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A NEW CONTRIBUTION TO THE KNOWLEDGE OF HELMINTH PARASITE FAUNA OF FISHES FROM THE CHANNELS BETWEEN THE MID-DALMATIAN ISLANDS, ADRIATIC SEA

NOVI PRILOG POZNAVANJU PARAZITARNE HELMINTOFAUNE RIBA
U PODRUČJU KANALA SREDNJODALMATINSKIH OTOKA

Ivan Jardas and Nikola Hristovski*

Institute of Oceanography and Fisheries, Split, Yugoslavia

**The University of Bitola, Educational Department, Bitola, Yugoslavia*

Endohelminth parasitofauna of marine fishes from the mid-Dalmatian area is rather abundant and diverse. Of a total of 63 analysed species (220 individuals) 48 fish species hosted 28 endohelminth species: 13 Trematoda Digenea, 10 Nematodes, 3 Cestodes and 2 Acanthocephales. Nematodes occurred most frequently, particularly *Contracaecum* spp. larvae and *Anisakis* sp. larvae (in total in 44.4% of analysed fish species). Cestode species *Acanthobothrium floridensis* is frequent in cartilaginous fishes. In addition, 54% of analysed fish species were invaded by nematodes, 22.2% by trematodes, and 12.7% by the rest of groups (cestodes and acanthocephales).

It was established which endohelminth species invaded both cartilaginous and bony fishes (3), which invaded exclusively cartilaginous (3) and which were specific parasites of individual fish species or genera (5).

Four endohelminth species (Cestodes and Trematoda Digenea) have not so far been known in the Adriatic: *Acanthobothrium folridensis*, *Sterrhurus musculus*, *Hemiurus communis* and *Lintonium vibex*.

INTRODUCTION

Helminth parasite fauna of fishes from the mid-Dalmatian area was up to now studied by Janiszewska (1949, 1953), Sey (1968, 1970, 1970a, 1970b) and Hristovski and Jardas (1983). These studies were of extensive character, that is they included a large number of fish species caught

from the area of Split or obtained from the Split fish market. Fish caught from the channels between mid-Dalmatian islands during ichthyological research cruises in the coastal area has also been recently included.

Some observations of endohelminth parasitism of marine fishes from the wider area of the middle Adriatic were also made by Rizzo (1929), Mužinić (1958), Jardas (1972, 1972a, 1979), Fabi and Froglija (1984) etc.

The results brought out there are in fact a continuation of our earlier studies of helminth parasitofauna in the area of mid-Dalmatian channels (Hristovski and Jardas, 1983). Material was collected from an area wider than the earlier one and from somewhat ecologically different environment in summer 1983.

STUDY AREA

Fish for helminth fauna researches were collected from the channels between the mid-Dalmatian islands. Material was mainly collected from trawling ground (I–IX) and somewhat less from the coastal locations (1–6) (Fig. 1).



Fig. 1. Study area

As distinct from our earlier researches the study area was extended to the trawling grounds of the channels of Brač, Korčula, Neretva River and Mali Ston.

The area is relatively shallow, the greatest depth not exceeding 106 m. The area was earlier studied in detail for ichthyological purposes (Županović, 1961).

MATERIALS AND METHODS

A total of 63 marine fish species, that is 220 specimens, of pelagic and benthic fishes of Chondrichthyes and Osteichthyes classes were analysed to reveal helminth parasites. The number of analysed individuals, with respect of individual fish species, varied from 1 to 14. List of analysed fish species and the number of analysed individuals of each fish species appear in Table 1 as well as their length ranges.

Material was collected in August 1983.

Methods of helminthological investigations of fishes and treatment of found helminths for further determination were described in our previous paper (Hristovski and Jardaš, 1983).

RESULTS AND DISCUSSION

Of the total number of fish species examined (63) helminths were found in 48 species or 76.2 %. In total, 100 specimens were infected what makes 45.5% of all the specimens examined (220). The largest number of fish species and individuals were infected by nematodes (34 fish species or 54 %) and trematodes (14 fish species or 22.2%). Other endohelminth groups were present in 8 fish species or 12.7 %.

Examined material yielded 28 endohelminth species: 13 Trematoda Digenea species, 10 Nematoda species, 3 Cestoda species and 2 Acanthocephala species.

Class TREMATODA Rudolphi, 1808

Fam. Acanthostomatidae Poche, 1925

Anisocoelium capitellatum (Rudolphi, 1819)

Rather large numbers (5-9) of this trematode were, as earlier, found in the gall-bladder of *Uranoscopus scaber*. It occurs as a specific parasite of this fish. It has been recently recorded from the same fish from the mid-Dalmatian area by Janiszewska (1953), Sey (1968) and Hristovski and Jardaš (1983). It was reported from the Aegean Sea (Saronikos Gulf) by Papoutsoglou (1976). Earlier Carus (1885) reported this trematode from the gall-bladder of *U. scaber* after the data of Rudolphi (Rimini, Naples) and Willemous-Suhm (Genova) as well as by Timon-David (1937) from the area of Marseilles citing earlier reports by Stossich, Monticelli, Lühe and Looss.

Metacercaria of this species were earlier found in the body muscles of gobiidae *Gobius niger* (Najdenova, 1974).

Table 1. List of analysed fish species and positions of catches (see Fig. 1)

Fish species	Number of analysed specimens	Range of lengths (cm)	Positions of catches
<i>Scyliorhinus canicula</i>	4	37.5-41	II
<i>Scyliorhinus stellaris</i>	2	57-71	IV
<i>Mustelus mustelus</i>	1	130	VIII
<i>Mustelus asterias</i>	3	77-125	IV, VIII
<i>Squalus blainvillei</i>	5	38-52	III
<i>Torpedo (Torpedo) marmorata</i>	2	19.5-33.5	2, VIII
<i>Raja (Raja) miraletus</i>	4	30-33.5	II
<i>Raja (Raja) clavata</i>	2	58-75	II
<i>Dasyatis pastinaca</i>	2	49-58	VIII
<i>Myliobatis aquila</i>	2	65-80	VIII
<i>Sardina pilchardus</i>	2	16.5	VIII
<i>Alosa falax nilotica</i>	1	24.5	VII
<i>Engraulis encrasicolus</i>	1	12	VIII
<i>Argentina sphyraena</i>	6	16-18	II, III
<i>Conger conger</i>	1	57	II
<i>Merluccius merluccius</i>	5	26-31.5	I
<i>Trisopterus minutus capelanus</i>	6	17-22	II, III
<i>Antonogadus megalokynodon</i>	2	11-13.5	IX
<i>Zeus faber</i>	2	41	II, V
<i>Serranus scriba</i>	3	12-18	2, 5
<i>Cepola macrophthalmia</i>	8	25-38	I, III, V
<i>Trachurus trachurus</i>	1	24	II
<i>Trachurus mediterraneus mediterraneus</i>	7	10-32.5	II, III, VII
<i>Sciaena umbra</i>	5	19-36	2, 3, 5, 6
<i>Mullus barbatus</i>	5	14.5-20	I
<i>Mullus surmuletus</i>	2	23-26.5	2, 3
<i>Boops boops</i>	3	17.5-24	II, VII, VIII
<i>Dentex (Dentex) dentex</i>	2	69-72	VIII
<i>Dentex (Cheimerius) gibbosus</i>	14	11-16.5	VIII
<i>Diplodus annularis</i>	1	16.5	6
<i>Diplodus vulgaris</i>	8	15.5-23	1, 2, V
<i>Diplodus puntazzo</i>	1	18	2
<i>Lithognathus mormyrus</i>	2	32.5-33	VIII
<i>Pagellus erythrinus</i>	4	18-23.5	III, V
<i>Pagellus acarne</i>	3	13-18	VII, VIII
<i>Sarpa salpa</i>	3	23-27.5	2
<i>Spondiliosoma cantharus</i>	3	15-15.5	1, 4
<i>Spicara maena maena</i>	2	17.5-21	II, 3
<i>Spicara maena flexuosa</i>	3	14-18	III
<i>Chromis chromis</i>	3	10.5-12.5	1, 2
<i>Symphodus (Crenilabrus) ocellatus</i>	1	9	2
<i>Symphodus (Crenilabrus) tinca</i>	1	24	2
<i>Labrus merula</i>	4	19.5-30.5	5, 6
<i>Trachinus draco</i>	1	21.5	II
<i>Uranoscopus scaber</i>	3	16.5-29	2
<i>Lepidopus caudatus</i>	1	54.5	VIII
<i>Scomber scombrus</i>	3	30-33	IV, VIII
<i>Gobius niger</i>	2	12-14	I, VI
<i>Lesueurigobius friesii</i>	8	6.5-7.5	IX
<i>Callionymus maculatus</i>	10	8.5-10	IX
<i>Blennius ocellaris</i>	2	15.5	I
<i>Scorpaena porcus</i>	1	20.5	2
<i>Scorpaena notata</i>	5	12.5-16.5	I
<i>Scorpaena scrofa</i>	1	27	2

<i>Trigloporus lastoviza</i>	4	15.5-21	I, V
<i>Citharus macrolepidotus</i>	10	8.5-17.5	I, V
<i>Phrynorhombus regius</i>	1	9	VI
<i>Arnoglossus laterna</i>	6	8-14	V, VIII
<i>Solea vulgaris vulgaris</i>	4	30.5-34.5	I
<i>Buglossidium luteum</i>	3	11-12	V, VI
<i>Microchirus variegatus</i>	8	11.5-15.5	I, V, VI
<i>Lophius piscatorius</i>	3	13.5-24.5	II
<i>Lophius budegassa</i>	2	22.5-24.5	IX

Aphallus tubarium (Rudolphi, 1819) Poche, 1926

This species was first described by Rudolphi (1819) as *Distomus fuscescens*. This author found it in fish *Dentex* (*Dentex*) *dentex* from the Adriatic Sea. Stossich (1882) and Carus (1885) reported it under the same name. However, somewhat later (1885), as reported by Janiszewska (1953), Stossich described it anew under name *Acanthochasmus inermis*. It was not earlier than 1926 (after Janiszewska, 1953) that Poche established a new genus *Aphallus* on the basis of this species earlier descriptions. The name *tubarium* Poche took from earlier author. Janiszewska (1953) reported it for the mid-Dalmatian area under the same name and described it in detail.

We found this species in an adult *Dentex* (*Dentex*) *dentex* like some authors (for example Rudolphi, 1819; Stossich, 1885; Janiszewska, 1953 etc.). It was also recorded from some other fish species such as *Scomber japonicus*, *Dicentrarchus labrax*, *Umbrina cirrosa*.

Fam. *Opecoelidae* Ozaki, 1925

Podocotyle atomon (Rudolphi, 1802) Odhner, 1905

This species was for the first time reported from the Adriatic by Stossich (1882). Sey (1970a) recorded this species from five fish species from the mid-Dalmatian area and suggested its wide distribution (Mediterranean, Atlantic, Pacific) since recorded from more than 100 fish species. It was reported from the Adriatic by Carus (1885) as well, after the data of Molin, as a parasite of the species of genus *Pleuronectes*.

We found this species in the intestines of two gobiid species: *Gobius niger* and *Lesueurigobius friesii*; of eight individuals of the latter species *P. atomon* was found in only one.

Both gobiid species are the new hosts of this trematode both for the mid-Dalmatian area and for the Adriatic as a whole.

Helicometra fasciata (Rudolphi, 1819) Odhner, 1902

In our material two species of genus *Scorpaena*: *S. porcus* and *S. notata* were infected by this species, of which the former is the new host of this trematode for the mid-Dalmatian area and the Adriatic in general.

It has recently been reported for the Adriatic (middle Dalmatia) by Janiszewska (1953) and Sey (1970a). It seems to be widely distributed hosted by many fishes (Paruhin, 1968). It was recorded from 13 fish species from the Aegean Sea (Saronikos Gulf) (Papoutsoglou, 1976), from six fish species from the western Mediterranean (Paruhin *et al.*, 1971) and from 18 fish species from the mid-Dalmatian area (up to now).

After Palombi (1929) and Najdenova (1974) metacercaria of this trematode invade the muscles of different shrimp species of genus *Leander*.

Fam. *Lepocreadiidae* Nicoll, 1935

Opechona bacillaris (Molin, 1859), Looss, 1907

It was in the stomach of *Scomber scombrus*. This species hosted by fish species of genus *Scomber*, was earlier reported by Janiszewska (1953) and Sey (1968) from the mid-Dalmatian area, and by Stossich (1882) for the Adriatic as a whole. The major part of other records of this species showed also the fishes of *Scomber* genus as hosts (as eg. Papoutsoglou, 1976). Thus this species may be taken as the specific parasite of these fishes.

Lepidopodon elongatum (Lebour, 1908) Nicoll, 1910

The first record of this species in the Adriatic was reported by Sey (1970a) who found it in three fish species: *Spicara smaris*, *S. maena flexuosa* and *Microchirus variegatus*. We recorded it from one individual of *Spicara maena maena*. This fish is therefore the new host of *L. elongatum* for the mid-Dalmatian area and for the Adriatic as a whole.

Fam. *Fellodistomatidae* Nicoll, 1913

Lomasoma wardi (Manter, 1934)

The first and so far single record of this species in the Adriatic was reported by Sey (1970a) who found relatively large numbers of this parasite in the intestine of *Microchirus variegatus*. We also noted rather large numbers (about 30—100 individuals) in the intestines of the same fish species. Of seven analysed individuals of *M. variegatus* six showed the presence of this parasite.

Haplocladus typicus Odhner, 1911

We found this widely distributed species of the European seas (Sey, 1970a) in fish *Cepola macrophthalma*.

This trematode species was earlier recorded from the area of the middle Adriatic by Janiszewska (1953) in the fish species of genus *Trachurus* as well as Sey (1970a) in fishes *Cepola macrophthalma* and *Microchirus variegatus*. It was not recorded in greater number.

Lintonium vibex (Linton, 1905) Stunkard et
Nigrelli, 1930

This Trematoda Digenea species has not been known in the Adriatic so far. Its first record for the Mediterranean was made by Papoutsoglou (1976) who found it in *Solea ocellata* from the Aegean Sea (Saronikos Gulf). We recorded a rather large number (about 20) of this parasite from the stomach of an individual of *Buglossidium luteum* from the trawling area of Šćedro (Kokčula Channel, V).

Fam. Acanthocolpidae Lühe, 1909

Stephanostomum cesticillus (Molin, 1858) Looss, 1899

It was recorded from the intestines of *Lophius piscatorius*. Earlier Adriatic records, all from the species *L. piscatorius*, were reported by Molin (after: Carus, 1885), Stossich (1882, 1883) and Sey (1970a). Papoutsoglou (1976) found it in the same fish from the Aegean Sea (Saronikos Gulf). Thus it is probably the specific parasite of the species of genus *Lophius*.

In addition to the Mediterranean it was also recorded from the southern Atlantic (Paruhin, 1968).

Fam. Lecithochiriidae Skrjabin et Guschanskaja, 1954

Sterrhurus musculus Looss, 1907

After the available literature this is probably the Termatoda Digenea species new for the Adriatic. It was recorded from the gall-bladder of an individual of *Symphodus (Crenilabrus) tinca* captured from the position U. Blaca (2). It was reported from the Mediterranean by Mola (1928) and Papoutsoglou (1976). Both these authors recorded it from nine different fishes what is indicative of the fact that this parasite is rather frequent.

Fam. Lecithasteridae Skrjabin et Guschanskaja, 1954

Lecithaster confusus Odhner, 1905

We recorded this widely distributed trematode species from two individuals of *Scomber scombrus* captured from the trawling ground near Pakleni otoci Islands (Vis channel, IV). This fish is at the same time the new host of *L. confusus* for the Adriatic.

Nikolaeva (1966) reported the occurrence of this species in the Adriatic on the basis of its records from the stomachs of *Mullus barbatus* and *Myctophum punctatum*.

L. confusus is the new species for the mid-Dalmatian area.

Fam. Hemiuridae Looss, 1899

Hemiurus communis Odhner, 1905

This widely distributed trematode was found in two individuals of *Pagellus erythrinus* caught from the trawling ground near Cape Kabal (Hvar

Channel, III). After the available literature this is the new species for the mid-Dalmatian area and probably the new Trematoda Digenea species for the Adriatic.

Class CESTODA Rudolphi, 1808

Fam. Onchobothriidae Braun, 1900

Acanthobothrium floridensis

This cestode was established as frequent in the spiral intestine of four cartilaginous fish species: *Raja* (*Raja*) *clavata*, *Myliobatis aquila*, *Scyliorhinus canicula* and *Mustelus asterias*. It was reported for the first time from the Mediterranean (Saronikos Gulf in the Aegean Sea) by Papoutsoglou (1976), and this is probably the first record from the Adriatic.

Fam. Bothriocephalidae Blanchard, 1849

Bothriocephalus scorpii (Müller, 1819)

This cestode occurred in the spiral intestine of shark *Mustelus mustelus* and gut of flat-fish *Arnoglossus laterna*. Presence of this species in fishes *Raja* (*Raja*) *miraletus*, *Sardina pilchardus*, *Bothus podas* and *Solea variegata* from the mid-Dalmatian area was earlier reported by Sey (1970a). The same author suggested the wide distribution of this parasite within different fish families, which, apart from the Mediterranean, occurred also in the Atlantic, Pacific, White Sea and other.

Paruhin *et al.* (1971) held this species common in flat-fishes both in the Adriatic and in the Mediterranean. It was found in *Arnoglossus laterna*, *A. rueppelli* and *Symphurus nigrescens*. It was found in 20% of analysed individuals of *Symphurus nigrescens* with the intensity of infection of 2 to 6 parasites.

Both fish species in which we recorded this cestode are the new hosts in the mid-Dalmatian area.

Intensity of infection by this cestode is almost equal in both bony and cartilaginous fishes.

Bothriocephalus andresi Porta, 1911

Sey (1970a) reported this cestode as very frequent species in *Citharus macrolepidotus* from the mid-Dalmatian area. The percentage of infected exceeded 78. We recorded it from the same host; of five analysed individuals three were infected.

After some earlier observations of the presence of this species in *C. macrolepidotus* caught from the channel and open sea of the middle Adriatic and the Montenegro coastal area (1972—1974) (Jardaš, unpublished data) this species seems to invade mainly pyloric caeca and proximal part of the intestines. Intestine cavity of some individuals of *Citharus* were almost completely filled with the cestode *B. andresi*. The intestines sometimes were considerably widened and thinned thus that cestode was clearly visible. Of 166 analysed individuals 73 or 44% were infected. The intensity of infection was 1—3.

Class NEMATODA Rudolphi, 1808

Fam. *Anisakidae* Skrjabin and Korakhin, 1945

Anisakis simplex Rudolphi, 1809, det. Krobbe, 1878 (larvae)

Rather large number of larvae of this species (3 — 10 individuals) were recorded from the body cavity of *Trachurus mediterraneus mediterraneus*

Anisakis sp. (larvae)

Anisakis larvae were recorded from the body cavity of *Trachurus mediterraneus mediterraneus*, *Cepola macrophthalma*, *Trigloporus lastoviza* and *Callionymus maculatus*. Larvae of this nematode were frequently recorded from the Adriatic fishes, earlier as well. More recently they were reported by Rizzo (1929), Scourtas (1940), Janiszewska (1949), Mužinić (1958), Nikolaeva and Najdenova (1964), Sey (1970a), Hristovski and Jardas (1983) and Petter *et al.* (1984).

The number of this nematode varied from 1 — 10 in different host from our material. Maximum number of this parasite was found in *Trachurus mediterraneus mediterraneus*.

Up to now this parasite has been reported from a total of 7 fish species from the middle Adriatic and from a total of 12 fish species for the Adriatic as whole. With the exception of *Trachurus mediterraneus mediterraneus* all other fish species which hosted this nematode both in the middle Adriatic and all over the Adriatic are the new hosts.

Larval forms of the *Anisakis* genus have been recorded from a large number of fish species from many world seas.

Contracaecum fabri (Rudolphi, 1819), Baylis, 1923 (larvae)

This generally frequent nematode species occurred in 17 benthic, benthopelagic and pelagic fishes (see Table 2). Intensity of infection was 1 to about 10. The infection was highest in *Spicara maena flexuosa* and *Serranus scriba*.

The fishes *Buglossidium luteum*, *Merluccius merluccius*, *Sciaena umbra*, *Diplodus annularis*, *Dentex (Dentex) dentex* and some others are newly discovered hosts of this larval nematode in the mid-Dalmatian area. Up to now larval stages of this nematode have been reported from a total of 35 mid-Dalmatian fish species.

A large number of earlier authors reported this species for the Adriatic in general (Rudolphi, 1819; Molin, 1858; Stossich, 1882, 1896; Mola, 1929 and others) as well as the more recent ones (Janiszewska, 1949; Nikolaeva and Najdenova, 1964; Nikolaeva and Kovaleva, 1966; Najdenova and Nikolaeva, 1968; Sey, 1970a; Hristovski and Jardas, 1983; Fabi and Frogia, 1984; Petter *et al.*, 1984 etc.).

Contracaecum clavatum (Rudolphi, 1809) (larvae)

This nematode larvae were found in five fish species: *Mullus barbatus*, *Sciaena umbra*, *Pagellus acarne* and species of genus *Lophius*. Intensity of infection was generally poor (1 to about 3).

Up to now larval stages of this nematode have been recorded from a total 10 mid-Dalmatian fish species. All fishes, except *Lophius piscatorius*, analysed for this study are newly established hosts.

Of earlier authors Stossich (1882), Looss (1901), Mola (1929) and others reported this nematode for the Adriatic. It has recently been reported by Hristovski and Jardas (1983) and Fabi and Froglija (1984).

Contracaecum aduncum (Rudolphi, 1802) Baylis, 1920 (larvae)

Larval stages of this nematode were found in *Diplodus vulgaris* and *Zeus faber* with poor intensity of infection. They have been up to now discovered in a total of 23 fish species from the mid-Dalmatian area.

This nematode was reported from the Adriatic by many authors; earlier by Stossich (1882, 1901) and recently by Nikolaeva and Najdenova (1964), Nikolaeva and Kovaleva (1966), Najdenova and Nikolaeva (1968), Janiszewska (1949), Sey (1970a), Hristovski and Jardas (1983), Fabi and Froglija (1984) and Petter *et al.* (1984).

Contracaecum sp. (larvae)

This insufficiently determined larva of the genus *Contracaecum* was found in the body cavity of the cartilaginous fish *Raja* (*Raja*) *miraletus*.

Raphidascaris sp. (larvae)

Larval forms of genus *Raphidascaris* nematode were found in the body cavity of fishes *Solea vulgaris vulgaris* and *Dentex* (*Cheimerus*) *gibbosus*; the latter being the new host of this nematode for the mid-Dalmatian area.

This nematode has been recently reported for the Adriatic by Janiszewska (1949) for the mid-Dalmatian area, as well as Nikolaeva and Najdenova (1964), Najdenova and Nikolaeva, (1968) and Petter *et al.* (1984).

Fam. *Cucullanidae* Cobbold, 1864

Cucullanus longicollis (Stossich, 1899)

Both larval and adult stages of this nematode were recorded from the intestines of *Mullus barbatus*. Two individuals of this fish revealed two nematodes each. This nematode was found in fish of *Mullus* genus during earlier researches of parasitofauna of fish from the mid-Dalmatian area (Janiszewska, 1949; Sey, 1970a; Hristovski and Jardas, 1983). This nematode was also recorded exclusively from the species of *Mullus* genus from the other Adriatic parts both during earlier researches and recently (Stossich, 1899; Najdenova and Nikolaeva, 1968; Petter *et al.*, 1984) as well as from the Mediterranean (Papoutsoglou, 1976). Therefore, it seems to be a specific parasite of these fishes.

Fam. *Physalopteridae* Leiper, 1908

Proleptus obtusus Dujardin, 1845

We recorded this nematode species from stomachs and small intestines of *Scyliorhinus canicula* like did the earlier authors (Sey, 1970a; Jarda, 1979). Of four analysed individuals of *Scyliorhinus canicula* two revealed this nematode species.

After some earlier data (Jarda, 1979) when a total of 151 *Scyliorhinus canicula* individuals were analysed, 126 individuals, or 83.4%, revealed this nematode. As large number of nematodes as 70 were found in stomachs of individual specimens whereas in some the lumen of small intestine was practically constipated. Considerable differences in number and size of nematodes with different age (length) of analysed *Scyliorhinus canicula* hosts was also observed.

Fam. *Gnathostomatidae* Railliet, 1895

Echinocephalus uncinatus Molin, 1858

This nematode was reported for the Adriatic by Molin (1858) who described it first, then Stossich (1882), Carus (1885) — on the basis of Molin's finding and Najdenova and Nikolaeva (1968). It was found again during this study in two cartilaginous species: *Myliobatis aquila* and *Dasyatis pastinaca* from the area of Mali Ston.

This species has, up to now, been recorded only from the cartilaginous fishes of Hypotremata from the Adriatic. Thus this parasite is likely to be a specific parasite of these fishes.

E. uncinatus is the new nematode for the mid-Dalmatian area.

Class ACANTHOCEPHALA Rudolphi, 1808

Fam. *Echinorhynchidae* (Cobbold, 1879) Hamann, 1892

Acanthocephalloides incrassatus (Molin, 1858) Mayer, 1933

This acanthocephalus was found in *Squalus blainvillei* which is its new host for the Adriatic.

Its Adriatic records were earlier reported by Molin (after Carus, 1885), who found it in the intestines of *Gobius paganellus* as well as Stossich (1882). Sey (1970a) reported on its records from the gobiidae *G. exanthematicus* and *G. geniporus* as well as from *Ophidion barbatum* from the mid-Dalmatian area, wherefrom Fabi and Froggia (1984) found it in *G. niger*. Papoustoglou (1976) recorded this species from the other four species from the Saronikos Gulf. Florescu and Ienistea (1984) also recorded it from different fish species from the Black Sea. This species seems to be rather frequent in the Mediterranean particularly in the *Gobius* genus.

Acanthocephalloides propinguus (Dujardin, 1845) Mayer, 1933

It was recorded from the stomachs of *Mustelus asterias* which is at the same time the new host for the Adriatic.

A. propinguus was earlier reported for the Adriatic by Carus (1835, after the record of Rudolphi, Rimini) and for the Dalmatian area by Sey (1970a) who found it in the intestines of *Spicara smaris*.

Janiszewska (1949) found 12 nematode species in 18 different marine fish species caught from the area of Split or obtained from the Split fish market during summer 1938. Somewhat later, 1953, the same author recorded 21 trematode species more from 13 fish species obtained in the same way and from the same area. This author established and described two species new for the mid-Dalmatian area and one species new from the Adriatic and Mediterranean and even the wider area.

Sey (1968, 1970) recorded 48 trematode species and two subspecies and six cestodes from the material containing 82 fish species, that is 824 marine fish individuals, obtained from the catches from the vicinity of Split and Split fish market. Of recorded parasite species more than a half trematodes (26 species and two subspecies) and four cestode species were reported for the first time for the Adriatic. From the same material this author (1970a) found 16 nematode species of which five new for the Adriatic as well as one genus and species new for the science (*Collarinema triglae*) which is separately and in more detail described later (Sey, 1970b). Sey also recorded five acanthocephalus species of which one new for the Adriatic.

Hristovski and Jardaš (1983) recorded 10 endohelminth species: seven nematode species and three cestode species already known in the Adriatic and mid-Dalmatian area from the material containing 24 species that is 161 specimen of marine fishes.

All the earlier researches established a large number of new hosts of different endohelminth species for an area wider than the middle Dalmatia and Adriatic.

Up to now a total of 91 endohelminth species in marine fishes have been established for the mid-Dalmatian area: 59 trematodes, 21 nematodes, 6 cestodes and 5 acanthocephales. This is a rather large number but by no means the ultimate one, what has been shown by the present results as well. Thus it may be said that the helminth parasitofauna of marine fish from the mid-Dalmatian area and the Adriatic as a whole is still insufficiently studied both from the faunal and ecological aspects.

Our analyses show that larval stages of nematodes of *Contracaecum* and *Anisakis* genus are most frequent endohelminths of bony fishes and cestode *Acanthobothrium floridensis* of cartilaginous fishes from the mid-Dalmatian area. Species of genus *Contracaecum* were found in 24 fish species and *Anisakis* in 4 fish species, altogether in 44.4% of fish species. Similar results were obtained for the same area earlier as well (Hristovski and Jardaš, 1983). Cestode *Acanthobothrium floridensis* was recorded from four fish species (Table 2).

It was also observed that some endohelminth species parasitized only defined fish species as their specific parasites. Thus for example the nematode

Table 2. List of parasites and its hosts

NEMATODA	
<i>Contracaecum fabri</i> (larvae)	: * <i>Merluccius merluccius</i> <i>Conger conger</i> <i>Trachinus draco</i> <i>Trachurus trachurus</i> <i>Spicara maena maena</i> <i>Spicana maena flexuosa</i> <i>Serranus scriba</i> * <i>Sciaena umbra</i> * <i>Diplodus annularis</i> * <i>Dentex (Dentex) dentex</i> * <i>Argentina sphyraena</i> * <i>Antonogadus megalokynodon</i> * <i>Lepidopus caudatus</i> <i>Citharus macrolepidotus</i> * <i>Buglossidium luteum</i> * <i>Phrynorhombus regius</i> * <i>Arnoglossus laterna</i>
<i>Contracaecum clavatum</i> (larvae)	: * <i>Mullus surmuletus</i> * <i>Sciaena umbra</i> * <i>Pagellus acarne</i> <i>Lophius piscatorius</i> * <i>Lophius budegassa</i>
<i>Contracaecum aduncum</i> (larvae)	: <i>Diplodus vulgaris</i> <i>Zeus faber</i>
<i>Contracaecum</i> sp. (larvae)	: * <i>Raja (Raja) miraletus</i>
<i>Cucullanus longicollis</i>	: <i>Mullus barbatus</i>
<i>Anisakis simplex</i>	: <i>Trachurus mediterraneus mediterraneus</i>
<i>Anisakis</i> sp. (larvae)	: <i>Trachurus mediterraneus mediterraneus</i> * <i>Cepola macrophthalma</i> * <i>Trigloporus lastoviza</i> * <i>Callionymus maculatus</i>
<i>Proleptus obtusus</i>	: <i>Scyliorhinus canicula</i>
<i>Echinocephalus uncinatus</i>	: * <i>Myliobatis aquila</i> * <i>Dasyatis pastinaca</i>
<i>Raphidascaris</i> sp. (larvae)	: * <i>Dentex (Cheimerius) gibbosus</i> <i>Solea vulgaris vulgaris</i>
CESTODA	
— <i>Acanthobothrium floridensis</i>	: <i>Raja (Raja) clavata</i> <i>Myliobatis aquila</i> <i>Scyliorhinus stellaris</i> <i>Mustelus asterias</i>
<i>Bothriocephalus andresi</i>	: <i>Citharus macrolepidotes</i>
<i>Bothriocephalus scorpii</i>	: * <i>Mustelus mustelus</i> * <i>Arnoglossus laterna</i>

TREMATODA

<i>Stephanostomum cesticillum</i>	:	<i>Lophius piscatorius</i>
<i>Lomasoma wardi</i>	:	<i>Microchirus variegatus</i>
<i>Haplocladus typicus</i>	:	<i>Cepola macrophthalma</i>
<i>Anisocoelium capitellatum</i>	:	<i>Uranoscopus scaber</i>
<i>Helicometra fasciata</i>	:	* <i>Scorpaena porcus</i> <i>Scomber scombrus</i>
— <i>Sterrhurus musculus</i>	:	<i>Symphodus (Crenilabrus) tinca</i>
— <i>Hemiurus communis</i>	:	<i>Pagellus erythrinus</i>
+ <i>Lecithaster confusus</i>	:	<i>Scomber scombrus</i>
<i>Lepidopedon elongatum</i>	:	* <i>Spicara maena maena</i>
— <i>Lintonium vibex</i>	:	<i>Buglossidium luteum</i>
<i>Podocotyle atomon</i>	:	* <i>Gobius niger</i> * <i>Lesueurigobius friesii</i>
<i>Opechona bacillaris</i>	:	<i>Scomber scombrus</i>
<i>Acanthochoasmus inerme</i>	:	<i>Dentex (Dentex) dentex</i>

ACANTHOCEPHALA

<i>Acanthocephalloides incrassatus</i>	:	* <i>Squalus blainvillei</i>
<i>Acanthocephalloides propinguus</i>	:	* <i>Mustelus asterias</i>

— new endohelminth species for the Adriatic Sea

* new hosts of endohelminths for the mid-Dalmatian area

+ new endohelminth species for the mid-Dalmatian area

Cucullanus longicollis lives in the species of genus *Mullus*, cestode *Bothriocephalus andresi* in *Citharus macrolepidotus*, trematode *Anisocoelium capitellatum* in *Uranoscopus scaber*, trematode *Opechona bacillaris* in species of genus *Scomber* etc.

Major part of found endohelminth species infect bony fishes whereas the number of cartilaginous fish parasites is somewhat smaller. Specific parasites of cartilaginous fishes are nematodes *Proleptus obtusus* and *Echinocephalus uncinatus* and cestode *Acanthobothrium floridensis*. Acanthocephales *Acanthocephalloides incrassatus* and *A. propinguus* and cestode *Bothriocephalus scorpii* are the only species found in both fish groups (Table 2).

It should be separately pointed out that four endohelminth species new for the Adriatic were established in the course of this study: cestode *Acanthobothrium floridensis* and trematodes *Sterrhurus musculus*, *Hemiurus communis* and *Lintonium vibex*.

A large number of new hosts of individual endohelminths in the mid-Dalmatian area were also established (Table 2). Some of those are also new

for the Adriatic as a whole: *Cepola macrophthalma*, *Trigloporus lastaviza*, and *Callionymus maculatus* for the larvae of the nematode *Anisakis* sp.; *Scorpaena porcus* for the trematode *Helicometra fasciata*; *Gobius niger* and *Lesueurigobius friesii* for the trematode *Podocotyle atomon* etc. As high as 55.6% of analysed fish species were noted as new hosts.

The largest number of infected fish hosted only one endohelminth species and rarely two of the same or different classes (Table 3). Similar was recorded during earlier studies as well carried out in the same area (Hristovski and Jardaš, 1983).

Intensity of infection was, as well, generally poor. Only nematodes *Anisakis* sp. (larvae), *Contracaecum fabri* (larvae), *Proleptus obtusus* and particularly trematodes *Lomasoma wardi* and *Lintonium vibex* were somewhat more abundant.

Table 3. List of analysed fish species and established parasites

<i>Scyliorhinus canicula</i>	: <i>Proleptus obtusus</i>
<i>Scyliorhinus stellaris</i>	: <i>Acanthobothrium floridensis</i>
<i>Mustelus mustelus</i>	: <i>Bothriocephalus scorpii</i>
<i>Mustelus asterias</i>	: <i>Acanthobothrium floridensis</i> <i>Acanthocephaloides propinguus</i>
<i>Squalus blainvillei</i>	: <i>Acanthocephaloides incrassatus</i>
<i>Raja (Raja) miraletus</i>	: <i>Contracaecum</i> sp.
<i>Raja (Raja) clavata</i>	: <i>Acanthobothrium floridensis</i>
<i>Dasyatis pastinaca</i>	: <i>Echinocephalus uncinatus</i>
<i>Myliobatis aquila</i>	: <i>Acanthobothrium floridensis</i> <i>Echinocephalus uncinatus</i>
<i>Mullus barbatus</i>	: <i>Cucullanus longicollis</i>
<i>Mullus surmuletus</i>	: <i>Contracaecum clavatum</i>
<i>Conger conger</i>	: <i>Contracaecum fabri</i>
<i>Trachinus draco</i>	: <i>Contracaecum fabri</i>
<i>Trachurus mediterraneus mediterraneus</i>	: <i>Anisakis simplex</i> <i>Anisakis</i> sp.
<i>Trachurus trachurus</i>	: <i>Contracaecum fabri</i>
<i>Zeus faber</i>	: <i>Contracaecum aduncum</i>
<i>Spicara maena maena</i>	: <i>Lepidopedon elolngatum</i> <i>Contracaecum fabri</i>
<i>Spicara maena flexuosa</i>	: <i>Contracaecum fabri</i>
<i>Diplodus vulgaris</i>	: <i>Contracaecum aduncum</i>
<i>Diplodus annularis</i>	: <i>Contracaecum fabri</i>
<i>Dentex (Cheimerius) gibbosus</i>	: <i>Raphidascaris</i> sp.

<i>Dentex (Dentex) dentex</i>	: <i>Contracaecum fabri</i> <i>Acanthochasmus inermis</i>
<i>Pagellus acarne</i>	: <i>Contracaecum clavatum</i>
<i>Pagellus erythrinus</i>	: <i>Hemiurus communis</i>
<i>Sciaena umbra</i>	: <i>Contracaecum clavatum</i> <i>Contracaecum fabri</i>
<i>Cepola macrophthalmia</i>	: <i>Anisakis</i> sp. <i>Haplocladus typicus</i>
<i>Uranoscopus scaber</i>	: <i>Anisocoelium capitellatum</i>
<i>Scorpaena notata</i>	: <i>Helicometra fasciata</i>
<i>Scorpaena porcus</i>	: <i>Helicometra fasciata</i>
<i>Serranus scriba</i>	: <i>Contracaecum fabri</i>
<i>Symphodus (Crenilabrus) tinca</i>	: <i>Sterrhurus musculus</i>
<i>Argentina sphyraena</i>	: <i>Contracaecum fabri</i>
<i>Trigloporus lastoviza</i>	: <i>Anisakis</i> sp.
<i>Scomber scombrus</i>	: <i>Lecithaster confusus</i> <i>Opechona bacillaris</i>
<i>Lepidopus caudatus</i>	: <i>Contracaecum fabri</i>
<i>Callionymus maculatus</i>	: <i>Anisakis</i> sp.
<i>Gobius niger</i>	: <i>Podocotyle atomon</i>
<i>Lesueurigobius friesii</i>	: <i>Podocotyle atomon</i>
<i>Antonogadus megalokynodon</i>	: <i>Contracaecum fabri</i>
<i>Lophius piscatorius</i>	: <i>Contracaecum clavatum</i> <i>Stephanostomum cesticillum</i>
<i>Lophius budegassa</i>	: <i>Contracaecum clavatum</i>
<i>Citharus macrolepidotus</i>	: <i>Contracaecum fabri</i> <i>Bothriocephalus andresi</i>
<i>Solea vulgaris vulgaris</i>	: <i>Raphidascaris</i> sp.
<i>Microchirus variegatus</i>	: <i>Lomasoma wardi</i>
<i>Buglossidium luteum</i>	: <i>Contracaecum fabri</i> <i>Lintonium vibex</i>
<i>Arnoglossus laterna</i>	: <i>Contracaecum fabri</i> <i>Bothriocephalus scorpii</i>
<i>Phrynorhombus regius</i>	: <i>Contracaecum fabri</i>
<i>Merluccius merluccius</i>	: <i>Contracaecum fabri</i>

CONCLUSIONS

Endohelminth parasitism in fish from the mid-Dalmatian area is rather marked. Of the total number of analysed fish species (63) 48 species or 76.2% were invaded by endohelminths what makes up 45.5% of the total number of analysed individuals (220).

A total of 28 endohelminth species were recorded: 13 Trematoda Digenea species, 10 Nematoda species, three Cestoda species and two Acanthocephala species.

As to the extension of parasitism nematodes are predominant particularly the genera *Contracaecum* and *Anisakis*. Larval stages of these genera were recorded from 44.4% of analysed fish species.

Intensity of infection by endohelminths was generally poor. It was somewhat more pronounced in fish affected by nematodes *Anisakis* sp. (larvae), *Contracaecum fabri* (larvae), *Proleptus obtusus* and trematodes *Lomasoma wardi* and *Lintonium vibex*.

A large number of new hosts of individual endohelminths from the mid-Dalmatian area were also established as well as from the Adriatic as a whole. Cestode species *Acanthobothrium floridensis* and trematodes *Sterrhurus musculus*, *Hemiurus communis* and *Lintonium vibex* are new for the Adriatic. Nematode *Echinocephalus uncinatus* is new for the endohelminth fauna from the mid-Dalmatian area.

A total of 96 endohelminth parasites of marine fish from the eastern middle Adriatic has been established so far: 63 Trematodes, 21 Nematodes, 7 Cestodes and 5 Acanthocephales.

Nematodes *Proleptus obtusus* and *Echinocephalus uncinatus* and cestode *Acanthobothrium floridensis* are characteristic endohelminths of cartilaginous fishes. Specific parasites of individual fish species and genera are nematode *Cucullanus longicollis*, cestode *Bothriocephalus andresi* and trematodes *Anisocoellium capitellatum*, *Opechona bacillaris* etc. Acanthocephales *Acanthocephaloides incrassatus* and *A. propinquus* found in both bony and cartilaginous species.

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NOVI PRILOG POZNAVANJU PARAZITARNE HELMINTOFAUNE RIBA U PODRUČJU KANALA SREDNJODALMATINSKIH OTOKA

Ivan Jardas i Nikola Hristovski*

Institut za oceanografiju i ribarstvo, Split, Jugoslavija

**Univerzitet u Bitoli, Pedagoška akademija, Bitola, Jugoslavija*

KRATKI SADRŽAJ

U novije vrijeme, počevši od 1982, pristupilo se ekstenzivnom izučavanju parazitarne helmintofaune morskih riba na području kanala srednje Dalmacije. Rezultati provedenih istraživanja tokom 1982. publicirani su ranije (Hristovski i Jardas, 1983), a ovom prilikom se iznose rezultati istraživanja provedenih tokom 1983. godine. Parazitarnu helmintofaunu morskih riba na tom području ranije izučavaju još Janiszewska (1949, 1953) i Sey (1968, 1970, 1970a, 1970b).

Materijal je sakupljen na 9 koćarskih i 6 priobalnih pozicija (Sl. 1). Analizom su obuhvaćene 63 vrste koštunjavih i hrskavičnih riba, odnosno 220 primjeraka riba. Broj analiziranih primjeraka pojedinih riba je varirao od 1—14 (Tab. 1).

Rezultati svih dosad izvršenih analiza pokazuju da je fauna parazitskih helminata morskih riba na istraživanom području brojna i raznolika. Ovom prilikom ustanovljeno je 28 vrsta endohelminata: 13 vrsta Trematoda Digenea, 10 vrsta Nematoda, 3 vrste Cestoda i 2 vrste Acanthocephala (Tab. 2). Endohelmintima je bilo invadirano 48 vrsta riba (76,2%), odnosno 45,5% od broja analiziranih primjeraka riba.

Ovom prilikom, a i ranije, uočeno je da s obzirom na ekstenzitet parazitizma općenito dominiraju vrste Nematoda, osobito rodovi *Contracaecum* i *Anisakis*, koji su ustanovljeni kod 44,4% analiziranih vrsta riba. Intenzitet invadiranosti bio je općenito slab. Intenzivniji parazitizam ustanovljen je jedino s nematodima *Anisakis* sp. (larve) *Contracaecum fabri* (larve) i *Proleptus obtusus* te digenim trematodima *Lomasoma wardi* i *Linthonium vibex*.

Kod pojedinih primjeraka ili vrsta riba ustanovljena je obično samo po jedna, a rijetko po dvije vrste endohelminata (Tab. 3).

Za većinu endohelminata ustanovljeni su novi domaćini za područje srednje Dalmacije, pa i za Jadran općenito (Tab. 2), a 4 vrste endohelminata se po prvi puta bilježi u Jadranu. To su: cestod *Acanthobothrium floridensis* i trematodi *Sterrhurus musculus*, *Hemiurus communis* i *Linthonium vibex*. Za područje srednje Dalmacije nova je vrsta *Echinocephalus uncinatus* (nematod).

Pojedine ustanovljene vrste endohelminata zabilježene su samo u hrskavičnim ribama (npr. nematodi *Proleptus obtusus* i *Echinocephalus uncinatus* te cestod *Acanthobothrium floridensis*), druge parazitiraju u koštunjavim i hrskavičnim ribama (npr. akantocefali *Acanthocephalloides incrassatus* i *A. propinquus* te cestod *Bothriocephalus scorpii*), a neke su dosad ustanovljene samo kod pojedinih vrsta riba ili rodova kao specifični paraziti (npr. *Cucullanus longicollis* u *Mullus* spp., *Bothriocephalus andresi* u *Citharus macrolepidotus*, *Anisocelium capitellatum* u *Uranoscopus scaber*, *Opechona bacillaris* u *Scomber* spp. i sl).

Dosad je na području istočnog srednjeg Jadrana ustanovljeno ukupno oko 96 vrsta endohelminata u morskim ribama: 63 vrste Trematoda, 21 vrsta Nematoda, 7 vrsta Cestoda i 5 vrsta Acanthocephala.