

Livoneca sinuata (Crustacea; Isopoda; Cymothoidae) on *Loligo vulgaris* from Turkey, and unusual cymothoid associations

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ABSTRACT: In this paper, an unusual association of *Livoneca sinuata* (Crustacea; Isopoda; Cymothoidae) with the cephalopod *Loligo vulgaris* is reported for the first time from the Aegean sea coasts of Turkey. Moreover, a review of all the cases of unusual associations involving cymothoids is performed.

KEY WORDS: Cymothoidae · Isopod · Unusual associations · *Livoneca* · *Loligo* · Turkey

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INTRODUCTION

Cymothoids (Crustacea, Isopoda) typically infect marine, freshwater or brackish water teleost fish. Elasmobranchs have occasionally been reported as hosts for some species, but these data are probably due to trawl transfers (Brusca 1981, Trilles 1994). Some specimens have also occasionally been collected (always only 1 individual) from cephalopods, in their mantle cavity and on their body surface (Hochberg 1990, Trilles 1994). For example: *Aegathoa loliginea*, now synonymous with *Aegathoa oculata* (Say, 1818), from the mouth of a squid, *Heterololigo* (= *Loligo*) *pealei*, in Savin Rock, near New Haven, Connecticut by Harger (1878); *Nerocila maculata* Edwards, 1840 from 'Calamars (*Loligo*)' in Catalogne (the Mediterranean) by Gibert i Olivé (1919–1920); *Nerocila orbignyi* (Guérin-Méneville, 1829–1832) from an unidentified species of *Loligo* off the coast of Argentina by Szidat (1955); *Codonophilus* (*Meinertia*) sp. settled in the neck of *Sepia elegans*, from Port Vendres (Pyrénées Orientales, France) by Dollfus (1958); *Anilocra carpentariensis* n. sp. from *Loligo* sp. in the Pacific and Indian Oceans by Avdeev (1977); *Livoneca sinuata* Koelbel, 1878, from the mouth cavity of *Sepiolo ligulata* Naef, 1912 in the Adriatic by Bello & Mariniello (1998). In

addition, Hochberg (1990) noted as unpublished a single individual of an unidentified isopod recovered from *Abraliopsis felis* in the North Pacific and, quoting Hanlon & Forsythe, another attached toward the distal end of the mouth of a mature male *Sepioteuthis lessoniana*.

In this study, we report the occurrence of several specimens (female and male) of the species *Livoneca sinuata* Koelbel, 1878, in the mantle cavity of *Loligo vulgaris* Lamarck, 1798. We also review all the cases of unusual cymothoid associations.

MATERIALS AND METHODS

The samples of *Loligo vulgaris*, given as feed to mature sea bass *Dicentrarchus labrax* (L., 1758), were obtained in 2003 from Egemar Aquatic Products (Aydin). Several parasites were collected from the mantle cavity of these cephalopods before disinfectant treatment with clorax. The specimens of Cymothoidae were preserved in 70% alcohol and measured using a micrometer. The data related to parasites were recorded on parasite cards. The restricted synonymy and some information about the geographic range and host preferences are provided, adapted mainly from

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Trilles (1994). The taxonomic position and the morphometric characteristics of the isopods were determined according to Schioedte & Meinert (1884), Trilles (1976) and Bello & Mariniello (1998).

RESULTS

Livoneca sinuata Koelbel, 1878

Synonymy:

? *Livoneca mediterranea* Heller, 1868; Koelbel, 1878; Schioedte et Meinert, 1884; Brian, 1912; Montalenti, 1948; Bruce, 1990.

Livoneca sinuata Koelbel, 1878; Schioedte & Meinert, 1884; Carus, 1885; Gerstaecker, 1901; Richardson, 1910; Nierstrasz, 1915; Galati-Mosella, 1920; Brian, 1912; Penso, 1939; Montalenti, 1948; Vasiliu and Carausu, 1948; Trilles, 1962, 1968; Boscolo, 1970, 1977; Bruce, 1990.

Cymothoa carryensis Gourret, 1891.

Livoneca sinuata Brian and Dartevelle, 1949; Trilles and Raibaut, 1973; Trilles, 1977; Rokicki, 1984; Trilles, Radujkovic and Romestand, 1989; Bello and Mariniello, 1998.

Not *Livoneca sinuata* Brian, 1912; Monod, 1924; Vasiliu, 1932; Borcea, 1933; Trilles, 1976.

Material examined. One female (length = 16 mm) and 4 males (length = 8, 8, 8 and 9 mm) were collected in the mantle cavity of 2 *Loligo vulgaris* among the 24 specimens observed; Prevalence = 8.3%; Intensity min. to max. = 1 to 4.

Distribution. *Livoneca sinuata* has been found in the Mediterranean (Sicily, Gulf of Naples, Sea of Sciacca and Palermo, Sète, Gulfs of the Lion and Marseilles, Tunis Gulf, Zembra, Bou Haroun, Algiers, Montenegro, Adriatic) and the Atlantic (2 km north of Punta Aguruncho, Isla de Arosa, Ria de Arosa, NW coast of Spain; NW Africa) (Trilles 1994). Recently, it has also been collected from a cephalopod host caught in the southwestern Adriatic Sea, off Manfredonia (Apulia, Italy), by Bello & Mariniello (1998).

Hosts. *Livoneca sinuata* has been found on *Cepola macrophthalma* (= *C. rubescens*), *Raja miraletus*, *Boops boops*, *Gobius* sp. (Trilles 1994) and, more recently, on *Brama brama*, *Trichiurus lepturus*, *Lepidopus caudatus* and *Sepioloa ligulata* (Bello & Mariniello 1998).

Comments. This is the fourth case of a cymothoid being found on a cephalopod in the Mediterranean. However, it is the first record of *Livoneca sinuata* from the sea coasts of Turkey, and also of an association with *Loligo vulgaris* and with several cymothoid individu-

als, both male and female. In contrast, many hundreds of sepiolid mantle cavities were examined by Bello & Mariniello (1998); only 1 isopod was collected and the prevalence, not specified by the authors, was comparatively very low. Lastly, we did not see any significant change in the mantle of the host, similar to that reported for *Sepioloa ligulata*. Bello & Mariniello (1998) observed that the mantle of this squid was rotated about 110° along the longitudinal body axis with respect to the head-arms complex, probably caused by the presence of the parasite.

Review of all cases (excluding cephalopods) of unusual cymothoid associations

Cymothoids are isopod crustaceans which typically infect osteichthyan fish. In addition to the cephalopods already mentioned, they have occasionally been found on several other organisms such as sponges, jellyfish, crustaceans, chondrichthyans, amphibians and humans.

Sponges. A juvenile (species unknown) was reported by Monod (1933) 'dans un spongiaire', from Stn XVI, Gulf of Suez.

A gravid female of *Ceratothoa oxyrrhynchaena* (Koelbel, 1878) was collected from a sponge from Stn XL, Gulf of Suez, by R. P. Dollfus (Trilles 1972).

Jellyfish. Haswell (1880) found *Ceratothoa imbricata* (Fabricius, 1775) (as *Codonophilus argus* sp. nov.) under the bell of a *Rhizostoma* in Port Jackson, Australian coast.

Aegathoa macrophthalma Dana, 1853 was collected by Boone (1935) from jellyfish from Muntok, Banka Island, Banka straits, Dutch East Indies.

Crustaceans. Here, we consider only the freshwater cymothoid species *Telotha henselii* (von Martens, 1869) and shrimps from the family Palaemonidae.

Telotha henselii was successively reported:

(1) As an ectoparasite on *Palaemonetes argentinus* from Taim, Rio Grande, Estado do Rio grande do Sul, South Brazil, by Lemos de Castro & Gomes Corrêa (1982). The association was suggested by the authors to be of an accidental nature ('accidental infestation'). However, several male specimens were found in the branchial chamber of the shrimp.

(2) As an ectoparasite on *Macrobrachium brasiliense*, in rivers of the Chapada dos Guimaraes and Nioaque regions, both in Mato Grosso do Sul, Brazil, by Lemos de Castro (1985). According to the author, a great number of specimens of *M. brasiliense* was collected and many were parasitized by the male phase of *Telotha henselii*. On the other hand, no isopods were found parasitizing the fishes collected at the same localities. Lemos de Castro (1985) deduced, therefore,

that perhaps the association was not accidental, but that these isopods, when young (in the male phase), utilize shrimps as intermediary hosts.

(3) As a parasite (1 male) on *Macrobrachium borelli* from Salado River, Santa Fe Province, Argentina, by Taberner (1993).

(4) On *Macrobrachium borelli* and *Pseudopalaemon bouvieri* by Grassini (1994), from Mandisovi Chico stream, tributary of the Uruguay Medio river, Entre Rios, Argentina. Out of the 827 shrimp examined, 101 were parasitized, mainly by 1 male, occasionally by 2 isopods. On the other hand, 13 species of Characidae, 3 Siluridae and 4 Cichlidae living in the same locality were without cymothoids. Moreover, experimental studies have proved that, when the choice between fish and shrimps is equal, *Telothea henselii* males prefer shrimps. Grassini (1994) concluded that the species is probably characterized by a heteroxenic life cycle; but, if that is so, the function of the shrimp stage remains to be determined!

(5) On a single specimen of *Palaemonetes argentinus* parasitized by 2 males, from Rio Gualeguaychu, Province of Entre Rios, Argentina, by Taberner et al. (2003).

Chondrichthyans. According to Moreira & Sadow-sky (1978), Trilles (1994) and the present study, 20 cymothoids have now been reported on chondrichthyan hosts:

(1) *Nerocila acuminata* Schioedte and Meinert, 1881: on sawfish (species unknown) from the Atlantic Ocean and Gulf of Mexico, Newport, Virginia, and St Mary's River, Florida (Richardson 1905, Menzies & Frankenberg 1966), on dog fish and other unknown species from Virginia to Mexico and Bermuda (Schultz 1969) and *Pristis pectinatus* at Beaufort, North Carolina (Pearse 1947).

(2) *Nerocila armata* Dana, 1853: on sharks (species unknown) from the Pointe Padron, Congo (Brian & Darteville 1949).

(3) *Nerocila californica* Schioedte and Meinert, 1881; synonymous with *N. acuminata* according to Bruce (1987): from *Triakis semifasciata* and *Myliobatis* sp. at San Diego, California (Schioedte & Meinert 1881), and Taboga Island, Panama Bay, and Point Sur, National City, California (Richardson 1905, Guryanova 1936).

(4) *Nerocila fluviatilis* Schioedte and Meinert, 1881: 1 female on *Mustelus canis* from the Montevideo coast, Uruguay, South America (Cordero 1937, Trilles 1975; as *N. orbigny*, Ringuélet 1947; as *N. armata*, Moreira 1973).

(5) *Nerocila maculata* Milne-Edwards, 1840; synonymous with *N. orbigny* according to Bruce (1987): on *Raja* sp. from the Croisic vicinity, France (Chevreux 1884, as *N. affinis*; Trilles 1975) and *R. alba* (Dollfus and Trilles 1976).

(6) *Nerocila munda* Harger, 1873: on the dorsal fin of *Mustelus canis* ('listed as *Nerocila* sp. in Marine Biological Laboratory card catalogue') from Woods Hole and vicinity (Summer et al. 1911, Trilles 1975).

(7) *Nerocila orbigny* (Guérin Méneville, 1829–1832): on the elephant shark *Callorhynchus milii*, off the Tasmanian coast (Hale 1940) and Bass strait, Frederick Henry Bay and Storm Bay on the Australian coast (Bruce 1987; several specimens female and Aegathoid), an ovigerous female (as *N. macleayi*) on the fins of *Chimaera* sp. from Warrnambool, Victoria (Hale 1926).

(8) *Creniola laticauda* (Schioedte and Meinert, 1881): 1 ovigerous female recorded (as *Nerocila laticauda*) on *Raja australis* from Kingston, the SE coast and Port Willunga, South Australia (Hale 1926, Trilles 1975, Bruce 1987).

(9) *Anilocra elviae* n. sp.: 1 female and 1 male collected on the mako shark *Isurus oxyrinchus* from the Gulf of Mexico, off the Port of Veracruz by Winfield et al. (2002).

(10) *Anilocra physodes* (L., 1758): 1 female on *Squatina squatina* (*S. angelus*) from Naples, Italy (Nierstrasz 1918), and 1 male on *Raja clavata* from Bizerte, Tunisia (Capapé & Pantoustier 1976), and also from *Torpedo* (as *Anilocra mediterranea*), from the Spanish Mediterranean coast (Gibert i Olivé 1919–1920).

(11) *Ceratothoa collaris* Schioedte et Meinert, 1883: 1 male on *Raja miraletus* from Tunis Bay (Trilles & Raibaut 1973) and another on *Torpedo marmorata* from Tabarka, Tunisia (Capapé & Pantoustier 1976).

(12) *Ceratothoa gaudichaudii* (Milne-Edwards, 1840): on *Squalus fernandinus* from the southern Chilean coast (Jaramillo 1977).

(13) *Ceratothoa oxyrrynchaena* (Koelbel, 1878): several ovigerous females on *Raja asterias*, *R. clavata*, *Torpedo marmorata* and *Scyliorhinus stellaris* from Tabarka and Bizerte, Tunisian coast (Capapé & Pantoustier 1976).

(14) *Ceratothoa parallela* (Otto, 1828): 2 females and 1 male on *Raja asterias* and *R. clavata* from Tabarka and Bizerte (Capapé & Pantoustier 1976). It should be noted that, according to Capapé & Pantoustier (1976), the prevalence of *C. collaris*, *C. oxyrrynchaena* and *C. steindachneri* on chondrichthyans is relatively low but this parasitism is not accidental or occasional.

(15) *Livoneca redmanii* Leach, 1818 (as *L. ovalis* according to Trilles 1976 and Bruce 1990): on the sawfish *Pristis semisagittatus* (*P. cuspidatus*) from Massachusetts on the Atlantic coast of North America (Richardson 1905), on sawfish (species unknown) from Vineyard Sound along the entire eastern seaboard to the mouth of the Mississippi River (Miner 1950), and on sawfish *Pristis* sp. from Great South Bay, New York (Alperin 1966, Briggs 1970).

(16) *Livoneca sinuata* Koelbel, 1878: an ovigerous female on *Raja miraletus* from Tunis Bay (Trilles & Raibaut 1973).

(17) *Livoneca* sp. ? (as *Lironeca* sp. ? according to Bruce, 1982 and *Livoneca* sp. 12 according to Trilles, 1994): 1 female from the stomach of *Callorhynchus kaimanus* caught at Tolo Harbour, Hong Kong (Bruce 1982).

(18) *Livoneca* sp. 1 (as *Lironeca* sp. 1 according to Sartor, 1986 and *Livoneca* sp. 13 according to Trilles, 1994): 1 female and 1 juvenile on *Squalus cubensis* from Rio de Janeiro, Brazil (Sartor 1986).

(19) *Elthusa raynaudii* (Milne-Edwards, 1840): as *Livoneca raynaudii* according to Bruce (1990) on shark (species unknown) from the Eastern Seas (Guryanova 1936) and from the stomach of the smooth-hound *Mustelus* from New Zealand (Hurley 1961).

(20) *Aegathoa medialis* Richardson, 1900: 8 specimens on *Dasyatis sabina* from Alligator Harbor, Florida (Pearse 1952).

Amphibians. Stadler (1972) reported that only freshwater cymothoids at the second larval stage swim freely, parasitizing various species of fishes and amphibians, before meeting the specific host.

Humans. Concerning *Nerocila orbigny* (Guérin-Meneville, 1829–1832) and other cymothoids from the Congo, it is worth remembering that, as Brian & Darteville (1949) wrote, 'Ces Crustacés sont particulièrement féroces; ils mordent même avec vigueur la peau des baigneurs aux endroits où se trouvent de petites érosions, occasionnant des démangeaisons; mais ces morsures ne peuvent causer de dermatites'.¹

DISCUSSION

Cymothoids typically infect osteichthyan fish (Brusca 1981, Trilles 1994, Bunkley-Williams & Williams 1998). However, as reported above, some settle or collect on other organisms such as sponges, jellyfish, cephalopods, crustaceans, chondrichthyans and amphibians. It seems that such unusual associations are much more frequent with cephalopods, shrimps and, particularly, with sharks and skates. We observed that not only juveniles and males, but also females, are involved. Indeed, several females were collected from cephalopods and chondrichthyans. However, it seems that shrimps constitute a particular case, since only juveniles and males have until now been collected from these crustaceans.

The main point is, therefore, to determine, following several previous authors (Trilles 1969, Stadler 1972,

Capapé & Pantoustier 1976, Lemos de Castro & Gomes Corrêa 1982, Lemos de Castro 1985, Grassini 1994, Bello & Mariniello 1998), whether such unusual associations are accidental, occasional or whether such unusual organisms are true potential hosts for some cymothoids. Concerning this last point, Williams & Bunkley-Williams (1994) reported that new associations are usually begun by immature stages, but may also be initiated by adults, and these observations make them excellent subjects for discerning complex parasitological processes.

In the case of cymothoids, we think that there are 2 main possibilities: an occasional transfer from one host to another, during or after fishing, especially in the case of females; or else random migrations, perhaps quite specific in the case of *Telotha henselii* and shrimps, accomplished by juveniles and some swimmer males.

In such cases, but particularly in the case of a durable settlement after an unusual transfer, the way in which the parasite adapts itself to the new conditions, especially given that cymothoids feed on fish blood, is unclear. In addition, the usefulness of the intermediate host needs to be clarified with regards to the possible specific attachment of *Telotha henselii* to shrimps (Grassini 1994).

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¹These crustaceans are particularly ferocious, even vigorously biting the skin of bathers in places with small erosions, producing itch, but not dermatitis.

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