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New Locality and Host Record of Some Myxozoan Parasite Species (Cnidaria) off Turkish Coast of the Black Sea

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Abstract: Nine marine fish species were studied for the presence of myxozoan parasites: Pontic shad *Alosa immaculata,* Mediterranean sand smelt *Atherina hepsetus,* knout goby *Mesogobius batrachocephalus,* round goby *Neogobius melanostomus*, black goby *Gobius niger,* shore rockling *Gaidropsarus mediterraneus*, thornback ray *Raja clavata,* grey wrasse *Symphodus cinereus* and European anchovy *Engraulis encrasicolus*. Fish were collected from Sinop coasts of the Black Sea. Gills, fins, skin, urinary bladder, kidney, gall bladder, liver, intestine, smooth muscles and gonads of each fish species were examined for myxosporean parasites. Ten myxosporean species, most of them identified at the species level, were found. They were *Ortholinea orientalis* from Pontic shad and European anchovy, *Fabespora nana* and *Sphaeromyxa sevastopoli* from knout goby, *Sphaeromyxa sevastopoli* and *Zschokkella iskovi* from shore rockling, *Chloromyxum partistriatus* from thornback ray, *Myxobolus* sp. 1 and *Ortholinea divergens* from grey wrasse, *Ortholinea* sp. from black goby, *Ceratomyxa* sp. from Mediterranean sand smelt and *Myxobolus* sp. 2 from round goby. Infection prevalence and intensity values as well as morphometric data for each parasite species are provided. While *Ortholinea orientalis* was found in new hosts for the Black Sea, *Sphaeromyxa sevastopoli, Ortholinea divergens* and *Fabespora nana* were found in new host for Turkish coast of the Black Sea. Furthermore, *Zschokkella iskovi* and *Chloromyxum partistriatus* are new records for the Turkish Black Sea parasite fauna.

Key words: parasite fauna, fish hosts, prevalence, morphometric data

Introduction

Myxozoan parasites have a cosmopolitan distribution in a wide range of marine, freshwater and brackish waters throughout the world (Lom & Dykova 1993, 2006, Özer & Okkay 2018, Gürkanli et al. 2018). They have substantial negative impacts on aquaculture and fisheries and occur in a wide range of both marine and freshwater fish species (Kent et al. 2001, Lom & Dykova 2006, Pascual et al. 2012, Henning et al. 2013, Özer et al. 2014). Studies focused on parasite inventories and new species discovery in both economically and ecologically important fish species have increased in the last decades (Eiras et al. 2014, Rangel et al 2017). The identification of myxozoan parasites is based primarily on their spore morphology, the number and shape of shell valves and polar capsules; however, new species identifications as the result of applying molecular techniques have increased in recent years (Gürkanli et al. 2018, Özer et al. 2018). Thus, more than 2400 valid species have been identified from fish hosts (e.g., Eiras et al. 2005, 2014, Özer et al. 2015b, Abdel-Baki et al. 2018, Özer & Ok-

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kay 2018). *Myxobolus* Bütschli, 1882 (900 species) (Eiras et al. 2005, 2014), followed by members of *Ceratomyxa* Thelohan, 1892 (232 species) (Eiras 2006, Eiras et al. 2018, Abdel-Ghaffar et al. 2008), *Chloromyxum* Mingazzini, 1890 (140 species) (Eiras et al. 2012), *Zschokkella* Auerbach, 1909 (68 species) (Lom & Dykova 2006), *Sphaeromyxa* Thelohan, 1892 (49 species) (Whipps & Zhao 2015), *Ortholinea* Shulman, 1962 (23 species) (Lom & Dykova 1992, Rangel et al. 2014, 2015, 2017, Gürkanli et al. 2018) and *Fabespora* Naidenova & Zaika, 1969 (2 species) (Naidenova & Zaika, 1969, Overstreet 1976), have been reported from all over the world.

Until now, a total of 36 myxosporean species, including 13 species of *Myxobolus*, four of *Ceratomyxa*, four of *Ortholinea*, one of *Fabespora*, one of *Zschokkella* and one of *Sphaeromyxa* have been reported from marine fish species in Turkish coastal areas of the Black Sea (Özer & Okkay 2018, Okkay et al. 2018).

In the present study, we aimed to describe myxosporean parasite fauna in some fish species collected from Sinop coasts of the Black Sea in Turkey and to reveal their host, including their site of infections, prvalebce and intensity of infection.

Materials and Methods

Fish samples of Pontic shad *Alosa immaculata* Bennett, 1835 (n=106), Mediterranean sand smelt *Atherina hepsetus* Linnaeus, 1758 (n=43), knout goby *Mesogobius batrachocephalus* (Pallas, 1814) (n=35), round goby *Neogobius melanostomus* (Pallas, 1814) (n=162), shore rockling *Gaidropsarus mediterraneus* (Linnaeus, 1758) (n= 44), thornback ray *Raja clavata* Linnaeus, 1758 (n=11), grey wrasse *Symphodus cinereus* (Bonnaterre, 1788) (n=6), black goby *Gobius niger* Linnaeus, 1758 (n=22) and European anchovy *Engraulis encrasicolus* (Linnaeus, 1758) (n=72) were collected either by angling or commercial fishermen from Sinop coasts of the Black Sea in Turkey (N 42º05'68'' E35º10'55'') in the period September 2015 – August 2017. Gills, fins, skin, urinary bladder, kidney, gall bladder, liver, intestine, smooth muscles and gonads of each fish species were examined for myxosporean parasites at the Faculty of Fisheries and Aquatic Sciences in Sinop, Turkey. Parasite species were identified using an Olympus light microscope (BX53) equipped with a digital camera (DP50) and DIC attachment at x400 and x1000 magnification. Measurements of each parasite species were based on 30 fresh spores in accordance with Lom & Dykova (1992) and provided in micrometres as the mean and the range. Calculation of infection prevalence (%) follow the definition given by Bush et al. (1997) and the intensity of infection of myxozoans was semiquantitatively evaluated following a scale 1+ (1−9); 2+ (10−19); 3+ (20−29); 4+ (30−39); 5+ (40−49); 6+ (>50) at the magnification 200× (modified after Gürkanli et al. 2018).

Results

A total of 10 myxosporean species was identified from fishes collected from the coastal area off Sinop, Black Sea, Turkey. They were *Ortholinea orientalis* (Shulman & Shulman-Albova, 1953) from Pontic shad and European anchovy, *Sphaeromyxa sevastopoli* Naidenova, 1970, and *Zschokkella iskovi* Kovaljova, Donetz & Kolesnikova, 1989 from shore rockling, *Chloromyxum partistriatus* Kovaljova, Donetz & Kolesnikova, 1989 from thornback ray, *Myxobolus* sp. 1 and *Ortholinea divergens* (Thelohan, 1895) from grey wrasse, *Ceratomyxa* sp. from Mediterranean sand smelt, *Fabespora nana* and *Sphaeromyxa sevastopoli* from knout goby, *Ortholinea* sp. from black goby and *Myxobolus* sp. 2 from round goby. Hosts, site of infection, prevalence and intensity of infections as well as morphological and morphometric peculiarities of each recorded myxosporean species are presented.

***Ortholinea orientalis* (Shulman & Shulman-Albova, 1953) (Fig. 1A,B)**

Hosts: Pontic shad *Alosa immaculata* Bennett, 1835, European anchovy *Engraulis encrasicolus* (L., 1758). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Spores oviform, with more or less pointed posterior end in sutural view; two spherical polar capsules opening anteriorly in sutural plane. For measurements, see Table 1. *Site of infection (sporogonic stages):* urinary bladder. *Prevalence: A. immaculata* – 1.9% (n=106); *E. engrasicolus* – 1.4% (n=72). *Intensity: A. immaculata* – 1+; *E. engrasicolus* – 1+.

***Ortholinea divergens* (Thelohan, 1895) (Fig. 1C)**

Host: Grey wrasse *Symphodus cinereus* (Bonnaterre, 1788). *Description of sporogonic stages:* Elliptical polysporous plasmodia measuring c. 20 x 40 µm; round polysporous plasmodia measuring c. 40 µm. *Description of spores:* Round or ovoid, valves with striations; polar capsules pyriform. For measurements, see Table 1. *Site of infection (sporogonic stages):* kidney. *Prevalence:* 33.3% (n=6). *Intensity:* 1+.

***Ortholinea* sp. (Fig. 1D)**

Host: Black goby *Gobius niger* L., 1758. *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Spores spherical, two anteriorly located polar capsules pyriform. Sporoplasm in the posterior part of the spore. For measurements, see Table 1. *Site of infection (sporogonic stages):* kidney. *Prevalence:* 9.1% (n=22). *Intensity:* 1+.

***Sphaeromyxa sevastopoli* Naidenova, 1970 (Fig. 1E,F)**

Hosts: Shore rockling *Gaidropsarus mediterraneus* (L., 1758); knout goby *Mesogobius batrachocephalus* (Pallas, 1814). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Fusiform, valves with longitudinal striation; two opposite, tapering and truncated polar capsules large. For measurements, see Table 1. *Site of infection (sporogonic stages):* gall bladder. *Prevalence: G. mediterraneus* – 15.9% (n=44); *M. batrachocephalus* – 2.8% (n=35). *Intensity: G. mediterraneus* – 5+; *M. batrachocephalus* – 5+.

***Zschokkella iskovi* Kovaljova, Donetz & Kolesnikova, 1989 (Fig. 1G)**

Host: Shore rockling *Gaidropsarus mediterraneus* (L., 1758). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Irregularly-oval, with bluntly pointed poles; spherical polar capsules with slightly extended end open at some distance from poles. For measurements, see Table 1. *Site of infection (sporogonic stages):* gall bladder. *Prevalence:* 4.5% (n=44). *Intensity:* 1+.

***Chloromyxum partistriatus* Kovaljova, Donetz & Kolesnikova, 1989 (Fig. 1H,I)**

Host: Thornback ray *Raja clavata* L., 1758. *Description of sporogonic stages:* Elliptical large polysporous plasmodia measuring between 22 µm to 38 µm. *Description of spores:* Oval spores in apical view have characteristic four polar capsules with surface striations; spores in frontal view taper at the top. For measurements, see Table 1. *Site of infection (sporogonic stages):* gall bladder. *Prevalence:* 9.1% (n=11). *Intensity:* 6+.

***Fabespora nana* Naidenova & Zaika, 1969 (Fig. 1J, K)**

Host: Knout goby *Mesogobius batrachocephalus* (Pallas, 1814). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Spores elongated; polar capsule very small, rounded; spore surrounded by a roller. For measurements, see Table 1. *Site of infection (sporogonic stages):* gall bladder. *Prevalence:* 20.0% (n=35). *Intensity:* 5+.

***Myxobolus* sp. 1 (Fig. 1L)**

Host: Grey wrasse *Symphodus cinereus* (Bonnaterre, 1788). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Spores round or roundish in frontal view; valves thin, symmetrical, smooth; two polar capsules pyriform, large. For measurements, see Table 1. *Site of infection (sporogonic stages):* kidney. *Prevalence:* 33.3% (n=6). *Intensity:* 3+.

***Myxobolus* sp. 2 (Fig. 1M)**

Host: Round goby *Neogobius melanostomus* (Pallas, 1814). *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Transversely-oval; polar capsules occupy nearly the half of the spore body. For measurements, see Table 1. *Site of infection (sporogonic stages):* kidney. *Prevalence:* 1.2% (n=162). *Intensity:* 1+.

***Ceratomyxa* sp. (Fig. 1N,O)**

Host: Mediterranean sand smelt *Atherina hepsetus* L., 1758. *Description of sporogonic stages:* Plasmodia not observed in our material. *Description of spores:* Spores both crescent-shaped and arcuate; subspherical polar capsules located at the middle of spore. For measurements, see Table 1. *Site of site (sporogonic stages):* gall bladder. *Prevalence:* 2.32% (n=43). *Intensity:* 6+.

Discussion

The present study provides new data on the myxosporean parasite fauna of some teleost and elasmobranch fish species inhabiting Sinop coast of the Black Sea and revealed 10 myxosporean species. Some of parasites are recorded from new hosts and a new geographical locality, i.e. the Turkish coastal areas in the Black Sea.

To date, 23 species of the genus *Ortholinea* Shulman, 1962 have been reported from fishes inhabiting various geographical areas, mostly from marine and brackish environments (Lom & Dykova 1992, Rangel et al. 2014, 2015, 2017, Gürkanli et al. 2018). *Ortholinea orientalis* has previously been reported from ureters and (rarely) posterior renal tubules of *Clupea harengus* and *Sprattus sprattus* in the northern Qresund, Denmark (Karlsbakk & Koie 2011), from the urinary bladder of *Clupea pallasi*, *Eleginus gracilis* and *Theragra chalcogramma* in the north-western Japan Sea and Far East Sea (Aseeva 2000, 2002) and from the urinary bladder of *Alosa tanaica* and *Mullus barbatus* in the southern Black Sea (Özer et al. 2015a). In the present study, this parasite species has been found from the urinary bladder of another clupeid fish species, *Alosa immaculata*. Thus, our study expands the host list

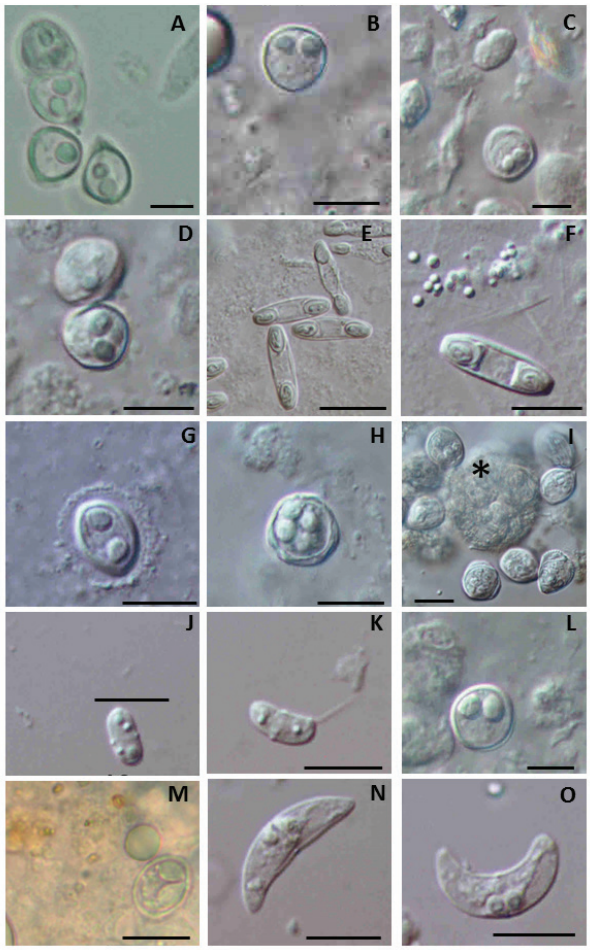

Fig. 1. A, B. *Ortholinea orientalis* (Shulman & Shulman-Albova, 1953). C. *Ortholinea divergens* (Thelohan, 1895). *D. Ortholinea* sp. E, F. *Sphaeromyxa sevastopoli.* G. *Zschokkella iskovi.* H, I. *Chloromyxum partistriatus*. J, K. *Fabespora nana.* L. *Myxobolus* sp. 1. M. *Myxobolus* sp. 2. N, O. *Ceratomyxa* sp. Scale-bars: 10 µm

of *O. orientalis*. Karlsbakk & Koie (2011) have reported prevalence of 20% and 11% in *C. harengus* and *S. sprattus*, respectively, and Özer et al. (2015b) – 2.5% in *A. tanaica* and 33.3% in *Mullus barbatus* off Sinop coasts of the Black Sea. When our data from *A. immaculata* (1.9%) are compared with those of the above-mentioned authors, prevalence recorded in the course of the present study is lower than that reported from other clupeids from Denmark but similar to that in *A. tanaica* (2.5%) from the Black Sea. We have another contributed to the knowledge of the host range of *O. orientalis* by adding another clupeid fish, *E. engrasicolus*, with prevalence of 1.4%. The morphological data of this parasite species based on samples from the two host species (*A. immaculata* and *E. engrasicolus*) corresponds well to one another but the measurements from the latter host are higher, still within the range reported by previous authors for this species.

The second species of the genus *Ortholinea*, *O. divergens*, has previously been reported from ureters of *Liza aurata* (prevalence 33.3%), *Diplodus annularis* (25.0-33.3%), *Salaria pavo* (1.8-100.0%), *Aidablennius sphynx*, *Parablennius tentacularis, Symphodus cinereus* (50.0%), *S. roissali* (100.0%), *S. ocellatus* (20.0%), *Blennius pholis* and *Crenilabrus melops* in the Black Sea (Schulman 1962, Yurakhno 1993, 1997, 2013) and from urinary bladders of *Reinchartius platessoides* (25.0%) and *Hippogloides platessoides* in the North Atlantic (Zubchenko 1980, 1985), *Paramyxoproteus reinhardti* from the Barents Sea (Wierzbiecka 1990) and *P. sanguinolentus* (2.7%) in Turkish coasts of the Black Sea (Özkan 2015). The present data for *S. cinereus* (33.3%) are higher than those reported for *S. ocellatus*, *R. platessoides*, *P. sanguinolentus* but lower than those recorded from *S. roissali*, *S. pavo*, *S. cinereus* in the Northern Black Sea and the Northern Atlantic. We have found this parasite only in the kidney of *S. cinereus* (in contrast to previous reports from urinary bladder). Furthermore, the finding in *S. cinereus* is a new host record for *O. divergens* off the southern coasts of the Black Sea. When the morphology of this parasite species is considered, the present study reveales that *O. divergens* from *S. cinereus* corresponds well to previous studies but the measurements of the samples from *Blennius pholis* and *Crenilabrus melops* are slightly higher than those of our samples.

We have found another *Ortholinea* parasite, which has remained identified at the generic level only – *Ortholinea* sp. from kidneys of *Gobius niger*. Four species of this genus have been recorded from fish hosts off the southern coasts of the Black Sea in Turkey: *O. divergens*, *O. gobiusi*, *O. orientalis* and *O. mullusi* from urinary bladders and kidneys of *P. sanguinolentus*, *N. melanostomus*, *A. tanaica* and *M.* barbatus, respectively (Gürkanli et al. 2018, Özer et al. 2015a,b). However, when we consider morphology and morphometry, it is seen that the present material differs from the four above-mentioned *Ortholinea* spp. Additional studies are needed in order to clarify the species identity of the third species of *Ortholinea* recorded by us.

To date, 49 species of the genus *Sphaeromyxa* Thelohan, 1892 have been described, mostly from marine fish from diverse geographical regions (Bartosova-Sojkova et al. 2015, Whipps & Zhao 2015). *Sphaeromyxa sevastopoli* has been reported from a wide range of host species (*Syngnathus typhle, Sprattus sprattus, Parablennius sanguinolentus, Lypophris pavo, Atherina boyeri, Mesogobius batrachocephalus, Neogobius melanostomus, N. platy-*

Table 1. Identified myxosporean species, their hosts, site of infection and measurements (μm) off Sinop coasts, Black Sea

Species	Host	Site of infection	Spore		Polar capsule	
			Length	Width	Length	Width
Ortholinea orientalis	*Alosa immaculata*	Urinary bladder	8.0 (7.7-8.3)	7.9 (7.7-8.2)	2.5 (2.3-2.7)	1.8 (1.7-2.0)
Ortholinea orientalis	*Engraulis encrasicolus*	Urinary bladder	9.1 (9.0-9.4)	8.6 (8.2-8.9)	3.1 (3.0-3.3)	2.3 (2.2-2.4)
Ortholinea sp.	*Gobius niger*	Kidney	8.5 (8.3-9.3)	7.7 (7.4-8.9)	2.7 (2.0-2.9)	1.9 (1.9- 2.2)
Ortholinea divergens	*Simphodus cinereus*	Kidney	9.1 (8.2-9.6)	9.3 (8.5-9.8)	2.0 (1.8-2.2)	2.1 (1.8-2.3)
Sphaeromyxa sevastopoli	*Gaidropsarus mediterraneus*	Gall bladder	18.1 (17.7-19.2)	5.0 (4.7-5.9)	6.3 (6.0-7.4)	3.0 (2.5-3.1)
Sphaeromyxa sevastopoli	*Mesogobius batrachocephalus*	Gall bladder	17.6 (16.9-18.0)	4.1 (3.9-4.6)	5.2 (5.0-5.3)	3.5 (3.3-3.7)
Zschokkella iskovi	*Gaidropsarus mediterraneus*	Gall bladder	10.6 (9.7-10.7)	7.1 (6.7-7.3)	4.0 (3.7-4.2)	3.0 (2.7-3.1)
Chloromyxum partistriatus	*Raja clavata*	Gall bladder	11.1 (10.9-11.2)	8.9 (8.1-9.1)	3.5 (3.4-3.6)	2.5 (2.4-2.5)
Myxobolus sp. *1*	*Symphodus cinereus*	Kidney	10.2 (8.7-10.9)	9.7 (8.3-10.1)	4.7 (3.8-5.0)	3.4 (2.9-3.5)
Myxobolus sp. *2*	*Neogobius melanostomus*	Kidney	11.0 (10.1-20.8)	8.0 (6.6-8.5)	5.9 (5.5-6.2)	3.0 (2.5-3.2)
Ceratomyxa sp.	*Atherina hepsetus*	Gall bladder	19.1 (16.1-22.1)	9.0 (8.1-10.0)	1.8 (1.6-2.1)	2.0 (1.7-2.2)
Fabespora nana	*Mesogobius batrachocephalus*	Gall bladder	8.6 (8.5-8.9)	4.1 (3.9-4.4)	1.0 (1.0-1.1)	1.0 (1.0-1.1)

rostris, N. eurycephalus, N. fluviatilis, Gobius buchichi, G. niger, G. cobitis, Pomatoschistus microps leopardinus, Proterorhinus marmoratus, Parablennius tentacularis, Gaidropsarus mediterraneus, Uranoscopus scaber and *Mugil cephalus*) near Sevastapol and Karadağ in the northern Black Sea and the Sea of Azov (Yurakhno 2009, 2013). Moreover, Özer et al. (2015b) have reported this parasite species in the gall bladder of *Parablennius sanguinolentus* near Sinop, southern Black Sea. Our study adds two further species, i.e. *Gaidropsarus mediterraneus* and *Mesogobius batrachocephalus*, to the host range of this parasite along the Turkish coast of the Black Sea. The recorded prevalence of *S. sevastopoli* in these two host species is 15.9% and 2.8%, respectively; these data are lower than those reported for *P. sanguinolentus* by Yurakhno (2013) (25%) and Özer et al. (2015b) (51.4%). The morphological observations of samples from the two host species are similar, with measurements of the samples from *G. mediterraneus* being slightly larger than those from the other host. However, both are within the morphometric range reported by previous authors.

A total of 68 species of the genus *Zschokkella* Auerbach, 1909 have been reported from marine and freshwater fishes (Lom & Dykova 2006). *Zschokkella iskovi* has previously been reported from the gall bladder of *G. mediterraneus* (48%), *Diplodus annularis* (6%) and *Uranoscopus scaber* (8%) near Karadağ and Sevastapol in the northern Black Sea (Kovaleva et al. 1989, Yurakhno 1997, 2015). In the present study, *Z. iskovi* has been found in the gall bladder of *G. mediterraneus* off Sinop. This is a new locality for this parasite species. The morphology of the recorded parasites corresponds well to that described by Kovaleva et al. (1989).

The genus *Chloromyxum* Mingazzini, 1890 consists of 140 species parasitic in marine and (mostly) in freshwater fish species (Eiras et al. 2012). The members of this genus infect gall bladders and urinary tracts of teleost and elasmobranch hosts, including *Raja miraletus* (Kovaleva 1988, Fiala & Dykova 2004, Lom & Dykova 2006). *Chloromyxum partistriatus* has been reported from the gall bladder of *Raja clavata* (20.8%) near Sevastopol in the northern Black Sea (Kovaleva et al. 1989). The present study is the first report of *Chloromyxum partistriatus* in *R. clavata* off the Turkish coast of the Black Sea. This is also the first record of a member of the genus *Chloromyxum* for the Turkish parasite fauna. The recorded prevalence is lower than that of previously reported from northern coasts of the

Black Sea. The morphology of the studied parasites corresponds well to previous descriptions.

Myxobolus Bütschli, 1882 is the most voluminous myxosporean genus, with its c. 900 species from various fishes inhabiting different geographical areas, mostly from freshwaters (Longshaw et al. 2003, Molnar et al. 2009, Eiras et al. 2005, 2014). It is well-known that *Myxobolus* spp. show strict host and tissue specificity (Molnar et al. 2009, Molnar & Esztebauer 2015). Nine *Myxobolus* spp., i.e. *M. episquamalis* from *Mugil cephalus, M. muelleri* from *Mugil cephalus* and *Diplodus annularis, M. asymmetricus* from *Parablennius tentacularis* and *P. sanguinolentus, M. parvus* from *Liza saliens, M. rotundus* from *Symphodus cinereus, M*. sp. 1 from *Neogobius melanostomus, M.* sp. 2 from *Gobius paganellus*, *M.* sp. 3 from *Gobius niger* and *M*. sp. 4 from *Mullus barbatus*, have been reported from several fish species off the Turkish coasts of the Black Sea (Özkan 2015, Özer & Okkay 2018, Özer et al. 2018). In the present study, we have found two species of *Myxobolus*, which are identified at the generic level only. One of them is from the kidney of *Symphodus cinereus* and the second is from the kidney of *Neogobius melanostomus*. Our *Myxobolus* sp. 1 from *S. cinereus* is identical to *M. rotundus* from the same host, which was reported by Özkan (2015). However, in the light of current knowledge of *M. rotundus* infections, this parasite has been reported from the gills of several freshwater fish species (Molnar et al. 2009, Longshaw et al. 2003, Eiras et al. 2005). We believe that its report from the kidney of *S. cinereus* in the Black Sea by Özkan (2015) needs more attention to check its species identity. Thus, we retain our *Myxobolus* spp. identified at the generic level only pending additional studies, even though the available morphological and morphometric data overlap well. The prevalence of infection values at both studies are very similar, 33.3% in the present study and 25.0% in the study by Özkan (2015). In the present study, we have also found another *Myxobolus* sp. in the kidney of *Neogobius melanostomus*. It is identical in morphology to of *Myxobolus* sp. 1 from *N. melanostomus* reported by Özkan (2015) from the same sampling locality. However, we retain it identified at the generic level only as more studies are underway.

A total of 2 species of *Fabespora* Naidenova & Zaika, 1969 have been reported from several marine fishes (Lom & Dykova 2006). *Fabespora nana* has been reported from the gall bladder of *Mesogobius batrachocephalus* (58%), *Ophidion rochei* (100%), *Gaidropsarus mediterraneus* (30%), *Scorpaena porcus* and *Proterorhinus marmoratus* in the Black Sea (Naidenova & Zaika 1969, Yurakhno 2009). In the present study, *F. nana* (20%) was found in the gall bladder of *M. batrachocephalus* off Sinop. This is a new host record and new geographical record. The prevalence (20%) is lower than those reported by previous authors (see above). The morphological and morphometric data of this species correspond well to the previous reports.

A total of 232 species have been identified as members of the genus *Ceratomyxa*; they infect only gall bladders of mostly marine host fishes (Eiras 2006, Eiras et al. 2018, Abdel-Ghaffar et al. 2008). Until now, *Ceratomyxa beloneae* from *Belone belone*, *C. merlangi* from *Merlangius merlangus*, *Ceratomyxa* sp. from *Scopthalmus maeoticus* and *Ceratomyxa* sp. from *Solea solea* have been reported from the gall bladder of their hosts in the southern Black Sea in Turkey (Özer et al. 2017, Yurakhno et al. 2017, Okkay et al. 2018, Özer & Öztürk 2011, Özer & Yurakhno 2013). In the present study, we found a *Ceratomyxa* parasite in the gall bladder of *Atherina hepsetus,* a new host for *Ceratomyxa* infections in this geographical area. *Ceratomyxa hepseti* (Syn. *Leptotheca hepseti*) has previously been reported from *Atherina hepsetus* in the northern Black Sea by Kovaleva (1966). However, its triangular spores and their measurements as reported in the original description (Kovaleva 1966) are different from those of our material. Therefore, we believe that our parasite might be a new species. Further studies are needed to clarify its species identity.

In conclusion, the present data provide new insights to the limited knowledge on myxosporean parasite fauna in fish species from the souther part of the Black Sea. We provide new hosts records. *Zschokkella iskovi* and *Chloromyxum partistriatus* are new parasite records for the Turkish Black Sea waters. Furthermore, *Ortholinea orientalis, O. divergens, Fabespora nana* and *Sphaeromyxa sevastopoli* have new host records in this geographical area. We believe that myxosporean species identified at the generic level in the present study have a potential to be proved as new species.

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