First record of ceratothoa oxyrrhynchaena (Isopoda: Cymothoidae) from Turkish marine waters

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First Record of *Anilocra physodes* (Isopoda, Cymothoidae) on the *Phycis blennoides* (Pisces; Phycidae) with Morphological Characters and Hosts Preferences

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Abstract

Anilocra physodes (Linnaeus, 1758) (Isopoda, Cymothoidae) is reported for the first time on *Phycis blennoides* (Brünnich, 1768) (Pisces; Phycidae) from the North Aegean Sea Coasts of Turkey. The present paper aims to present the morphological characters of *Anilocra physodes* from Turkey. Some morphological characters of this parasitic isopod are illustrated. A new host species for *Anilocra physodes* and the host's preferences with it, according to family characteristics, habitat selections, feeding habits, are presented.

Keywords: *Anilocra*, Cymothoidae, Isopoda, morphology, *Phycis*, Turkey.

1. Introduction

Cymothoids are ectoparasitic isopods on the body, fins, or inside the buccal or the branchial cavities of numerous freshwater and marine fishes. They are the protandrous hermaphrodite (Bariche and Trilles, 2005). Cymothoids are serious parasites currently affecting a number of fish farms in the World (Sarusic, 1999; Papapanagiotou *et al*., 1999; Papapanagiotou and Trilles, 2001).

The family Cymothoidae includes 43 genera according to Hadfield *et al*. (2017). Although that Cymothoidae family is well-known, there are some deficiencies from the taxonomic point of view. Studies concerned with molecular and morphological are needed on this family according to some researchers (Poore and Bruce, 2012; Martin *et al*., 2013; Hadfield *et al*., 2016).

Fifty-one species in the genus *Anilocra* were listed by The World Register of Marine Species (Bruce and Schotte, 2008). Two species (*Anilocra physodes* and *Anilocra frontalis*) were reported from Turkish waters, but these studies include limited information about the morphology of mouth-parts (Öktener and Trilles, 2004; Kırkım, 1998).

The present study aims to report a new host species for *Anilocra physodes* and its host preference according to family characteristics, habitat selections, feeding habits.

2. Material and Methods

Seventy greater forkbeard, *Phycis blennoides* (Brünnich, 1768) (Pisces; Phycidae) were collected from the North Aegean Sea in 2014. Collected parasites were fixed in 70% ethanol. Mouthparts and pleopods were dissected using a Wild M5 stereo microscope. The dissected parts were mounted on slides in a glycerin-gelatine mounting medium. The pleopods were stained with methylene blue. The appendages were drawn with the aid of a camera lucida (Olympus BH-DA). The photos were taken with the aid of Canon camera (EOS 1100D) attached to the microscope. Measurements were taken in millimeter (mm) with a micrometric program (Pro-way). Scientific names, synonyms were checked with the WoRMS Editorial Board (2018). The information of feeding habits, habitat characteristics of the host were prepared according to Froese and Pauly (2017). Specimens of *Anilocra physodes* were deposited in the collections of the Muséum National d'Histoire Naturelle (MNHN), Paris, France (MNHN-IU-2013-18754).

3. Results

Anilocra physodes (Linnaeus, 1758) (Figures 1-5)

Synonyms

Oniscus physodes Linne, 1758: 636. —Linne, 1767: 1060. —Fabricius, 1787: 241

Asellus physodes Olivier, 1789: 255

Cymothoa physodes Fabricius, 1793: 507

Idotea physodes Fabricius, 1798: 320

Anilocra cuvieri Leach, 1818: 350. —Desmaret, 1825: 306. —White, 1847: 109. —Lucas, 1850: 250. —Ellis, 1981: 123. —Bruce, 1987: 91

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Anilocra mediterranea Leach, 1818: 350.—Desmaret, 1825: 306.—Audouin, 1826: 94, pl.11, fig.10-11.—Edwards, 1833: 321-334, pl.14.—Edwards, 1839: 66, fig.1.—Edwards, 1840: 257.—White, 1847: 108.—Lucas, 1850: 250.—Hope, 1851: 32.—Heller, 1866: 741.—Barcelo Combis, 1875: 67.—Bullar, 1877: 254-256.—Stalio, 1877: 234.—Mayer, 1879: 165-179.—Stossich, 1880: 46.—Saint-Loup, 1885: 175-176.—Gourret, 1891: 13-14, pl.I, fig.8.— Ide, 1892: 106, pl.VII, fig.84-92.—Bolivar, 1892: 132.—Gerstaecker, 1901: 255,257, taf.XXVI, fig.2.—Gourret, 1907: 50,89.—Coulon, 1908: 92.—Gibert i Olive, 1919-1920: 87.—Zimmer, 1926-1927: 746.—Gunther, 1931: 1-79.—Demir, 1952-1954: 363-364, fig.150,tab.VI(fig.3).—Balcells, 1953: 550.—Fain-Maurel, 1966: 7-10, fig.1-3.—Ellis, 1981: 123

Canolira albicornis Guérin, 1832-1835: 48.—Gerstaecker, 1901: 257

Anilocra physodes Edwards, 1840: 257.—Lucas, 1849: 77.—Hope, 1851: 32.—Heller, 1866: 741.—Stalio, 1877: 234-235.—Stossich, 1880: 46.—Schioedte and Meinert, 1881: 131-139, tab.IX, fig.4-7.—Carus, 1885: 441.—Saint-Loup, 1885: 175-176.—Buen, 1887: 14.—Bolivar, 1892: 132.—Gerstaecker, 1901: 255-257, taf.XXVI, fig.2.—Tattersall, 1905: 85.—Gourret, 1907: 89.—Nierstrasz, 1915: 80.—Buen, 1916: 363.—Nierstrasz, 1918: 115.—Gibert i Olive, 1919-1920: 87.—Monod, 1923a: 16-18.—Dudich, 1931: 18.—Monod, 1931: 496.—Nierstrasz,1931: 130.—Montalenti, 1941: 357-362, fig.9-11.—Montalenti, 1948: 63-67, tab.VII, 1-6, fig.24-25.—Holthuis, 1950: 7.—Amar, 1951: 530.—Balcells, 1953: 550.—Remy and Veillet, 1961: 54.—Lee, 1961: 470.—Trilles, 1962: 114-118, fig.8-9.—Trilles, 1964a: 110-116.—Trilles, 1964b: 365-369.—Trilles, 1964c: 127-134.—Trilles, 1965: 575-594.—Cicero, 1965: 119, 122-123,125-128, fig.5.—Quintard-Dorques, 1966: 10-11.—Fain-Maurel, 1966: 7-10, fig.1-3.—Trilles, 1968: 85-101, phot.18-21, pl.XXV-XXIX.—Macquart-Moulin, 1969: 266.—Berner, 1969: 93.—Trilles, 1969: 433-445.—Lagarrigue and Trilles, 1969: 117-136, phot.2.—Roman, 1970: 501-514.—Trilles and Raibaut, 1971: 80-81, pl.II.—Ktari-Chakroun and Azouz, 1971: 21.—Romestand, Trilles and Lagarrigue, 1971: 447-450.—Geldiay and Kocataş, 1972: 19, 23-24, fig.I.—Trilles and Raibaut, 1973: 275-276,280.—Romestand, 1974: 571-591, fig.1-13.—Thampy and John, 1974: 580-582.—Trilles, 1975: 347-354, fig.1-74, pl.I.—Lombardo, 1975: 301-316, fig.1-4, fig.5A-C.—Capape and Pantoustier, 1976: 203.—Romestand, Voss-Foucart, Jeuniaux and Trilles, 1976: 981-988.—Trilles, 1977: 10-12.—Romestand, Janicot and Trilles, 1977: 171-180, p.I-IV.—Romestand and Trilles, 1977: 91-95.—Rokicki, 1977: 178.—Holthuis, 1978: 29.—Brusca, 1978: 10.—Romestand and Trilles, 1979: 195-202.—Trilles, 1979: 514.—Romestand, 1979: 423-448, pl.I-IV.—Quignard and Zaouali, 1980: 357.—Williams and Williams, 1980: 578.—Renaud, Romestand, Trilles, 1980: 467-476, pl.I.—Brusca, 1981: 127.—Ellis, 1981: 123.—Korner, 1982: 248-250.—Radujkovic, 1982: 155-161.—Radujkovic, Romestand, Trilles, 1984: 161-181.—Rokicki, 1985: 95-122.—Rokicki, 1984: 1-220, figs.1-68.—Sartor, 1987: 49.—Segal, 1987: 351-360.—Bruce, 1987: 91.— Wägele, 1987: 1-398.—Trilles, Radujkovic and Romestand, 1989: 279-306, fig.1.—Avdeev, 1990: 32-42, fig.1-6.

Anilocra edwardsii Saint-Loup, 1885: 175-176.—Carus, 1885: 441.—Buen, 1916: 363

Anilocra frontalis Monod, 1923b: 84-85

Anilocra mediterranea Sanada, 1941: 209

Livoneca motasi Vasiliu and Carausu, 1948: 176-180, pl.1, fig.1-21

Nec Anilocra physodes (Linnaeus, 1758): Holthuis, 1950: 7.—Fryer, 1968: 40.—Lincoln, 1971: 185, fig.1.—Holthuis, 1972: 22-23, pl.I.—Lanzing and Connor, 1975: 360.—Holthuis, 1975: 65.—Huwae, 1977: 23

Host: Phycis blennoides

Locality: Babakale Port

Infection site: Caudal peduncul

Prevalence: 7.14%

Mean intensity: 1

Total parasite number: 5

Dissected parasite number: 4

Female morphological characteristics: Body (Figure 1) length varies from 25 to 35 mm. Body expands from anterior to posterior, later narrower at 7. pereonite. Body about 2-2.5 times as long as wide. The width of the head is about 2 times the head length. The eyes are small, 0.33 times at head width. Coxal plates visible in dorsal view, posterior margins with sharpened. Pereon longest at pereonite 1, shortest at pereonite 7. Pereon widest at pereonite 6, most narrow at pereonite 1. All pleonites visible in dorsal, the first pleonite distinctly narrow, 2-5. pleonites slightly wider. Pleon 1 largely and pleon 2 partially concealed by pereonite 7. Pleotelson 0.75 times as length as width, posterior margin broadly rounded. Pleotelson not wider than seven pleonite.

Antennula (Figures 2b, 3b) composed of 8 articles, antenna longer than antennula. Antenna (Figures 2 a, 3a) composed of 9 articles, extending to the middle of 1. pereon. Maxillula (Figures 2i, j, 3f) with four terminal spines, one long and three short. Maxilla (Figure 2e, f, 3d) medial and lateral lobe with 2 spines. Mandible (Figures 2 c, d, 3c) palp third article distinctly shorter than others. First and second article without seta, the third article with 16-20 seta. Maxilliped (Figures 2g, h, 3e) article 3 with three hooked spines.

Pereopods (Figures 4a-g) 1-5 nearly in size, 6-7 pereopods longer than others. The behind edge of carpus at all of pereopods include with one setae while only the front edge of the propodus, carpus, merus at seventh pereopod with various seta. Pleopods (Figures 5a-e) 1-3 nearly in size, pleopods 4-5 smaller than others. Pleopods 1 to 5 having peduncle medial margin with 4 hooks. The proximomedial lobe of pleopod 3-5 developed. Fifth pleopod with three curved structures. Uropods (Figure 4h). beyond margin of pleotelson. Exopod slightly larger than endopod. Endopod beyond slightly margin of pleotelson. Uropod peduncle without spines.

Figure 1. *Anilocra physodes* ♀

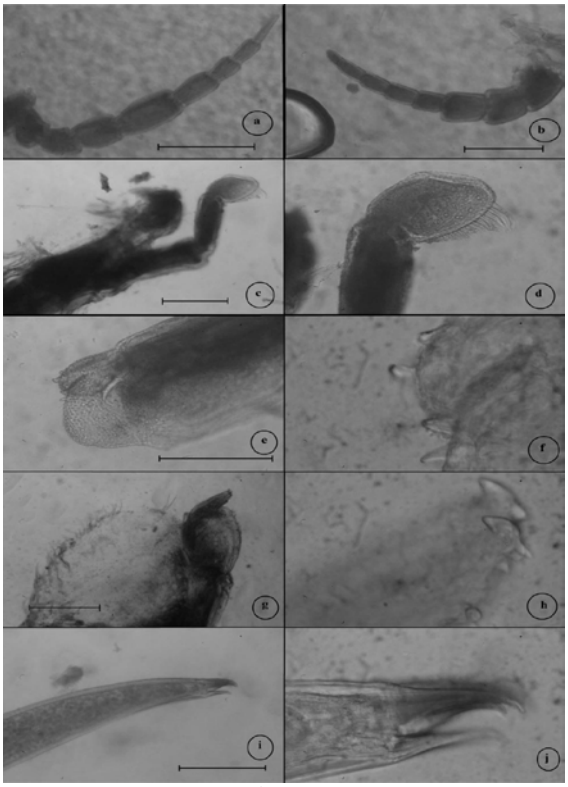

Figure 2. *Anilocra physodes* ♀, a) antenna (1.16mm), b) antennula (1.73mm), c) mandible (0.32mm), d) distal of mandible, e) maxilla (0.43mm), f) distal of maxilla, g) maxilliped (0.35mm), h) distal of maxilliped, i) maxillula (0.67mm), j) distal of maxillula.

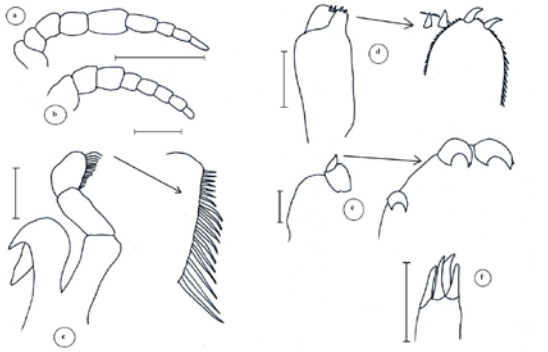

Figure 3. *Anilocra physodes* ♀, a) antenna (1.16mm), b) antennula (1.73mm), c) mandible (0.46mm), d) maxilla (0.43mm), e) maxilliped (0.35mm), f) maxillula (0.18mm).

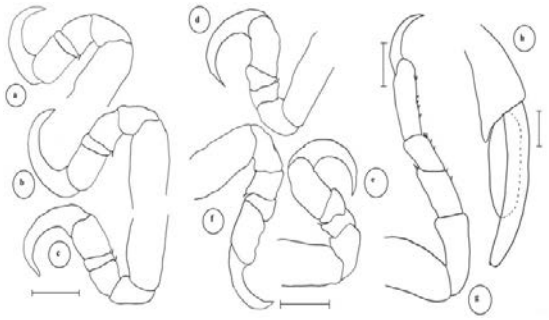

Figure 4. *Anilocra physodes* ♀, a) Pereopod I, b) Pereopod II, c) Pereopod III, d) Pereopod IV, e) Pereopod V, f) Pereopod VI, g) Pereopod VII (1.81mm), h) Uropod (0.72mm).

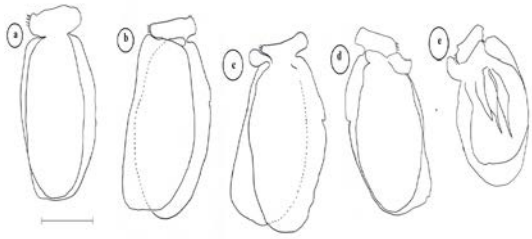

Figure 5. *Anilocra physodes* ♀, a) Pleopod I, b) Pleopod II, c) Pleopod III, d) Pleopod IV, e) Pleopod V (2.51mm).

4. Discussion

Anilocra physodes has been reported from North Atlantic Ocean, Mediterranean Sea, Adriatic Sea (Trilles, 1994). It is associated with Actinopterygii and Elasmobranchii (Table 1). The hosts' parasitism with *Anilocra physodes* was examined according to family characteristics, 28% of 57 hosts belong to Sparidae, %30 to Carangidae, Mugilidae, Centracanthidae, Sciaenidae, Mullidae, Scorpaenidae, 44% to 25 different families. The host's parasitism with *Anilocra physodes* was examined according to habitat selections; 40% of 57 species host fish species are demersal, 26% to benthopelagic, 16% to pelagic-neritic, 11% reef-associated, 5% pelagic-oceanic, 2% bathydemersal. The host parasitism with *Anilocra physodes* according to feeding habits; 68% of 57 species host fish species are carnivorous, 30% omnivorous, %2 herbivorous.

It may be said that this parasite selects the fishes with carnivorous and demersal character. In the present study, the examined *Phycis blennoides* is carnivorous and demersal character fish. It is fit as a preferred host for *Anilocra physodes*.

Table 1. *Anilocra physodes* and hosts

Host species	References
Boops boops	Balcells (1953); Berner (1969); Trilles and Raibaut (1973); Romestand *et al.* (1976); Trilles *et al.* (1989); Akmirza (1998); Charfi-Cheikhrouha *et al.* (2000); Bariche and Trilles (2005); Perez-del-Olmo (2008).
Diplodus annularis	Berner (1969); Trilles and Raibaut (1973); Papoutsoglou (1976); Trilles (1977); Trilles *et al.* (1989); Akmirza (2000); Charfi-Cheikhrouha *et al.* (2000); İnnal *et al.* (2007).
Spondyliosoma cantharus	Holthuis (1972); Trilles and Raibaut (1973); Dollfus and Trilles (1976); Akmirza (2000); Charfi-Cheikhrouha *et al.* (2000); Ramdane *et al.* (2007).
Pagellus erythrinus	Balcells (1953); Berner (1969); Trilles *et al.* (1989); Akmirza (2000); Bariche and Trilles (2005); İnnal *et al.* (2007); Kırkım *et al.* (2008).
Lithognathus mormyrus	Charfi-Cheikhrouha *et al.* (2000); Bariche and Trilles (2005); İnnal *et al.* (2007).
Merluccius merluccius	Balcells (1953); Trilles and Raibaut (1973); Trilles *et al.* (1989).
Spicara smaris	Demir (1952-1954); Berner (1969); Geldiay and Kocataş (1972); Trilles (1977); Trilles *et al*. (1989); Kırkım *et al.* (2008).
Diplodus vulgaris	Papoutsoglou (1976); Akmirza (2000); Öktener *et al.* (2010).
Mullus surmuletus	Papoutsoglou (1976).
Scorpaena porcus	Papoutsoglou (1976).
Umbrina cirrosa	Papoutsoglou (1976).
Solea solea	Papoutsoglou (1976).
Serranus scriba	Papoutsoglou (1976); Kırkım *et al.* (2008); Öktener *et al*. (2009).
Torpedo sp	Gibert i Olive (1919-1920).
Trigla sp	Gibert i Olive (1919-1920).
Lichia sp	Gibert i Olive (1919-1920).
Scorpaena sp	Gibert i Olive (1919-1920).
Naucrates ductor	Gibert i Olive (1919-1920).
Sardina pilchardus	Gibert i Olive (1919-1920), Lee (1961).
Liza ramada	Trilles (1977).
Sciaena sp	Trilles (1977).
Lophius piscatorius	Stalio (1877).
Oblada melanura	Berner (1969); Papoutsoglou (1976); Akmirza (2000);, Öktener *et al.* (2010).
Pagellus sp	Montalenti (1948); Geldiay and Kocataş (1972).
Dentex dentex	Trilles and Raibaut (1973); Trilles and Öktener (2009).
Pagellus acarne	Bariche and Trilles (2005).
Pagrus auriga	Trilles and Raibaut (1973).
Pomatomus saltatrix	Trilles and Raibaut (1973).
Pagrus caeruleostictus	Trilles *et al.* (1989); Bariche and Trilles (2005).
Sarpa salpa	Berner (1969); Papoutsoglou (1976).
Sciaena umbra	Charfi-Cheikhrouha *et al.* (2000); Kırkım *et al.* (2008).
Uranoscopus scaber	Charfi-Cheikhrouha *et al.* (2000).
Serranus hepatus	Trilles *et al.* (1989).
Trachinus draco	Trilles *et al.* (1989).
Atherina boyeri	Trilles *et al.* (1989).
Sparisoma cretense	Thorsen *et al.* (2000).
Siganus luridus	Shakman *et al.* (2009).
Trisopterus capelanus	Berner (1969).
Sparus aurata	Oğuz and Öktener (2007); Kırkım *et al.* (2008).
Spicara maena	Berner (1969); Dollfus and Trilles (1976); Akmirza (2001); Öktener *et al.* (2010);
Spicara sp	Montalenti (1948); Trilles and Raibaut (1973).
Squatina squatina	Nierstrasz (1918).
Zeus faber	Rokicki (1985).
Sphyraena chrysotaenia	İnnal *et al*. (2007).
Liza aurata	İnnal *et al*. (2007).
Raja clavata	Capape and Pantoustier (1976).
Trachurus trachurus	Oğuz and Öktener (2007).
Dentex macrophthalmus	Kırkım *et al.* (2008).
Dicentrarchus labrax	Kırkım *et al.* (2008).
Labrus merula	Kırkım *et al.* (2008).
Chromis chromis	Öktener *et al*. (2009).
Conger conger	Öktener *et al*. (2009).
Belone belone	Öktener *et al*. (2009).
Diplodus sargus	Akmirza (2000).
Mullus barbatus	Roman (1970).
Mugil cephalus	Roman (1970).
Scomber japonicus	Akmirza (1997).

Anilocra physodes was also reported in the cephalopod *Loligo vulgaris* from the northern Tyrrhenian Sea (western Mediterranean) by Gestal *et al.* (1999). There are the symbiotic associations of *Anilocra physodes*, such as that betwen *Obelia geniculata* and *Anilocra physodes* (Stechow, 1921), between epiphytes and *Anilocra physodes* (Öktener *et al.*, 2010). There are some reports as feeding source among diets of some fish (Pais, 2002; Narvaez *et al*., 2015; Châari *et al*., 2016).

The number of articles on antennula and antenna found in the present study agree with findings of Schioedte and Meinert (1881), Montalenti (1948), Trilles (1975), Kussakin (1979), Kırkım (1998). The maxillula with four terminal spines found in the present study is compatible with Trilles (1975), while two spines found by Kussakin (1979). The medial lobe and lateral lobe with two spines of maxilla found in this study are compatible with the findings indicated by Kussakin (1979), while medial lobe with 2 spines and lateral lobe 4 spines found by Trilles (1975), medial lobe 1 spine and lateral lobe with 2 spines found by Montalenti (1948). The third article with setae on the lateral margin of the mandible palp found in this study are compatible with the descriptions of Trilles (1975), Kussakin (1979), while without setae found by Montalenti (1948). Three spines on article 3 of the maxilliped of

ovigerous female observed in this study are compatible with the descriptions of Trilles (1975), while five spines found by Kussakin (1979).

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