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# Nematode and acanthocephalan parasites of marine fish of the eastern Black Sea coasts of Turkey

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**Abstract:** A total of 625 fish belonging to 25 species were sampled from the coasts of Trabzon, Rize, and Artvin provinces and examined parasitologically. Two acanthocephalan species (*Neoechinorhynchus agilis* in *Liza aurata*; *Acanthocephaloides irregularis* in *Scorpaena porcus*) and 4 nematode species (*Hysterothylacium aduncum* in *Merlangius merlangus euxinus*, *Trachurus mediterraneus*, *Engraulis encrasicholus*, *Belone belone*, *Caspialosa* sp., *Sciaena umbra*, *Scorpaena porcus*, *Liza aurata*, *Spicara smaris*, *Gobius niger*, *Sarda sarda*, *Uranoscopus scaber*, and *Mullus barbatus*; *Anisakis pegreffii* in *Trachurus mediterraneus*; *Philometra globiceps* in *Uranoscopus scaber* and *Trachurus mediterraneus*; and *Ascarophis* sp. in *Scorpaena porcus*) were found in the intestines of their hosts. The infection rates, hosts, and morphometric measurements of the parasites are listed in this paper.

**Key words:** Turkey, Black Sea, nematode, Acanthocephala, teleost

## 1. Introduction

This is the first paper on the endohelminth fauna of marine fish from the eastern Black Sea coasts of Turkey. The acanthocephalan fauna of Turkey includes 11 species (Öktener, 2005; Keser et al., 2007) and the nematode fauna includes 16 species (Öktener, 2005). There is currently no study on acanthocephalans of marine fish from the Black Sea coasts of the country. In the present study, *A. irregularis*, *Ascarophis* sp., and *Philometra globiceps* have been recorded for the first time from Turkey. The purpose of this study is to contribute to the fauna of acanthocephalans and nematodes of marine fish from the north of Turkey.

## 2. Materials and methods

The study area is the eastern Black Sea coast of Turkey (Trabzon: 41°01′N, 39°43′E; Rize: 41°02′N, 40°32′E; and Artvin: 41°25′N 41°23′E) (Figure). Between June 2007 and December 2010, 625 fish from 25 species were collected. The parasites were fixed with 70% ethyl alcohol for nematodes and AFA (acetic acid : formalin : alcohol) for acanthocephalans. The samples were brought to the Parasitology Research Laboratory of the Biology Department of the Faculty of Science of Atatürk University, where the materials were deposited in the appropriate manner.

The identification of the fish was established using the works of Slastenenko (1955), Geldiay (1969), and Can and Bilecenoğlu (2005). The descriptions of the parasites were executed using the works of Yamaguti (1963a, 1963b), Golvan (1969), Yorke and Maplestone (1962), Gaevskaya et al. (1975), and Fagerholm (1982). The preparation of the parasites was carried out according to Kruse and Pritchard (1982).

The parasitological statistics were calculated according to Bush et al. (1997) and are presented in Table 1. The morphometric values of the parasites are presented in Tables 2 and 3.

## 3. Results

**Acanthocephala**

**Eoacanthocephala**

**Neoechinorhynchida**

**Neoechinorhynchidae**

***Neoechinorhynchus agilis* (Rudolphi, 1819)**

Syn: *Echinorhynchus agilis* Rudolphi, 1819
Host: *Liza aurata*
Infection site: intestine

According to Cleave (1922), *Neoechinorhynchus agilis* is restricted to fish of the genus *Mugil* in the Mediterranean Sea.

Numerous authors (Keser et al. [2007] in the Dardanelles; Merella and Garippa [2001] and Schmidt and Paperna [1978] in the Mediterranean Sea; Kostylew

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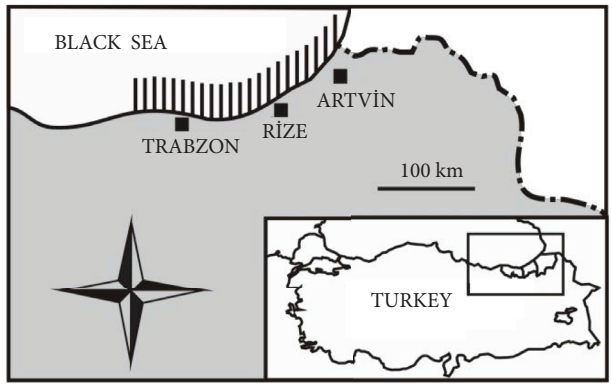


**Figure.** Sampling area.

**Table 1.** Statistical values of the parasites (L: locality, A: Artvin, R: Rize, T: Trabzon, EFN: examined fish number, IFN: infected fish number, TPN: total parasite number, %: prevalence, MA: mean abundance, MI: mean intensity).

| PARASITE | HOST | L | EFN | IFN | TPN | % | MA | MI |
|---|---|---|---|---|---|---|---|---|
| ACANTHOCEPHALA | | | | | | | | |
| *Neoechinorhynchus agilis* | *Liza aurata* | A | 50 | 5 | 23 | 10 | 4.6 | 0.5 |
| *Acanthocephaloides irregularis* | *Scorpaena porcus* | T | 115 | 1 | 1 | 1 | 1.0 | 0.0 |
| NEMATODA | | | | | | | | |
| *Hysterothylacium aduncum* | *Belone belone* | A, R, T | 36 | 11 | 19 | 31 | 1.7 | 0.5 |
| *Hysterothylacium aduncum* | *Caspialosa sp.* | A | 13 | 13 | 170 | 100 | 13.1 | 13.1 |
| *Hysterothylacium aduncum* | *Engraulis encrasicholus* | A, R, T | 71 | 63 | 744 | 89 | 11.8 | 10.5 |
| *Hysterothylacium aduncum* | *Gaidropsarus mediterranes* | T | 6 | 2 | 20 | 33 | 10.0 | 3.3 |
| *Hysterothylacium aduncum* | *Gobius niger* | A, R, T | 9 | 5 | 27 | 56 | 5.4 | 3.0 |
| *Hysterothylacium aduncum* | *Merlangius merlangus euxinus* | A, R, T | 147 | 138 | 1384 | 56 | 10.0 | 9.4 |
| *Hysterothylacium aduncum* | *Mullus barbatus* | T | 17 | 16 | 81 | 94 | 5.1 | 4.8 |
| *Hysterothylacium aduncum* | *Neogobius melanostomus* | A, R, T | 11 | 3 | 12 | 27 | 4.0 | 1.1 |
| *Hysterothylacium aduncum* | *Ophidion rochei* | T | 3 | 2 | 17 | 67 | 8.5 | 5.7 |
| *Hysterothylacium aduncum* | *Platichthys flesus* | T | 3 | 1 | 1 | 33 | 1.0 | 0.3 |
| *Hysterothylacium aduncum* | *Sarda sarda* | T | 6 | 3 | 45 | 50 | 15.0 | 7.5 |
| *Hysterothylacium aduncum* | *Sciaena umbra* | A | 4 | 1 | 2 | 25 | 2.0 | 0.5 |
| *Hysterothylacium aduncum* | *Scorpaena porcus* | A, R, T | 115 | 33 | 89 | 29 | 2.7 | 0.8 |
| *Hysterothylacium aduncum* | *Solea vulgaris* | T | 7 | 2 | 7 | 29 | 3.5 | 1.0 |
| *Hysterothylacium aduncum* | *Spicara smaris* | A | 3 | 3 | 85 | 100 | 28.3 | 28.3 |
| *Hysterothylacium aduncum* | *Syngnathus acus* | A | 1 | 1 | 2 | 100 | 2.0 | 2.0 |
| *Hysterothylacium aduncum* | *Trachinus draco* | R | 1 | 1 | 32 | 100 | 32.0 | 32.0 |
| *Hysterothylacium aduncum* | *Trachurus mediterraneus* | A, R, T | 56 | 54 | 510 | 96 | 9.4 | 9.1 |
| *Hysterothylacium aduncum* | *Uranoscopus scaber* | R, T | 50 | 35 | 276 | 70 | 7.9 | 5.5 |
| *Anisakis pegreffii* | *Trachurus mediterraneus* | T | 56 | 1 | 11 | 2 | 11.0 | 0.2 |
| *Philometra globiceps* | *Trachurus mediterraneus* | T | 56 | 1 | 2 | 2 | 2.0 | 0.0 |
| *Philometra globiceps* | *Uranoscopus scaber* | T | 50 | 2 | 4 | 4 | 2.0 | 0.1 |
| *Ascarophis sp.* | *Scorpaena porcus* | T | 115 | 1 | 1 | 1 | 1.0 | 0.0 |

**Table 2.** Measurements of acanthocephalans (μm) (L: total length; W: width; PL: proboscis length; PW: proboscis width; PSL: proboscis sac length; PSW: proboscis sac width; LL1: lemniscus-1-length; LW1: lemniscus-1-width; LL2: lemniscus-2-length; LW2: lemniscus-2-width; H1: apical hook; H2: median hook; H3: basal hook; ATL: anterior testis length; ATW: anterior testis width; PTL: posterior testis length; PTW: posterior testis width; BL: bursa length; BW: bursa width; EL: egg length; EW: egg width). Values are mean ± SD (min–max).

| | *Neoechinorhynchus agilis* | | | *Acanthocephaloides irregularis* | |
|---|---|---|---|---|---|
| | General | Male | Female | Female | Female |
| | Gaevskaya et al., 1975 | Present study | Present study | Amin et al., 2011 | Present study |
| L | 7000–45,000 | 5643 ± 119 (4121–7511) | 12,495 ± 1002 (4852–26,126) | 3160 ± 720 (1254–5658) | 7085 |
| W | 800–1000 | 601 ± 160 (426–832) | 711 ± 250 (406–1015) | 560 ± 170 (319–1402) | 954 |
| PL | - | 168 ± 20 (137–194) | 183 ± 36 (137–234) | 280 ± 40 (129–371) | 234 |
| PW | - | 127 ± 2 (97–170) | 128 ± 29 (97–162) | 130 ± 20 (72–153) | 121 |
| PSL | - | 410 ± 130 (178–501) | 500 ± 152 (242–671) | 452 ± 90 (246–615) | 610 |
| PSW | - | 152 ± 40 (89–218) | 164 ± 37 (121–202) | 131 ± 40 (73–196) | 150 |
| LL1 | - | 2195 ± 370 (1827–2984) | 2969 ± 689 (1989–3451) | 560 ± 100 (369–861) | 740 |
| LW1 | - | 119 ± 20 (81–142) | 132 ± 26 (102–162) | - | 80 |
| LL2 | - | 1865 ± 370 (1563–2639) | 2390 ± 598 (1644–3045) | - | - |
| LW2 | - | 107 ± 30 (81–162) | 117 ± 35 (81–162) | - | - |
| H1 | 84–140 | 64 ± 20 (41–87) | 63 ± 18 (49–87) | 36 ± 4 (26–44) | 32 |
| H2 | - | 41 ± 20 (24–61) | 41 ± 14 (26–61) | 53 ± 6 (34–64) | 49 |
| H3 | 36–60 | 33 ± 10 (22–41) | 29 ± 6 (24–37) | 19 ± 2 (13–24) | 16 |
| ATL | 650–1820 | 394 ± 220 (121–670) | - | - | - |
| ATW | 370–560 | 296 ± 150 (97–467) | - | - | - |
| PTL | - | 449 ± 340 (145–1076) | - | - | - |
| PTW | - | 297 ± 140 (129–426) | - | - | - |
| BL | - | 731 | - | - | - |
| BW | - | 345 | | - | - |
| EL | 35–42 | - | 22 | 52 ± 12 (36–76) | 47 |
| EW | 9–12 | - | 12 | 12 ± 2 (8–14) | 14 |

**Table 3.** Morphometric measurements of nematodes (µm) (L: length; W: width; A–N: distance of nerve ring to anterior; A–Ex: distance of excretory pore to anterior; EL1: esophagus length; VAL: ventricular appendix length; ICL: intestinal ceca length; VL: ventricles length; TL: tail length; V–A: distance of vulva to anterior; EGGL: egg length; EGGW: egg width; SLL: left spicule length; SRL: right spicule length). Values are mean ± SD (min–max).

| | *Hysterothylacium aduncum* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3rd stage | | 4th stage | | Adult male | | Adult female | |
| | Present study | Fagerholm, 1982 | Present study | Fagerholm, 1982 | Present study | Fagerholm, 1982 | Present study | Fagerholm, 1982 |
| L | 8326 ± 2055 (4263–14,190) | 6600–20,600 | 11,528 ± 4242 (7613–20,219) | 12,000–31,000 | 25,544 ± 9661 (18,879–44,457) | 21,900–46,200 | 37,770 ± 6771 (30,958–48,029) | 26,800–52,000 |
| W | 174 ± 41 (73–226) | 160–330 | 174 ± 63 (97–299) | 230–470 | 344 ± 33 (315–406) | 300–430 | 496 ± 138 (348–669) | 400–790 |
| A–N | 242 ± 50 (162–364) | 280–450 | 304 ± 59 (220–404) | 340–610 | 356 ± 23 (323–372) | 480–850 | 443 ± 71 (356–541) | 560–840 |
| A–Ex | 286 ± 35 (228–347) | 310–500 | 335 ± 59 (260–444) | 420–640 | 401 ± 17 (388–420) | 490–880 | 479 ± 78 (412–566) | 620–910 |
| EL | 1023 ± 203 (687–1421) | 1000–2600 | 1140 ± 306 (792–1680) | 1940–3850 | 1983 ± 241 (1766–2416) | 2600–4670 | 3025 ± 794 (2314–4283) | 3230–6000 |
| VAL | 350 ± 84 (202–480) | 400–680 | 346 ± 147 (192–485) | 610–930 | 498 ± 65 (444–614) | 800–1150 | 684 ± 249 (533–1056) | 1100–1400 |
| ICL | 414 ± 84 (240–566) | 330–920 | 453 ± 140 (323–719) | 650–1230 | 569 ± 62 (508–687) | 690–1180 | 899 ± 257 (649–1299) | 1040–1550 |
| VL | - | - | - | - | - | - | | |
| TL | 132 ± 41 (73–242) | 120–210 | 181 ± 49 (81–244) | 110–290 | 134 ± 40 (81–203) | 120–180 | 252 ± 77 (137–323) | 310–350 |
| V–A | - | - | - | - | - | - | 13,515 ± 2338 (11,693–16,849) | 10,180–18,350 |
| EGGL | - | - | - | - | - | - | 43 ± 9 (36–56) | 63–76 |
| EGGW | - | - | - | - | - | - | 35 ± 6 (32–44) | 41–57 |
| SLL | - | | - | | 1119 ± 211 (970–1269) | 650–2980 | | |
| SRL | | | | | 954 | 890–2180 | | |

**Table 3.** Continued

| | *Anisakis pegreffii* | | *Philometra globiceps* | | *Ascarophis* sp. | |
|---|---|---|---|---|---|---|
| | Present study | Quiazon et al., 2008 | Present study | Gaevskaya et al., 1975 | Present study | Gaevskaya et al., 1975 |
| L | 14,849 ± 1776 (12,058–17,641) | 11,100–26,780 | 5140 ± 437 (4730–5887) | 1700–4600 | 6090 | 2400–2655 |
| W | 456 ± 63 (305–548) | 380–600 | 79 ± 9 (65–89) | - | 64 | 40–47 |
| A–N | 289 ± 94 (137–469) | 200–310 | 50 ± 2 (47–53) | 104 | - | - |
| A–Ex | - | - | - | - | - | - |
| EL | 1353 ± 310 (690–1786) | 1040–2110 | 264 ± 34 (223–305) | 320 | 364 | 138–238 |
| VAL | - | - | - | - | - | - |
| ICL | - | - | - | - | - | - |
| VL | 629 ± 90 (508–812) | 500–780 | - | - | - | - |
| TL | 111 ± 43 (73–218) | 50–120 | - | - | 48 | 37–41 |
| V–A | - | - | - | - | - | - |
| EGGL | - | - | - | - | - | - |
| EGGW | - | - | - | - | - | - |
| SLL | - | - | 115 ± 6 (108–124) | 137 | 261 | - |
| SRL | - | - | - | - | | - |

[1926], Florescu and Ieniştea [1984], Radujkovic [1989], Dmitrieva and Gaevskaya [2000], and Kostadinova [2008] in the Black Sea) found *N. agilis* in fish of the family Mugilidae. Nevertheless, Pérez-del Olmo et al. (2007) and Pérez-del Olmo (2008) found the parasite in *Boops boops* (Sparidae) in the Mediterranean Sea.

**Palaeacanthocephala**

**Echinorhynchida**

**Arhythmacanthidae**

***Acanthocephaloides irregularis* Amin et al. 2011**

Host: *Scorpaena porcus*

Infection site: intestine

*A. irregularis* was established in *Parablennius zvonimiri* (Blenniidae), *Ponticola eurycephalus* (Gobiidae), and *Syngnathus abaster* (Syngnathidae) in the Black Sea by Amin et al. (2011).

**Nematoda**

**Secernentea**

**Ascaridida**

**Anisakidae**

***Hysterothylacium aduncum* (Rudolphi, 1802)**

Syn: *Contracaecum aduncum* (Rudolphi, 1802)

Hosts: *Merlangius merlangus euxinus*, *Trachurus mediterraneus, Engraulis encrasicholus, Belone belone, Caspialosa* sp., *Sciaena umbra, Scorpaena porcus, Spicara smaris, Gobius niger, Sarda sarda, Uranoscopus scaber, Mullus barbatus*.

Infection site: intestine, pyloric ceca, stomach

*Hysterothylacium aduncum* is a common parasite not only of marine fish but also of brackish fish (Fagerholm, 1982). This parasite was found in various marine fish in the Pacific Ocean (Shih and Jeng, 2002) and the Atlantic Ocean (Sey, 1970a; Gaevskaya and Rodyuk, 1988; Williams and Bunkley-Williams, 1996; Alvarez et al., 2002; Costa and Biscoito, 2003; Morozinska-Gogol, 2006, 2008; MacKenzie et al., 2008; Kellermanns et al., 2009) and the Antarctic region (Brickle et al., 2005). Furthermore, it is understood from an analysis of research presented in various related

studies that this parasite is found in various fish from the Mediterranean Sea, the Aegean Sea, the Sea of Marmara, and the Black Sea.

***Anisakis pegreffii* Campana-Rouget & Biocca, 1955**

Host: *Trachurus mediterraneus*

Infection site: intestine

The genus *Anisakis* is a cosmopolitan endoparasite of various cetacean species in its adult stage and of various invertebrate and fish hosts in its larval stages. *A. simplex* (s. s.) is the most common species found in all samples from NE Atlantic waters, with its relative proportion decreasing from north (south coast of Norway) to south (Portuguese coast off Algarve). In contrast, *A. pegreffii* is the most prevalent species in the Mediterranean Sea (Mattiucci et al., 2008). *A. pegreffii* was recorded in the same host by Utuk et al. (2012) in Turkey.

**Spirurida**

**Cystidicolidae**

***Ascarophis* sp.** Beneden, 1871

Syn: *Ascaropsis* Power and Sedgwick, 1880

Host: *Scorpaena porcus*

Infection site: intestine

This parasite was previously recorded in the Atlantic Ocean by Sey (1970b), Klimpel et al. (2006b), and Palm and Klimpel (2008) and from the Mediterranean Sea by Arculeo et al. (1997) in various fish. In addition, *Ascarophis* sp. was found in some crustaceans in the Black Sea by Lozovskiy and Mordvinova (2009) and Korniychuk (2009).

**Philometridae**

***Philometra globiceps* Rud., 1819**

Syn: *Filaria globiceps* Rud., 1819; *Philometra retricaudata* Costa, 1845

Host: *Uranoscopus scaber*, *Trachurus mediterraneus*

Infection site: intestine

*Philometra* sp. is the ninth nematode reported from marine fish of the Mediterranean Sea (Moravec et al., 2006). This species was reported around the Bulgarian coasts of the Black Sea in *Ophidion rochei* by Dimitrov (1989) and in the Atlantic Ocean in *Uranoscopus scaber* by Sey (1970b).

## 4. Discussion

It was established that 360 of 609 fish were infected by parasites, and a total of 3565 parasites (3541 nematodes, 24 acanthocephalans) were recorded.

According to Mattiucci (2008), *Anisakis pegreffii* is abundant in the Mediterranean Sea. Infection rates of *A. pegreffii* were 48%–100% (Mattiucci, 2008) in *Trachurus trachurus* in the Mediterranean Sea.

Larval forms of *Hysterothylacium aduncum* are extremely concentrated in teleost fish compared to adult forms (Dimitrov, 1989; Kvach and Skora, 2007). According to Akmirza (2001), the parasite was more abundant in March (100%) than in August (53.3%) in *T. trachurus*. Values of prevalence of *H. aduncum* were 3.2% (adult) and 95% (larvae) in *T. mediterraneus*, 16.8% (adult) and 88.2% (larvae) in *O. merlangus euxinus* (Dimitrov, 1989), 10%–40% in Pleuronectiform fish (Gaevskaya and Solonchenko, 1997), 21.8%–54.8% in *M. merlangus euxinus* (İşmen and Bingel, 1999), 18% in *Liza aurata* (Pronkina, 2001), 84%–100% in *S. sprattus phalericus* (Korniychuk and Zavjalov, 2005), 15% in *N. melanostomus* (Özer, 2007), and 2.8%–5.6% in *Apollina melanostoma* (Kvach and Skora, 2007) in the Black Sea; 53%–100% in *T. trachurus* (Akmirza, 2001) in the Sea of Marmara; 5% in *S. solea*, 14.6% in *P. saltatrix*, 35% in *L. saliens*, 8% in *S. aurata*, and 7% in *E. encrasicholus* (Keser et al., 2007) in the Dardanelles; 5.88% in *Scomber japonicus* (Akmirza, 1997) in the Aegean Sea; and 0.5% in *Mullus surmuletus* (Arculeo et al., 1997) in the Mediterranean Sea.

The infection rate of *Philometra globiceps*, which was previously recorded in *Seriola dumerili* in the Mediterranean Sea by Grau et al. (1999), was evaluated as being 2%. Genç et al. (2005) recorded *P. lateolabracis* in *Epinephelus aeneus* (22%) and *E. marginatus* (14.8%) from the coasts of the Mediterranean Sea of Turkey.

*Ascarophis* sp. belongs to the order Spirurida, which uses arthropods as intermediate hosts (Moravec et al., 2003). The parasite was recorded previously in *Xantho poressa* (9%–10%) by Lozovsky and Mordvinova (2009) and in *Palaemon elegans* (1.43%) by Mordvinova (1985) in the Black Sea.

The prevalence value of *Neoechinorhynchus agilis* was measured as 60% (*Liza saliens*) by Keser et al. (2007) in the Dardanelles. It was measured as 91% (*Mugil cephalus*), 54% (*Chelon labrosus*), 32% (*Liza saliens*), 18% (*Liza ramada*), and 16% (*Liza aurata*) by Merella and Garippa (2001) and as 3.3% (*Boops boops*) by Pérez-del Olmo (2008) in the Mediterranean Sea. It meanwhile was recorded as 29.6% (*Chelon labrosus*), 4.4% (*Liza ramada*), and 1.8% (*Liza aurata*) by Radujkovic (1989) and 10% (*Liza aurata*) by us in the Black Sea.

The infection rate of *Acanthocephaloides irregularis* was calculated in *Proterorhinus marmoratus* as 65.6% (from the Gulf of Odessa) and 81.3% (from the Sukhyi Lyman), in *Syngnathus abaster* as 9.1% (from the Gulf of Odessa) and 50% (from the Sukhyi Lyman), in *Parablennius zvonimiri* as 14.3% (from the Gulf of Odessa), and in *Ponticola eurycephalus* as 66.7% (from the Sukhyi Lyman) by Amin et al. (2011) from the Black Sea.

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