

RESEARCH ARTICLE

ARAŞTIRMA MAKALESİ

Digenean parasites of Atlantic horse mackerel (*Trachurus trachurus*) in the Turkish Black Sea coast

Türkiye'nin Karadeniz kıyısındaki karagöz istavrit balığının (*Trachurus trachurus*) Digenea parazitleri

Türky Öztürk* • Ahmet Özer

Sinop University, Faculty of Fisheries and Aquatic Sciences, 57000, Sinop, Turkey

*Corresponding author: turkay.ozturk@gmail.com

Received date: 16.4.2015

Accepted date: 14.3.2016

How to cite this paper:

Öztürk, T. & Özer, A. (2016). Digenean Parasites of Atlantic Horse Mackerel (*Trachurus trachurus*) in the Turkish Black Sea Coast. *Ege Journal of Fisheries and Aquatic Sciences*, 33(1): 35-40. doi: 10.12714/egejfas.2016.33.1.06

Abstract: In the present study, we investigated the digenean parasites of Atlantic horse mackerel, *Trachurus trachurus* (L., 1758), in the Turkish Black Sea coast for the first time. Fish were collected throughout a year period from local fishermen in Sinop. A total of 256 fish specimens were weighed and measured, subsequently examined for parasites using conventional methods under an Olympus microscope (BX53) equipped with a digital camera (DP50). The examination included gills, pharynx, body cavity and visceral organs (stomach, intestine, liver, swim bladder and gonads). Parasites recovered were fixed and preserved using methods commonly applied. A total of five species including adults of *Prodistomum polonii* (Molin 1879) Bray and Gibson 1990, *Ectenurus lepidus* Looss, 1907, *Monascus filiformis* (Rudolphi, 1819) Looss, 1907, *Lasiotocus typicus* (Nicoll, 1912) and metacercaria of *Stephanostomum cesticillum* (Molin, 1858) Looss, 1899 were identified. Each parasite species were counted, their prevalence (%) and mean intensity values were determined according to Bush et al. (1997). The difference between parasite loading on two length classes of fish were tested by Mann-Whitney U-test. All the statistical tests were performed at the significance level of 5%. The calculated overall infection prevalence (%) and mean intensity values were 48.8% and 3.78±0.34, respectively. This data is the first on the digenean parasite fauna of the Atlantic horse mackerel collected from the Turkish Black Sea coast. *Lasiotocus typicus* and *Stephanostomum cesticillum* are new parasite records for Turkey.

Keywords: *Trachurus trachurus*, horse mackerel, digenean parasite, Black Sea

Öz: Bu araştırmada, karagöz istavrit balığının, *Trachurus trachurus* (L., 1758) digenea parazitleri Türkiye'nin Karadeniz kıyısında ilk kez araştırıldı. Balıklar 1 yıl boyunca Sinop'taki yerel balıkçılardan temin edildi. Toplam 256 adet istavrit balığının boyları ve ağırlıkları ölçüldü, ardından dijital kamera (DP50) ile donatılmış Olympus (BX53) marka bir mikroskop altında rutin parazitolojik metotlar kullanılarak parazitleri tanımlandı. Solungaç, yutak, vücut boşluğu ve iç organlar (mide, bağırsak, karaciğer, yüzme kesesi ve gonadlar) incelendi. Bulunan parazitler yaygın olarak uygulanan yöntemler kullanılarak fiksede edildi ve saklandı. Ergin *Prodistomum polonii* (Molin 1879) Bray ve Gibson 1990, *Ectenurus lepidus* Looss, 1907, *Monascus filiformis* (Rudolphi, 1819) Looss, 1907, *Lasiotocus typicus* (Nicoll, 1912) ve metaserker *Stephanostomum cesticillum* (Molin, 1858) Looss, 1899 olmak üzere toplam beş tür tespit edildi. Her bir parazit türü sayıldı ve onların enfeksiyon oranı (%) ile enfekte balık başına ortalama parazit sayısı Bush ve ark. (1997) göre belirlendi. İki boy sınıfındaki parazit yükü arasındaki fark Mann-Whitney U testi ile test edildi. Tüm istatistiksel testler %5 önem seviyesine göre değerlendirildi. İncelenen balıkların tamamındaki enfeksiyon oranı %48.8 ve enfekte balık başına ortalama parazit sayısı ise 3.78±0.34 olarak hesaplandı. Bu veriler Türkiye'nin Karadeniz kıyısından yakalanan karagöz istavrit balığı için bir ilktir. *Lasiotocus typicus* ve *Stephanostomum cesticillum* türleri Türkiye parazit faunası için yeni kayıtlardır.

Anahtar kelimeler: *Trachurus trachurus*, karagöz istavrit, digenea parazit, Karadeniz

INTRODUCTION

The horse mackerels are distributed worldwide and are found throughout temperate, tropical and subtropical seas (Cárdenas et al., 2005). The genus *Trachurus* is represented by the Atlantic horse mackerel *Trachurus trachurus* and Mediterranean horse mackerel *T. mediterraneus*, the previous is the most northerly representative and is distributed from Western Africa to the Norwegian Sea, including Iceland, throughout the North Sea, the Mediterranean and Black Seas (Smith-Vaniz, 1986). This species is a small pelagic fish and is among the most important fishing resources in Turkish waters. Despite its high commercially value, studies on the digenean

parasites of *T. trachurus* are limited and mainly focused in the seas, except the Black Sea, surrounding Turkey (Akırız, 2001; Oğuz and Bray, 2006; Keser et al., 2007; Sağlam and Sarıyüpeoğlu, 2008). This study is the first to provide data on the digenean parasites and their infection indices in *T. trachurus* collected from the Turkish Black Sea coast.

MATERIAL AND METHODS

The horse mackerel were collected throughout a year from local fishermen in the period from December 2009 to December 2010. A total of 256 fish specimens near Sinop were transferred

to parasitology laboratory at the Faculty of Fisheries. All fish were weighed and measured, subsequently examined for digenean parasites using conventional methods under a dissecting microscope. The examination included gills, pharynx, body cavity and visceral organs (stomach, intestine, liver, swim bladder and gonads). The isolated parasites were fixed with 70% ethyl alcohol. Each digenean species was identified and counted using a phase contrast Olympus microscope (BX53) equipped with a digital camera (DP50). The identification of the parasites was conducted according to the keys provided by [Bychovskaya-Pavlovskaya \(1964\)](#), [Gibson and Bray \(1986\)](#), [Bartoli and Bray \(2004\)](#). Infection prevalence (%) and mean intensity values were calculated according to [Bush et al. \(1997\)](#). Kruskal-Wallis test (Non-parametric ANOVA) was performed to find out the significant differences in the mean intensity values of the parasite for length classes of fish as well as for the seasons. All the statistical tests were performed at the significance level of 5%.

RESULTS AND DISCUSSION

The current study is the first to report on the digenean parasite fauna of Atlantic horse mackerel from the Turkish Black Sea coast. A total of five species including adults of *Prodistomum polonii* (Molin 1879) [Bray and Gibson 1990](#), *Ectenurus lepidus* Looss, 1907, *Monascus filiformis* (Rudolphi, 1819) Looss, 1907, *Lasiotocus typicus* (Nicoll, 1912) and

metacercaria of *Stephanostomum cesticillum* (Molin, 1858) Looss, 1899 were identified. The infection prevalence (%) and mean intensity values as well as microhabitat preferences of each parasite species are provided in [Table 1](#) and [Figure 1](#). Photomicrographs of each parasite species are given in [Figures 2-6](#). The overall infection prevalence (%) and mean intensity (MI) values were 48.83% and 3.78±0.34, respectively. *Lasiotocus typicus* and *Stephanostomum cesticillum* represented new parasite records for Turkey.

Order: Plagiorchiida

Family: Lepocreadiidae

Genus: Prodistomum

***Prodistomum polonii* (Molin, 1859) (Figure 2A-C)**

Syns: *Distomum polonii* Molin, 1859; *Distomum* (*Echinostomum*) *polonii* (Molin, 1859) Stossich, 1886; *Pharyngora polonii* (Molin, 1859) Odhner, 1911; *Opechona polonii* (Molin, 1859) Odhner, 1911

Parasitological indices: These data are provided in [Table 1](#) and [Figure 1](#).

Infection site: intestine

Table 1. Site of infection (microhabitat), prevalence (%) and mean intensity (MI) values of identified digenean parasites in the Atlantic horse mackerel with respect to the fish length classes and seasons (S.E.: Standard Error)

Digenean parasites of the Atlantic horse mackerel			Fish length classes		Seasons			
Parasites species	Microhabitat	Prevalance (%) M.I. ± S.E.	<13 cm (n:144)	≥13 cm (n:112)	Spring (n: 39)	Summer (n: 0)	Autumn (n: 110)	Winter (n: 107)
<i>Prodistomum polonii</i>	Intestine	43.4 3.79±0.37	40.3% 4.55±0.63	47.3% 2.94±0.35	30.8% 2.33±0.91	-	62.7% 4.59±0.56	33.64% 2.89±0.47
<i>Monascus filiformis</i>	Pyloric ceace, intestine	1.6 5.21±3.08	-	3.6% 1.00±0.00	-	-	-	3.74% 1.00±0.00
<i>Ectenurus lepidus</i>	Stomach	2.7 2.00±0.40	-	6.3% 2.00±0.44	-	-	-	6.54% 2.00±0.44
<i>Lasiotocus typicus</i>	Rectum, intestine	5.1 1.85±0.09	6.9% 1.80±0.33	2.7% 2.00±1.00	2.56% 3.00±0.00	-	8.2% 1.67±0.33	2.80% 2.00±1.00
<i>Stephanostomum cesticillum</i>	Gills, pharynx	0.8 1.00±0.00	-	1.80% 2.00±0.00	5.13% 2.00±0.00	-	-	-
Overall		48.8 3.78 ± 0.34	45.1% 4.34±0.57*	53.6% 2.95±0.32*	33.3 2.38±0.84^a	-	62.7 4.41±0.52^b	40.2% 2.91±0.42^a

*Means followed by the same supercript letter are not significantly different (P>0.05)

This is a commonly reported adult parasite of *T. trachurus* in the Black Sea ([Bray and Gibson, 1990](#); [Bray and Cribb, 1996](#)), in the Mediterranean Sea ([Bartoli et al., 2005](#)), in the Northeas Atlantic ([Bray and Gibson, 1997](#)). [Sezen-Akandere \(1972\)](#) reported *Lepidapedon sengunii* and *L. ricci* from *T.*

trachurus in the Sea of Marmara, but [Bray and Gibson \(1990\)](#) considered both species as synonyms of *P. polonii*. This parasite was reported in *T. trachurus* from the Sea of Marmara ([Keser et al., 2007](#)) and in *Merlangius merlangus* in the Turkish coast of the Black Sea ([Özer et al., 2012](#)).

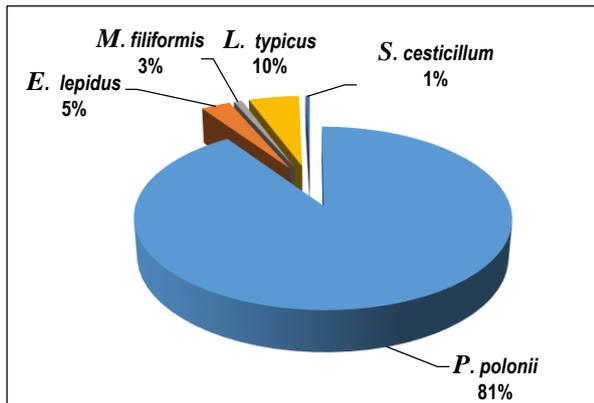


Figure 1. Percentage distribution of identified parasite species in the Atlantic horse mackerel throughout the survey study

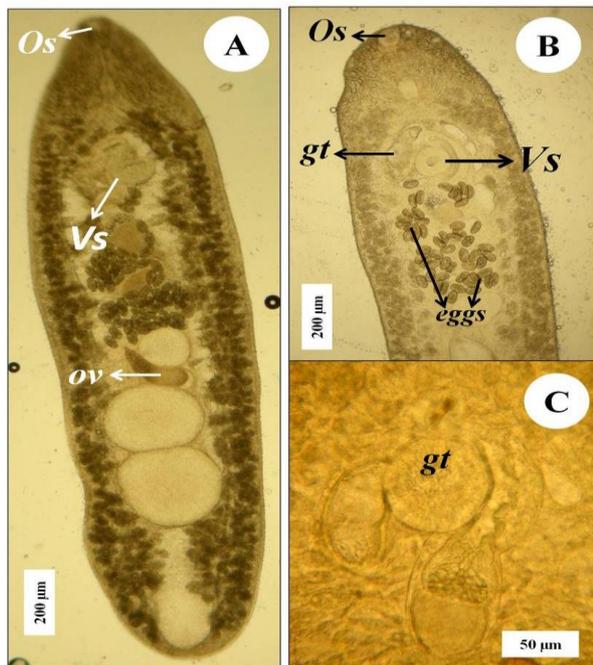


Figure 2. *Prodistomum polonii* (Molin 1879) Bray and Gibson 1990. (unstained, original). A. general view of adult individual, B. anterior section of the parasite, C. details of genitalia. Os. Oral sucker, Vs. ventral sucker, t. testes, Ov. ovary, gt. genitalia

Order: Plagiorchiida

Family Hemiuridae

Genus Ectenurus

Ectenurus lepidus Looss, 1907 (Figure 3A-C)

Syns. *Ectenurus trachuri* Nikolaeva and Kovaleva, 1966; *Hemiurus shalabyi* El-Serafy, Ramadan, Morsy and Lashein, 2002; *Magnacetabulum trachuri* Yamaguti, 1934

Parasitological indices: These data are provided in Table 1 and Figure 1.

Infection site: stomach

This species in adult form is a common parasite of *T. trachurus* (Gibson and Bray, 1986; MacKenzie et al., 2004) and many other hosts. This species has been reported from *T. mediterraneus* in the Mediterranean Sea (Fernandez-Jover et al., 2010) and from *T. mediterraneus ponticus* in the Black Seas (Nikolaeva, 1965), from *Scomber japonicus* in the Aegean and Marmara Seas (Akmirza, 1997, 2000, 2003) and from *T. trachurus* from Marmara Sea (Keser et al., 2007). This is the first report of this parasite in the Turkish coast of the Black Sea.

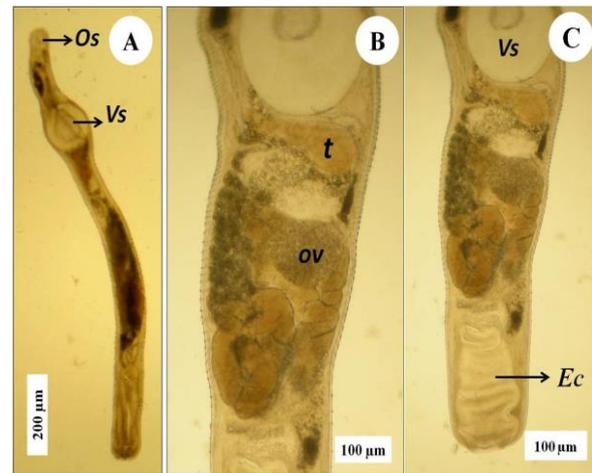


Figure 3. *Ectenurus lepidus* Looss, 1907 (unstained, original), A. Ventral view of adult individual, B. body surface with plaited, C. posterior section of the parasite and tail. Os. oral sucker, Vs. ventral sucker, t. testes, ov. ovary and Ec. ecsoma (inverted)

Order: Plagiorchiida

Family: Monorchidae

Genus: Lasiotocus

Lasiotocus typicus (Nicoll, 1912) (Figure 4A-D)

Syn. *Ancylocoelium typicum* Nicoll, 1912

Infection sites: Rectum, intestine, pyloric caeca.

Parasitological indices: These data are provided in Table 1 and Figure 1.

This species in adult form has been reported from *T. trachurus* in the Black and Azov Seas (Osmanov, 1940), in the Atlantic Ocean and Mediterranean Sea (Gaevskaya and Kovaleva, 1980, 1982; Naidenova and Mordvinova, 1997; Gaevskaya, 2003; Bartoli and Bray, 2004) and from *T. mediterraneus* in the Mediterranean Sea (Fernandez-Jover et al., 2010). This is the first report of this parasite in the Turkish coast of the Black Sea as well as Turkish parasite fauna.

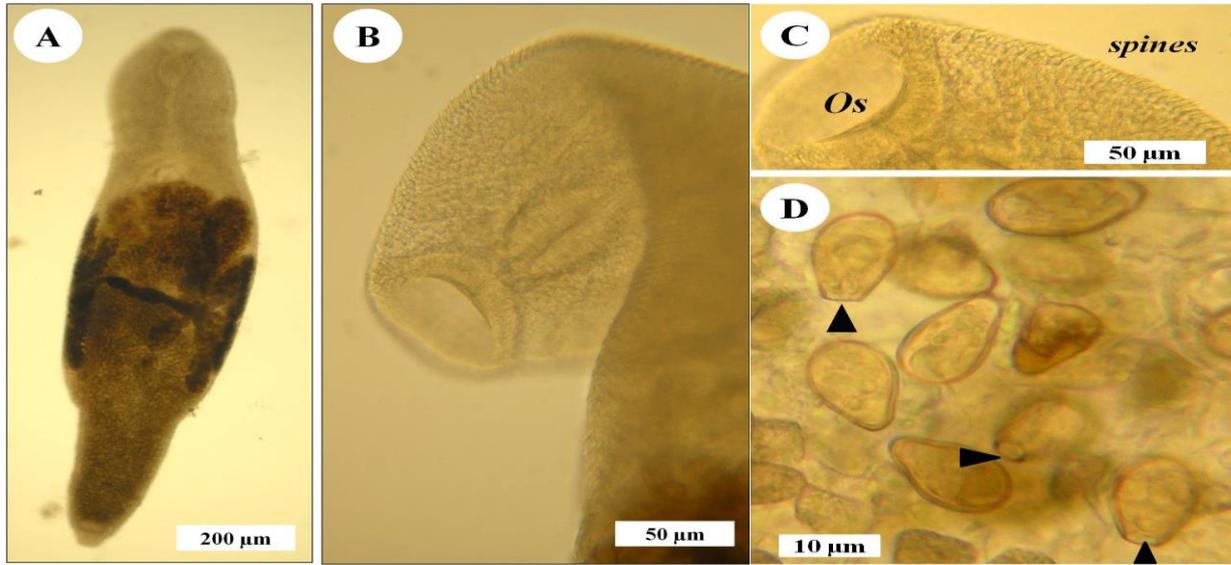


Figure 4. *Lasiotocus typicus* (Nicoll, 1912) (unstained specimen, original). A. Slightly flattened adult specimen (dorsal view), B. Oral sucker (Os) with ventrally subterminal opening, transversely flattened, C. anterior body surface with spines, D. capsulated eggs (arrow heads show capsulate)

Order: Plagiorchiida

Family: Fellodistomidae

Genus: Monascus

***Monascus filiformis* (Rudolphi 1819) (Figure 5A-C)**

Syns. *Distome filiforme* Rudolphi, 1819; *Haplocladus filiformis* Odhner, 1911; *Haplocladus typicus* Odhner, 1911; *Haplocladus orientalis* Yamaguti, 1958 *Karachitrema trilobata* Bilqeas, 1973, *Monascus trilobatus* (Bilqeas, 1973) Hafeezullah, 1984, *M. americanus* Amato, 1982, *M. mediolongiusculus* Ding, 1993

Infection site: Intestine

Parasitological indices: These data are provided in [Table 1](#) and [Figure 1](#).

The adult worms occur mainly in the members of Carangidae, although a wide range of other fishes are also infected. *Monascus filiformis* has a wide distribution, which includes not only the Atlantic Ocean and the Mediterranean, Red, and Black seas, but also the Gulf of Mexico, the Mexican Pacific, and the coastal regions of India and the Arabian peninsula (Amato, 1982; Martorelli and Cremonte, 1998; Sey et al., 2003; Fernandez-Jover et al., 2010). Oguz and Bray (2006) and Keser et al., (2007) reported this parasite from *T. trachurus* in the Sea of Marmara, and pointed out that it has frequently been reported in this host in the Mediterranean and Black Seas. This is the first report of this parasite in the Turkish coast of the Black Sea.

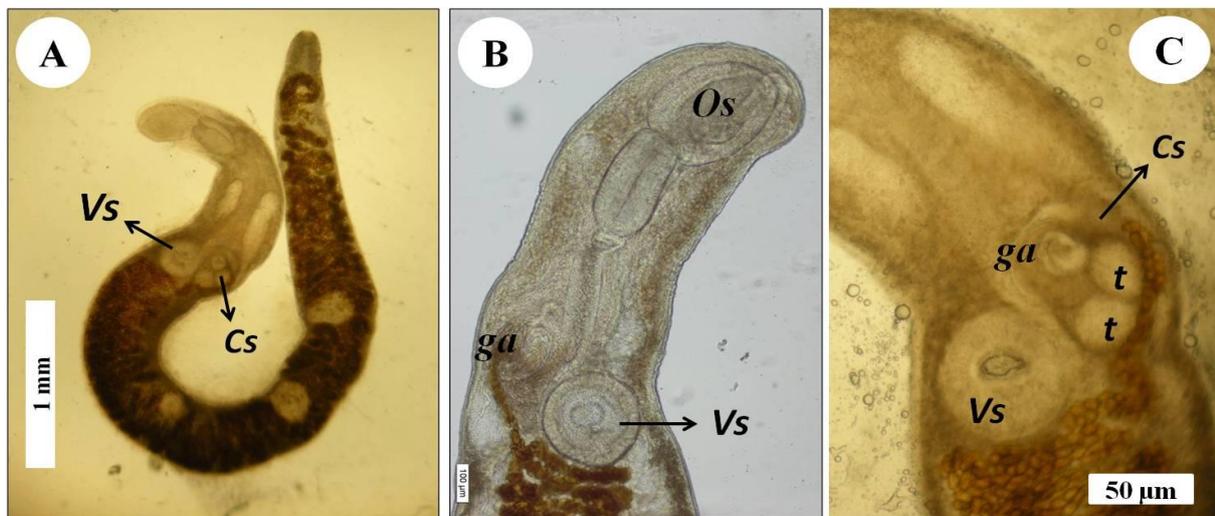


Figure 5. *Monascus filiformis* (Rudolphi, 1819) Looss, 1907 (unstained specimen, original). A. adult individual (ventral view.) B. Anterior section of the parasite, oral (Os) and ventral sucker (Vs). C. general view of genital atrium (ga), cirrus sac (Cs), testes (t) and ventral sucker

Order: Plagiorchiida
 Family: Acanthocolpidae
 Genus: *Stephanostomum*

Stephanostomum cesticillum (Molin, 1858) Looss, 1899
 (Figure 6A-C)

Syns. *Distoma cesticillus* Molin, 1858; *Echinostomum cesticillus* (Molin, 1858) Monticelli, 1893; *Anoiktostoma cesticillus* (Molin, 1858) Stossich, 1899; *Stephanochasmus cesticillus* (Molin, 1858) Looss, 1901.

Infection sites: gills, pharynx.

Parasitological indices: These data are provided in Table 1 and Figure 1.

The genus *Stephanostomum* has a wide distribution and its members infect marine teleosts, especially carangids. *Stephanostomum cesticillum* has been reported from the north-eastern Atlantic region, including the Baltic, Mediterranean and Black Seas (Nikolaeva, 1965; Dimitrov, 1989; 1991; Kostadinova and Dimitrov, 1994; Bartoli and Bray, 2001). Carangid fishes can be both definitive and secondary intermediate hosts for this parasite (Dimitrov, 1991; Kostadinova and Dimitrov, 1994).

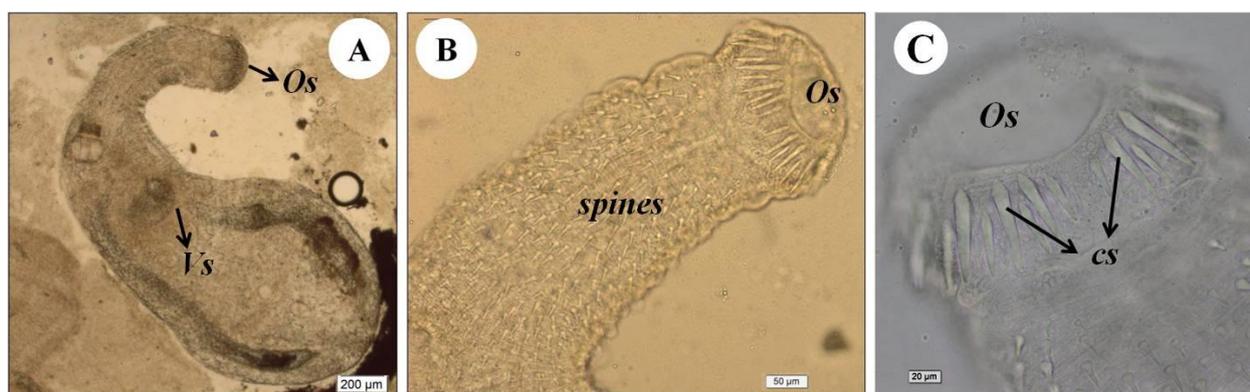


Figure 6. *Stephanostomum cesticillum* (Molin, 1858) Looss, 1899 metacercaria (unstained, original). A. Excysted metacercarial individual. B. General view of anterior section of the parasite and body spines. C. Circum-oral spines. Os. Oral sucker, Vs. Ventral sucker, cs: circum-oral spines

The calculated overall infection prevalence (%) and mean intensity values were 48.8% and 3.78 ± 0.34 , respectively. Of the five digenean species identified in the present study, *P. polonii* was the most prevalent species (Table 1) and the rest had very low infection prevalence values. Infection intensity values of all species were also very low as can be seen in Table 1. While smaller sized fish (<13 cm) had only two parasite species, larger sized fish (≥ 13 cm) had five, in the fish length range between 9.1 - 16.3 cm. Moreover, larger fish had higher infection prevalence than did small fish. There was a seasonal parasitic occurrence that fish examined in winter was occupied by 4 parasite species, spring by 3 and autumn by only 2 species, though infection values were not high enough to make more evaluation. In the light of current literature, total number of parasite species encountered in the present study is higher than that of Keser et al. (2007), Oğuz and Bray (2006), Akmirza (2001) and lower than of MacKenzie et al. (2004). Despite the less number of comparative data to make comparison between

our infection indices and the other, we can conclude that our data has a similarity to the data provided by above mentioned authors.

CONCLUSIONS

This study revealed first data on the digenean fauna of a commercially important fish species. It is important to determine the parasitological data for investigating population structure and stock discrimination in migratory fish species, the use of parasites as biological tags population studies, their phylogeny, interactions with other hosts and environment. Moreover, being heteroxenous parasites, digeneans provide valuable comparable data for host behaviour and distribution in a wide range of areas. This study revealed the first data on the digenean fauna of a commercially important fish species, the Atlantic horse mackerel, in Turkish water, thus, results obtained have a value to be used by other parasitological investigations.

REFERENCES

- Akmirza, A. (1997). The parasites of chub mackerel (*Scomber japonicus*) (in Turkish with English abstract). *Ege Journal of Fisheries and Aquatic Sciences*, 14(1-2): 173 - 181.
- Akmirza, A. (2000). Seasonal distribution of parasites detected in fish belonging to the Sparidae family found near Gokçeada (in Turkish with English abstract). *Turkish Society for Parasitology*, 24(4): 435 - 441.
- Akmirza, A. (2001). Seasonal variations in the parasites of horse mackerel (*Trachurus trachurus* (Linnaeus, 1758)). (in Turkish with English abstract). *Ege Journal of Fisheries and Aquatic Sciences*, 18(1-2): 33-37.
- Akmirza, A. (2003). Distribution of parasite fauna of chub mackerel in Aegean and Mediterranean Sea. *Turkish Journal Marine Sciences*, 9: 187 - 195.
- Amato, J.F.R. (1982). Digenetic trematodes of percid fishes of Florianópolis, southern Brasil—Fellodistomidae, Monascidae, Diplangiidae, Zoogonidae,

- and Waretrematidae with description of two new species. *Revista Brasileira de Biologia*, 42: 681–699.
- Bartoli P. & Bray R.A. (2001). Contribution to the knowledge of species of the genus *Stephanostomum* Looss, 1899 (Digenea: Acanthocolpidae) from teleosts of the Western Mediterranean, with the description of *S. gaidropsari* n. sp. *Systematic Parasitology*, 49: 159–188.
- Bartoli P. & Bray R.A. (2004). *Ancylocoelium typicum* Nicoll, 1912 (Digenea: Monorchidae), a poorly known parasite of *Trachurus* spp. (Teleostei: Carangidae) from the western Mediterranean and north-eastern Atlantic, and observations on its taxonomic position. *Systematic Parasitology*, 58: 23–39.
- Bartoli P., Gibson, D.I. & Bray R.A. (2005). Digenean species diversity in teleost fish from a nature reserve off Corsica, France (Western Mediterranean), and a comparison with other Mediterranean regions. *Journal of Natural History*, 39(1): 47–70.
- Bray, R.A. & Cribb, T.H. (1996). Two species of *Prodistomum* Linton, 1910 (Digenea: Lepocreadiidae) from marine fishes of Australia. *Systematic Parasitology*, 35: 59–67.
- Bray R.A. & Gibson, D.I. (1990). The Lepocreadiidae (Digenea) of fishes of the north-east Atlantic: review of the genera *Opechona* Looss, 1907 and *Prodistomum* Linton, 1910. *Systematic Parasitology*, 15: 159 – 202.
- Bray, R.A. & Gibson, D.I. (1997). The Lepocreadiidae Odhner, 1905 (Digenea) of fishes from the north-east Atlantic: summary paper, with keys and checklists. *Systematic Parasitology*, 36: 223–228.
- Bush, A.O., Lafferty, K.D., Lotz, J.M. & Shostak, A.W. (1997). Parasitology meets ecology on its own terms: Margolis et al. revisited. *Parasitology*, 83: 575–583.
- Bykhovskaya-Pavlovskaya, I.E., Gusev, A.V., Dubinina, M.N., Izyumov, N.A., Smirnova, T.S., Sokolovskaya, I.L., Shtein, G.A., Shulman, S.S. & Epshtein, V.M. (1964). Key to Parasites of Freshwater Fish of the USSR. Translated from Russian Israel Program for Scientific translations. Jerusalem, Israel.
- Cárdenas, L., Hernández, C.E., Poulin, E., Magoulas, A., Kornfield, I., & Ojeda, F.P. (2005). Origin, diversification, and historical biogeography of the genus *Trachurus* Perciformes: Carangidae. *Molecular Phylogenetics and Evolution*, 35(2): 496–507. doi:10.1016/j.ympev.2005.01.011
- Dimitrov, G.I. (1989). [Investigations of the helminths of fishes of the Bulgarian Black Sea coast]. Autoreferat na Disertacija. Sofia: *Bulgarian Academy of Sciences*, 35 pp.
- Dimitrov, G.I. (1991). Helminths of Mediterranean scad (*Trachurus mediterraneus ponticus*) from the Bulgarian Black Sea coast. Parasite Host Environment. Poster Abstracts, Second International School, 28 May–1 June, 1991. Sofia: Bulgarian Academy of Sciences, p. 231.
- Fernandez-Jover, D., Fallix, E., Sanchez-Jerez, P., Sasal, P. & Bayle-Sempere, J.T. (2010). Coastal fish farming does not affect the total parasite communities of wild fish in SW Mediterranean. *Aquaculture*, 300: 10–16. doi: 10.1016/j.aquaculture.2009.12.006
- Gaevskaya, A.V. & Kovaleva, A.A. (1980). Ecological geographical peculiarities of parasitic fauna of the Atlantic horse mackerel (*in Russian*). In: Fedorov, S.S. (Ed.) [Investigations of the biological resources of the Atlantic Ocean]. Kaliningrad: AtlantNIRO, pp. 18–24.
- Gaevskaya, A.V. & Kovaleva, A.A. (1982). Trematodes infesting Atlantic horse mackerels of the genus *Trachurus* (*in Russian*, English translation in *Hydrobiological Journal*, 18: 50–55). *Gidrobiologicheskii Zhurnal*, 18: 60–65.
- Gaevskaya A. V. (2003). *Ancylocoelium typicum* (Trematoda, Monorchidae), a parasite of the Horse-Mackerel of the Genus *Trachurus* (*in Russian*). *Vestnik Zoologii*, 37(3): 43–48. doi: 576.895.122:597.586.1(261)
- Gibson D.I. & Bray R.A. (1986). The Hemiridae (Digenea) of fishes from the north-east Atlantic. *Bulletin of the British Museum (Natural History) Zoology*, 51(1):1-125.
- Keser R., Bray R.A., Oguz M.C., Celen S., Erdogan S., Doguturk S., Aklanoglu G. & Marti, B. (2007). Helminth parasites of digestive tract of some teleost fish caught in the Dardanelles at Canakkale, Turkey. *Helminthologia*, 44: 217-221. doi: 10.2478/s11687-007-0035-3.
- Kostadinova, A. & Dimitrov, G. (1994). Seasonal variation in helminth communities of *Trachurus mediterraneus ponticus* (Pisces: Carangidae) in the Black Sea. In: Özcel, M.A. & Alkan, M.Z. (Eds) Abstracts. 8th International Congress of Parasitology, 10–14 October, 1994, vol. 2 Izmir: Turkish Society for Parasitology, p. 433.
- MacKenzie, K., Campbell, N., Mattiucci, S., Ramos, P., Pereira, A. & Abauza, P. (2004). A checklist of the protozoan and metazoan parasites reported from the Atlantic horse mackerel, *Trachurus trachurus* (L.). *Bulletin of the European Association of Fish Pathologists*, 24(4): 180-184.
- Martorelli, S.R. & Cremonese, F. (1998). A proposed three-host life history of *Monascus filiformis* (Rudolphi, 1819) (Digenea: Fellodistomidae) in the southwest Atlantic Ocean. *Canadian Journal of Zoology*, 76: 1198-1203.
- Naidenova, N.N. & Mordvinova, T.N. (1997). Helminth fauna of Mediterranean Sea fish upon the data of the IBSS's expeditions (1959–1973). *Ekologiya Morya, Kiev*, 46, 69–74 (in Russian).
- Nilkolaeva, W.M. (1965). Parasite fauna of local stocks of some pelagic fishes of the Black Sea. *Trudy Sevastopolskoi Biologicheskoi Stantsii*, 16, 387-438.
- Oğuz, M.C. & Bray, R.A. (2006). Digenetic trematodes of some teleost fish off the Mudanya Coast (Sea of Marmara, Turkey). *Helminthologia*, 43 (3): 161 – 167. doi: 10.2478/s11687-006-0030-0.
- Osmanov, S.U. (1940). [Studies on the parasite fauna of fish of the Black Sea.] *Uchenye Zapiski Leningradskogo Gosudarstvennogo Pedagogicheskogo Instituta imeni A I Gertsena*, 30, 187–265 (in Russian).
- Özer, A., Korniychuk, J.M., Öztürk, T., Yurakhno, V.M. (2012). Parasite Fauna of The Whiting, *Merlangius merlangus* L., 1758, and Its Dynamics in Relation With Some Host and Seasonal Factors. EMOP XI. European Multicollequium of Parasitology, 2012 (pp.395) Cluj-Napoca, Romania: Abstract Book.
- Sağlam, N. & Sarıyüpeoğlu, M. (2008). *Eunice norvegica* (Polychaeta: Eunicidae) in the Gill of Horse mackerel (*Trachurus trachurus*). *International Journal of Natural and Engineering Sciences*, 2 (1): 37-39.
- Sey, O., Nahhas, F.M., Uch, S. & Vang, C. (2003). Digenetic trematodes from marine fishes off the coast of Kuwait, Arabian Gulf: Fellodistomidae and some smaller families, new host and geographic records. *Acta Zoologica Academiae Scientiarum Hungaricae*, 49 (3): 179–200
- Sezen-Akandere, Y. (1972). Three new species of the genus *Lepidapedon* obtained from horse mackerel. *Turkish Journal of Biology*, 22: 89–94.
- Smith-Vaniz, W.F. (1986). The Carangidae. In "Fishes of the North-Eastern Atlantic and the Mediterranean, vol. II" (Whitehead, P.J.P., Bauchot, M. - L., Hureau, J.-C., Nielsen, J. And Tortonese, E., Eds) pp.815-844. Unesco, Paris.