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Research Article

Occurrence of the Scavenger Crustaceans *Natatolana neglecta* (Hansen, 1890) (Isopoda: Cirolanidae) and *Scopelocheirus hopei* (Costa in Hope, 1851) (Amphipoda: Scopelocheiridae) on Bento-pelagic Fish Species in the Turkish Straits System

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Abstract: The scavenger crustaceans *Natatolana neglecta* (Hansen, 1890) (Isopoda: Cirolanidae) and *Scopelocheirus hopei* (Costa in Hope, 1851) (Amphipoda: Scopelocheiridae), along with several other peracarid crustaceans, were recorded on demersal fish species in the Turkish Straits System. Samples were collected on (in) *Raja clavata*, *Chelidonichthys lucerna*, *Trachurus* sp., *Scorpaena scrofa*, *Merluccius* sp., *Solea solea* and *Squalus acanthias* captured by trammel nets at depth of 50 m on 26th January 2021. *Natatolana neglecta*, *Scopelocheirus hopei* and *Nebalia abyssicola* Ledoyer, 1997 are new for the fauna of the Turkish Straits System.

Key words: *Natatolana neglecta*, *Scopelocheirus hopei*, peracarid crustaceans, bento-pelagic fish, Turkish Straits System

Introduction

Several marine benthic animal groups such as hagfish, cirolanid isopods and lysianassid amphipods may be obligate scavengers. Some groups of invertebrates attacking to bait are amphipods such as *Orchomene* spp. and *Scopelocheirus hopei* (Costa in Hope, 1851), the isopod *Natatolana borealis* (Lilljeborg, 1851), asteroids such as *Asterias rubens* L., 1758, some species of ophiuroids and some neogastropods of the families Buccinidae and Nassariidae (Depestele et al. 2019). Scavenge type feeding is quite common in deep-sea systems, especially among amphipods and isopods. The cirolanid isopod *Natatolana neglecta* (Hansen, 1890) is one of 73 species belong to the genus *Natatolana* Bruce, 1981 (WoRMS 2021); it is known from the west coast of France in the Mediterranean and Tyrrhenian Seas as well as in to the Atlantic coast of north-western Africa (Keable 2006, Rincón et al. 2014, Kirkim et al. 2019). Cirolanid isopods are also observed as endobiont and micro-predators in marine turtles. Amphipods are also important scavengers, especially in deep-sea systems (Revuelta et al. 2019), occurring

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on many demersal fish and invertebrates in marine environments (Brusca et al. 1995). Recently, it has been reported that scavenging isopods, especially *N. neglecta*, have caused significant financial losses in fisheries (Kirkim et al. 2019, Öndes 2019). The majority of the scavenging isopods are classified in the family Lyssidanidae (see Käim-Malka 2003). *Scopelocheirus hopei* is one of the four species of the genus *Scopelocherius* (WoRMS 2021); it may feed on dead or moribund fish captured by nets and long lines. This species has a wide geographic distribution (Käim-Malka 2003) and has often been found with the scavenger isopod *N. borealis* in same samples (Albertelli et al. 1992, Käim-Malka 2003). *Natatolana borealis* was reported by Moore (1984) to attack echinoids, especially spatangoids.

In this study, we report aggregate feeding by scavenging isopod and amphipod species on several dead demersal fish species.

Materials and Methods

Crustacean samples were collected from several bento-pelagic fish species such as *Raja clavata*, *Chelidonichthys lucerna*, *Trachurus* sp., *Scorpaena scrofa*, *Merluccius* sp., *Solea solea* and *Squalus acanthias* caught by trammel nets at a depth of around 50 m in the Turkish Straits System on 26 January 2021 (GPS coordinates 40º27' N, 27º03' E) (Fig. 1). All samples were preserved *in situ* in 4 % formaldehyde solution. Samples were identified and photographed using trinocular stereomicroscope. The species were identified based on the descriptions by Bellan-Santini et al. (1989), Moreira et al. (2012) and Rincón et al. (2014). The dominance was calculated using the Dominance Index formula (Bellan-Santini 1969): $DI = N_t / N_n \times 100$, where N_t is the number of the ividuals of the t species and N_n is the number of individuals of all species.

Results

Totally, 409 individuals belong to eight crustacean species (two isopods, four amphipods and two leptostracans) in seven different fish species were sampled (Table 1). The most dominant of the crustacean species was the isopod *N. neglecta* with a dominance index value of 63.32 % followed by the amphipod *S. hopei* (34.96 %).

***Natatolana neglecta* (Hansen, 1890)** (Fig. 2 A, B, C)

Material: 259 individuals, Sea of Marmara, January 26, 2021, 50 m depth, muddy bottom.

The majority of specimens (145 individuals) of *N. neglecta* were found in or on the thornback ray *Raja clavata* L., 1758, with a dominance value is 55.98 %. Specimens of *N. neglecta* were most commonly observed in the vent of this species. The species was also observed in the tub gurnard *Cheli-*

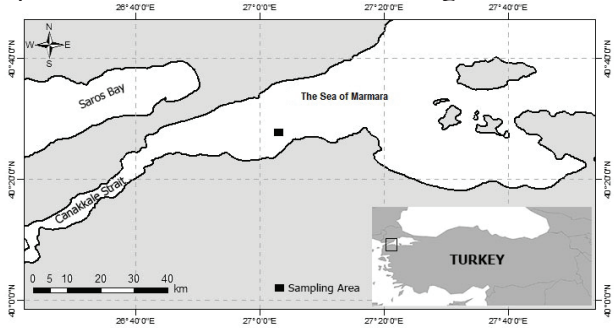

Fig. 1. Map of the study area.

Table 1. List of the recorded crustacean species on fishes collected in the study area; d% – dominance.

Fish species	Species of the Crustacea								Σ	d% of *N. neglecta*	d% of *S. hopei*
	Natatolana neglecta	*Scopelocheirus hopei*	*Lysianassa pilicornis*	Lysianassidae sp.	*Nebalia abyssicola*	*Nebalia* sp.	Amphipoda sp.	*Natatolana* sp.			
Raja clavata	145	13					1		159	55.98	9.09
Chelidonichthys lucerna	106	32	2		1				141	40.92	22.37
Trachurus sp.	1	1		1					3	0.38	0.69
Scorpaena scrofa		11							11	0	7.69
Merluccius sp.		25				1			26	0	17.48
Solea solea	2	49						1	52	0.77	34.26
Squalus acanthias	5	12							17	1.93	8.39
No. of specimens	259	143	2	1	1	1	1	1	409	100	100

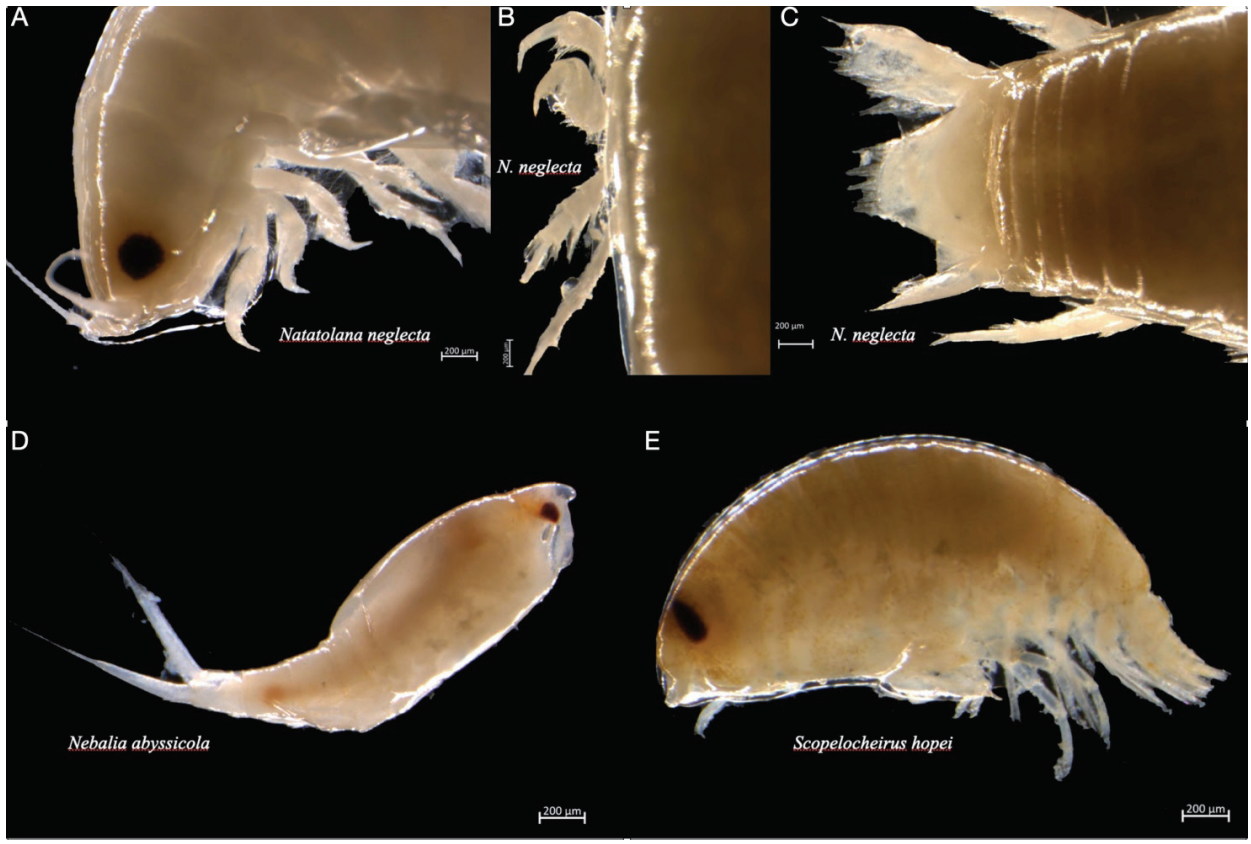

Fig. 2. Peracarid crustaceans found on (in) fishes captured in the study area.

donichthys lucerna (L., 1758) with 106 individuals (dominance of 40.92 %). *Natatolana neglecta* was also observed in *Solea solea* (L., 1758), *Trachurus* sp. and picked dogfish *Squalus acanthias* L., 1758; however, the abundance in these species was low, accounting for only 2 %. No specimens of *N. neglecta* were not found in red scorpionfish *Scorpaena scrofa* L., 1758 and *Merluccius* sp. Specimens of *N. neglecta* were particularly abundant on the ventral side of *Raja clavata* (Fig. 3).

***Scopelocheirus hopei* (Costa in Hope, 1851)** (Fig. 2E)

Material: 143 individuals, Sea of Marmara, January 26, 2021, 50 m depth, muddy bottom.

The scavenger amphipod *S. hopei* was observed in all fish species caught in this area. *Scopelocheirus hopei* was mostly found in *Solea solea* (with 49 individuals, dominance value of 34.26 %). The dominance of *S. hopei* in other fish species was: *Chelidonichthys lucerna* – 32 individuals (22.37 % dominance) and *Merluccius* sp. – 25 individuals (17.48% dominance). Only a single specimen of *S. hopei* was observed in *Trachurus* sp.

***Nebalia abyssicola* Ledoyer, 1997** (Fig. 2D)

Material: Single specimen, the Sea of Marmara, January 26, 2021, 50 m depth, muddy bottom.

Six species of the genus *Nebalia* are known from the Mediterranean Sea (Koçak & Moreira 2015). The bathyal leptostracan *N. abyssicola* was first reported by Moreira et al. (2012) from the Aegean Sea (Gökçeada coast) and the Mediterranean coast of Turkey at depth 820 m. The single individual found in this study is a new record of this species from the Turkish Straits System. In the presents study, only a single specimen was found, which was associated with *Chelidonichthys lucerna*.

Discussion

The deposit feeding scavenger amphipod *S. hopei* has been found at depths ranging from 40 to 2,500 m in the western Mediterranean (Bellan-Santini 1998, Käim-Malka 2003). The study by Käim-Malka (2003) on the population structure and life cycle of the *S. hopei* reported specimens at depths of 500 m in the western Mediterranean. Dense populations of this species have been recorded in deep-sea systems detected by funnel traps at depths of 50 to 60 m in the southern Clyde Sea (western Scotland) (Bergmann et al. 2002). Similarly, Groenewold & Fonds (2000) reported that *S. hopei*, which mainly feeds on crustacean carrion, was abundant at a of

Fig. 3. Specimens of *Natatolana neglecta* (Hansen, 1890) *in situ* in two bento-pelagic fish species found in the study area. Left: *Raja clavata*. Right: *Chelidonichthys lucerna*.

depth of 40 m within oyster beds found on the Dutch coast (southern North Sea). This species was abundant also in the Catalan Sea (north-western Mediterranean) at depths between 549 and 601 m (Cartes & Sorbe 1999).

Concerning the coexistence of cirolanid isopods and lysianassid amphipods, Williams (1938) published a short review on the occurrence of *S. hopei* and *N. borealis* in the spiny dogfish *Acanthias vulgaris* (= *Squalus acanthias*). Käim-Malka (2005) also mentioned that *S. hopei* was observed together with *Natatolana borealis* and *Tmetonyx similis* during the samplings performed in the Toulon Canyon in the western Mediterranean. In terms of the prey-predator relationship, Castro et al. (2005) indicated that *S. hopei* and *N. borealis* were part of the diet of decapod crustaceans such as *Nephrops norvegicus* and *Parapenaeus longirostris*. The same authors emphasised and *S. hopei* and *N. borealis* were part of the diet of decapod crustaceans such as *Nephrops norvegicus* and *Parapenaeus longirostris* were the most important invertebrates in recycling of organic matter on the sea bottom. Yet, *S. hopei* is a diet of jewel lanternfish *Lampanyctus crocodilus* (Risso, 1810) in the western Mediterranean (Stefanescu & Cartes 1992). It is likely that most demersal fish specimens were scavenged dead in the net as these crustaceans have been reported to attack moribund fish in flocks, particularly at night (Wong & Moore 1995).

The scavenger isopod *N. neglecta* was previously reported on the Aegean Sea coast of Turkey (Geldiay & Kocataş 1972, Kırkım et al. 2006). Recently, Kirkim et al. (2019) reported that *N. neglecta* caused considerable damage to fish captured during fishery activities in the Güllük Bay (eastern Aegean Sea) and attacked fish in line nets. This isopod species does not attack certain types of fish and its prey can consist of both bony and cartilaginous fish. As the attacks on fish caught in the nets were mostly at night and, by this reason, local fishermen hesitated to set up nets during this time (Kirkim et al. 2019). According to Kirkim et al. (2019), a significant increase in the abundance of *N. neglecta* has been observed in the area in recent years, which may be a result of a large number of fish farms in Güllük Bay. Rincón et al. (2014) have stated that *N. neglecta* is feeding on both living and dead animals and therefore it is an ecologically important species in the marine environment. According to Mizzan (1995), scavenger crustaceans feed on moribund fish captured in trammel nets as evident by observations on *N. neglecta* off the Italian coast attacking an individual of *Sciena umbra* L., 1758. Recently, Youssef et al. (2020) reported individuals of *N. neglecta* from the nasal cavities of 480 specimens of *Raja clavata* from the Bizerte Bay, Tunisia, which is in agreement this the present study reporting this species from the internal organs and body surfaces of several fish species, including *R. clavata*.

As a result of the present study, *N. neglecta* and *S. hopei* are confirmed to predate on bento-pelagic fish caught by trammel or line nets in the Turkish Straits System. This phenomenon may have negative consequences for local fishing activities. To reduce the fish loss due to nocturnal predators reported herein, fishing nets can be kept in seawater for a shorter period; however, this may result in a reduction of the catch yield. Further detailed studies may help to eliminate this problem.

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