

Four Parasitic Copepods on Marine Fish (Teleostei and Chondrichthyes) from Turkey

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Four species of copepod, Caligus bonito Wilson, 1905 (Caligidae), Clavellisa scombri Kurz, 1877 (Lernaeopodidae), Pandarus bicolor Leach, 1816 (Pandaridae) and Anchistrotos laqueus Leigh-Sharpe, 1935 (Bomolochidae) were reported from Coryphaena hippurus Linnaeus, 1758, Scomber scombrus Linnaeus, 1758, Mustelus mustelus Linnaeus, 1758 and Serranus hepatus Linnaeus, 1758. These parasites were recorded for the first time in the Aegean Sea and the Sea of Marmara.

Key words: parasitic copepods, marine fish, Aegean Sea, Sea of Marmara, Turkey

INTRODUCTION

Lernaeopodidae Olsson, 1869 are parasitic copepods found mainly on marine fish, both Selachii and Teleostei that display an important sexual dimorphism. Sometimes only the female is parasitic, often showing a characteristic attachment organ held by the second maxilla, the bulla, being an isolated case among parasitic copepods (BENKIRANE *et al.*, 1999). The family Lernaeopodidae currently includes 45 genera (BENZ *et al.*, 2000) and 8% of the species are reported from fish cultured in brackish and marine waters (STEWART *et al.*, 2004).

The Caligidae Burmeister, 1835 is the largest family of parasitic copepoda including more than 450 species classified in 33 genera (BOX-

SHALL & HALSEY, 2004; BOXSHALL, 2008; BOXSHALL, pers. commun.). *Caligus* Müller, 1785 and *Lepeophtheirus* von Nordmann, 1832 are the two largest genera with more than 250 species (HO *et al.*, 2000) and 107 species (HO & LIN, 2001) respectively. Their features include flattened body and adaptation to being surrounded by blood and mucus on the epithelial cells of their host (HO, 2004).

Taeniacanthidae are among those relatively few families that contain species parasitic both on fish (elasmobranchs and teleosts) and invertebrates (KABATA, 1979). While currently including no more than 60 species, this family is very closely related to Bomolochidae.

Twelve genera are currently identified in the family Pandaridae including exclusively

ectoparasitic species on sharks and rays. They are usually isolated from the skin, fins, gills and the nasal cavities (CRESSEY, 1967; KABATA, 1979) where they graze the epidermis, often inducing secondary infections (BENZ, 1981).

Studies on ectoparasites, mainly parasitic copepods on marine fish, are scarce in Turkey. In this study, four species were reported for the first time in the Sea of Marmara and the Aegean Sea. Additional geographical and host records are also given.

Along with these new records, 29 parasitic copepods have been currently reported on 27 host fish from the Mediterranean Sea, Aegean Sea, Black Sea and Sea of Marmara in Turkey (OĞUZ & ÖKTENER, 2007; ÖKTENER, 2008; ÖKTENER *et al.*, 2008).

MATERIAL AND METHODS

Six common dolphinfish, *Coryphaena hippurus* Linnaeus, 1758, twenty six atlantic mackerels, *Scomber scombrus* Linnaeus, 1758, eight smooth-hounds, *Mustelus mustelus* Linnaeus, 1758 and twenty one brown combers, *Serranus hepatus* Linnaeus, 1758 were examined during the period from June 2007 to August 2008. *Coryphaena hippurus* and *Mustelus mustelus* were caught by trawl and gill nets from the Aegean Sea (39°29'N; 26°02'E). *Scomber scombrus* and *Serranus hepatus* were collected from the Sea of Marmara (41°03'-40°20'N; 29°40'-29°55'E). Collected copepods were fixed and preserved in 70% alcohol. After clearing with lactic acid, the appendages were dissected for detailed study according to HUMES & GOODING (1964). Identification of parasitic copepods was performed according to BRIAN (1906); YAMAGUTI (1963); BEN HAS-SINE *et al.* (1978); KABATA (1979); CRESSEY & CRESSEY (1980); ESSAFI *et al.* (1984); BOXSHALL & MONTU (1997); BENKIRANE *et al.* (1999); HO & LIN (2005); INGRAM & PARKER (2006). The terms mean intensity of infestation and prevalence were used according to MARGOLIS *et al.* (1982). Voucher specimens were deposited in the collection of Prof. J.S.HO, Prof. R.C.ROMERO and the first author.

RESULTS AND DISCUSSION

Order Siphonostomatoida Burmeister, 1835

Family Caligidae Burmeister, 1835

Genus *Caligus* Müller, 1785

Caligus bonito Wilson, 1905

Material examined: 48 specimens collected from the abundant mucus surrounding the gill filaments and on the inner surface of the operculum of 6 *Coryphaena hippurus*.

Infestation rate: *Caligus bonito* was recorded with a prevalence of 100% on *Coryphaena hippurus*. The mean intensity of infestation for the population, the mean intensity per fish, and the minimum-maximum parasite load per infested fish were 100%, 8 and 4-13 respectively.

Generally, several researchers have recorded low prevalence and mean intensities on different hosts except *Coryphaena* sp, i.e. 0.28% prevalence on *Katsuwonus pelamis* (ROHDE *et al.*, 1980), 12.9% on *Mugil curema* (CAVALCANTI *et al.*, 2006), 3.57% prevalence and 1 mean intensity on *Oligoplites palometa* (TAKEMOTO & LUQUE, 2002), 23.33% prevalence and 2 mean intensity on *Lutjanus griseus* (ZAMBRANO *et al.*, 2003) and 13.33% prevalence and 1.45 mean intensity on *Mugil platanus* (KNOFF *et al.*, 1994). In spite of these low levels, CARBONELL *et al.* (1999) reported 40-60% prevalence on *Coryphaena hippurus* and *C. equiselis*.

Geographical range: Strait of Florida, Galapagos Islands, Trivandrum, Calicut, Queensland, Dominican Republic, Panama, Japan, Louisiana, Massachusetts, Bikini Island, Angola, South Africa, New Zealand, New Caledonia, Hawaii, Gulf of Mexico, Italy, California, Peru, Chile, Cedros Islands, Red Sea, India, China, Western Atlantic, Texas, Scotland, Norway, Tunisia, Gulf of Guinea, Antigua, Rio Grande do Norte, Brazil and Taiwan (HO & LIN, 2005; CAVALCANTI *et al.*, 2006; BLANCHET *et al.*, 2001; LUQUE & TAVARES, 2007).

Hosts: *Caligus bonito* parasitizes several teleost species belonging to the family Scombr-

dae, such as *Euthynnus affinis*, *E. alletteratus*, *E. lineatus*, *Katsuwonus pelamis*, *Gymnosarda unicolor*, *Sarda sarda*, *S. australis*, *S. orientalis*, *S. chilensis chilensis*, *S. chilensis lineolata*, *Scomberomorus carvalla*, *S. maculatus* and *Thunnus thynnus*. However, it has been collected on hosts from other families (Mugilidae, Carangidae, Lutjanidae, Sciaenidae, Pomatomidae, Serranidae) including *Mugil cephalus*, *M. platanus*, *M. curema*, *Oligoplites saurus*, *O. palometa*, *Trachurus murphyi*, *Lutjanus griseus*, *L. novemfasciatus*, *Cynoscion nebulosus*, *Pomatomus saltatrix* and *Cratinus agassizii* (HO & LIN 2005; CAVALCANTI *et al.*, 2006; BLANCHET *et al.*, 2001).

Remarks: The only caligids previously reported from Turkish waters are *Caligus pageti* Russel, 1925 on *Mugil cephalus*, *Liza saliens*, *Liza ramada* and *Chelon labrosus* from the Aegean Sea (ALTUNEL, 1983), *Caligus minimus* Otto, 1821 on *Dicentrarchus labrax* from the Aegean Sea (TOKŞEN, 1999), *Pseudocaligus apodus* Brian, 1924 on *Mugil cephalus*, *Liza saliens*, *Liza ramada* and *Chelon labrosus* from the Aegean Sea (ALTUNEL, 1983), *Caligus* sp. on *Sardina pilchardus* from the Sea of Marmara (DEMIRHINDI, 1961) and *Lepeophtheirus europaensis* (ZEDDAM *et al.*, 1988) on *Platichthys flesus* from Ekinli Lagoon (OĞUZ & ÖKTENER, 2007). Morphological differences with respect to previous descriptions have not been observed. *Caligus bonito* is reported for the first time in Turkey.

Order Siphonostomatoida Burmeister, 1835
Family Lernaeopodidae Olsson, 1869
Genus *Clavellisa* C. B. Wilson, 1915
Clavellisa scombri Kurz, 1877

Material examined: 3 specimens collected from the gill rakers of three *Scomber scombrus* among the 26 examined.

Infestation rate: *Clavellisa scombri* was recorded with a prevalence of 6% on *Scomber scombrus*. The mean intensity of infestation in the population, the mean intensity per fish

and the minimum-maximum parasite load per infested fish were 6%, 1.6 and 1-2 respectively. ALVES *et al.* (2003) reported 2% prevalence and mean intensity 2 on *Scomber japonicus*. OLIVIA *et al.* (2008) recorded several infestation values for *Clavellisa scombri* in *Scomber japonicus* in South America and the Madeira Islands; 7.9% prevalence and 1.5 mean intensity in Madeira; 2% prevalence and 1 mean intensity in Rio de Janeiro; 20% prevalence and 1.7 mean intensity in Callao and 6.5% prevalence and 1.8 mean intensity in Antofagasta.

Geographical range: *Clavellisa scombri* is widely distributed in the North Sea, the Mediterranean Sea, the Adriatic Sea, South-western Africa, Philippines, Peru, Gulf of Mexico, Liberia, Taiwan and Australia (BRIAN, 1906; NUNES RUVIO, 1954; BEN HASSINE *et al.*, 1978; CRESSEY & CRESSEY, 1980; ESSAFI *et al.*, 1984; BENMANSOUR & BEN HASSINE, 1997; BENKIRANE *et al.*, 1999; KABATA, 1979; DIPPENAAR, 2005).

Hosts: *Clavellisa scombri* parasitizes mackerels, *Scomber scombrus*, *S. japonicus*, *S. australasicus* and *S. colias* (BRIAN, 1906; NUNES RUVIO, 1954; BEN HASSINE *et al.*, 1978; KABATA, 1979; CRESSEY & CRESSEY, 1980; ESSAFI *et al.*, 1984; BENMANSOUR & BEN HASSINE, 1997; RAIBAUT *et al.*, 1998; BENKIRANE *et al.*, 1999).

Remarks: The only Lernaeopodids previously reported from Turkish waters were *Clavellothis fallax* Heller, 1868 on *Diplodus sargus sargus*, *Pagellus erythrinus*, *Sarpa salpa* and *Spondylisoma cantharus* from the Aegean Sea (AKMIRZA, 2000), *Lernaeopoda galei* Krøyer, 1837 on *Mustelus mustelus* from the Aegean Sea (KARAYTUĞ *et al.*, 2004), *Neobrachiella impudica* von Nordmann, 1832 on *Trigla lucerna* from the Sea of Marmara (ÖKTENER & TRILLES, 2004a), *Eubrachiella exigua* Brian, 1906 on *Pagellus erythrinus* from the Mediterranean (ÖKTENER & TRILLES, 2004b), *Neobrachiella bispinosa* von Nordmann, 1832 on *Trigla lucerna* from the Mediterranean (ÖKTENER & TRILLES, 2004b) and *Clavellothis strumosa* (Brian, 1906) on *Pagellus erythrinus* from the Sea of Marmara (ÖKTENER

et al., 2008). *Clavellisa scombri* has not been previously reported from Turkey.

Order Siphonostomatoidea Burmeister, 1835
Family Pandaridae Milne Edwards, 1840
Genus *Pandarus* Leach, 1816
Pandarus bicolor Leach, 1816

Material examined: 9 specimens collected from the ventral surface and fins of three *Mustelus mustelus* among the 8 examined.

Infestation rate: The prevalence and the mean intensity reached 37.5% and 3 respectively. ROKICKI & MOROZINSKA (1995) have already observed different values of infestation rate for some *Pandarus* species parasitizing *Isurus oxyrinchus* from the central Atlantic ocean: 63.5% prevalence and 13.5 mean intensity for *Pandarus smithii*, 58.7% prevalence and 10.3 mean intensity for *P. cranchii* and 44.5% prevalence and 8.6 mean intensity for *P. floridans*. NORMAN *et al.* (2000) reported 26% prevalence for *Pandarus rhincodonicus* parasitizing *Rhincodon typus* from the North West Cape of Western Australia. HENDERSON *et al.* (2002) recorded 11.8% prevalence and 1.4 mean intensity on *Squalus acanthias* from the west coast of Ireland.

Geographical range: *Pandarus bicolor* has a wide geographical distribution that includes the Mediterranean Sea, the Atlantic and Pacific Oceans and Australia (BRIAN, 1906; YAMAGUTI, 1963; KABATA, 1979; BOXSHALL & MONTU, 1997; INGRAM & PARKER, 2006).

Hosts: This species infests several sharks, *Galeorhinus galeus*, *G. sp.*, *G. australis*, *Mustelus mustelus*, *M. canis*, *M. sp.*, *Scyliorhinus stellaris*, *Scyliorhinus sp.*, *Squalus acanthias* and *Squalus sp.*, *Prionace glauca*, *Carcharinus sp.*, *C. falciformis*, *C. signatus*, *C. obscurus*, *Carcharodon sp.*, *Isurus mako*, *I. oxyrinchus*,

Notorhynchus cepedianus, *Cynias* and *Eulamia sp.* (BRIAN, 1906; YAMAGUTI, 1963; KABATA, 1979; BOXSHALL & MONTU, 1997; INGRAM & PARKER, 2006). However, DOLLFUS (1946) reported this species from the teleostean *Mola mola* in the Atlantic ocean. This single instance of association with a non-elasmobranch host must be seen as occasional or accidental.

Remarks: Until now *Pandarus bicolor* has not been reported from Turkey.

Order Cyclopoida Burmeister, 1835
Family Taeniacanthidae Wilson, 1911
Genus *Anchistrotos* Brian, 1906
Anchistrotos laqueus Leigh-Sharpe, 1935

Material examined: 127 specimens collected from the gill filaments of 21 examined *Serranus hepatus*.

Infestation rate: The prevalence and the mean intensity reached 100% and 6.04 respectively.

Geographical range *Anchistrotos laqueus* is narrowly distributed in the North Atlantic Ocean and the Mediterranean (KABATA, 1979).

Hosts: This species is known only from *Serranus cabrilla* (KABATA, 1979).

Remarks: *Anchistrotos laqueus* has not been previously reported from Turkey.

ACKNOWLEDGEMENTS

We thank to anonymous reviewers and Anita MARUŠIĆ for their time taken to carefully review our manuscript, Prof. J.S. HO, Prof. R.C. ROMERO for their identifications and Prof. G.A. BOXSHALL for his comments. We believe that their positive comments have substantially improved this article.

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Received: 27 October 2008

Accepted: 21 August 2009

Četiri kopepodna parazita na morskim ribama (Teleostei i Chondrichthyes) u turskim vodama

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SAŽETAK

Četiri vrste kopepoda, *Caligus bonito* Wilson, 1905 (Caligidae), *Clavellisa scombri* Kurz, 1877 (Lernaeopodidae), *Pandarus bicolor* Leach, 1816 (Pandaridae) and *Anchistrotos laqueus* Leigh-Sharpe, 1935 (Bomolochidae) su pronađene na lampugi, *Coryphaena hippurus* Linnaeus, 1758, na skuši, *Scomber scombrus* Linnaeus, 1758; na psu mekušu, *Mustelus mustelus* Linnaeus, 1758 i na vučiću, *Serranus hepatus* Linnaeus, 1758. Ovo je prvi nalaz navedenih parazita u Egejskom i Mramornom moru.

Ključne riječi: kopepodni paraziti, morske ribe, Egejsko more, Mramorno more, Turska