte & Meinert (1883) and Montalenti (1948). The maxillula with four spines, found in the present study, is compatible with Trilles (1968, 1972), but it is different from the three spines found by Montalenti (1948). The medial lobe of maxilla with 4-6 spines and the lateral lobe with 4-9 spines are found in the present study, while medial lobe with four spines and lateral lobe with six spines were found by Montalenti (1948) and medial lobe with one spines and lateral lobe with six spines were found by Trilles (1968, 1972). The third article with setae on lateral margin of mandible palp, found in this study, is compatible with Trilles (1968, 1972), but it is different from the mandible palp without setae which was found by Montalenti (1948). Three spines on article 3 of maxilliped of ovigerous females and 6-7 spines on article 3 of maxilliped of ovigerous females are found in the present study, while two spines on article 3 of maxilliped of non-ovigerous females were found by Montalenti (1948), five spines on article 3 of maxilliped of non-ovigerous females were reported by Trilles (1968) and six spines on article 3 of maxilliped of non-ovigerous females were stated by Trilles (1972). Morphological characters of *C. parallela* were given in a key to the *Ceratothoa*, prepared by Horton (2000) as “Expansions of the basis of pereopods VI and VII on both upper and lower edges; body distinctly parallel sided not round or oval.” So, the morphological characters of the present investigation are compatible with Horton (2000). The hooks were determined on medial part of pleopod peduncle (Figure 14).

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