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Third-Stage Larvae of *Anisakis simplex* (Rudolphi, 1809) in the Red Sea Fishes, Yemen Coast

Ali B. Al-Zubaidy

Department of Marine Biology & Fisheries
Faculty of Marine Science & Environment
Hodeidah University, Yemen

Abstract. There is much less information on the occurrence of parasitic nematodes in the Red Sea fish, Yemeni Coast, therefore, the aim of this study was to assess the anisakid nematode distribution pattern in the fish collected from fish market (Al-Mehwat) in the Hodeidah City, during the period between January 2006 - March 2007.

Out of 471 marine fishes (5 species belonging to 4 families) dissected, 94 (20%) were found infected with one genera of L_3 larval nematodes. The larvae had been studied by using light microscope, and morphologically comparison of all larvae specimens studied revealed no differences. According to cephalic region structure, presence or absence of an intestinal cecum and a ventricular appendix, cuticle, body size and color, the larvae were identified as stage L_3 larvae of *Anisakis simplex* nematodes belonging to genus Anisakis.

The infection rates among the examined fish species, *Lethrinus lentjan,* 22.4% (n=98); *L. nebulosus,* 22.7% (n=66); *Carangoides bajad,* 34.9% (n=109); *Rastrelleger kanagurta,* 10.6% (n=94) and *Variota louti,* 18.3% (n=104). The host *C. bajad* was the highest susceptible fish to infection by Anisakis larvae, whereas, the *R. kanagurata* was the lowest. The prevalence of parasite infections in different fish species in relation to length of their hosts was studied. Considerable differences in parasite intensities between the five host species was examined and the results were analyzed, the differences are probably due to different feeding behaviours of the hosts and the habitat characteristics. There was no previous report on the Anisakid larvae from any fish host in Yemen. The present work represents the first record for the presence of this parasite in the Yemen's water at the Red Sea.

Introduction

The parasitism and diseases are important factors affecting the viability of natural populations and communities (Morand and Arias Gonzalez, 1997). In the marine environment, it has been demonstrated that individual fish may suffer from parasitic attacks (Faliex and Morand, 1994), and Sasal *et al.,* (1996) have shown the conspicuous role of parasites on fish in marine reserves. However, it still remains to explain why some fish species have higher parasite species richness (*i.e.* the number of parasite species occurring in one host species) than others, and how parasite communities build up on these host.

Feeding habits and wide diet spectrum of fishes puts them into contact with several potential intermediate hosts of parasites. This might be increasing the presence of endo-parasites in these fishes (Alves and Luque, 2001). The diet of the host species is the main factor affecting to the parasite community structure, especially for the trematodes, acanthocephalans and nematodes transmitted to their host through a predator-prey relationship (Sasal *et al.,* 1999). Parasite species might accumulate along food chain (Aho and Bush, 1993).

Parasites transferred by marine fish to human (consumption of poorly cooked infected fish) are found rarely among the acanthocephalans (*Bolbosoma* sp.), occasionally among the digeneans (*Diplogonoporus* spp.) and more frequently among the nematodes (Petersen *et al.,* 1993). Nematodes are common parasites in freshwater and marine fish, amphibians, reptiles, birds and mammals. In the Red Sea and other Seas, marine fishes are often teeming with nematodes: adult worms in stomach and intestine, but more striking are the large numbers of nematode larvae encapsulated on and in their viscera and also in their somatic muscles. Larval stages of Anisakid nematodes (super family: Ascaridioidea, Family: Anisakidae) of some genera such as *Anisakis,* Dujardin, 1845; *Contracaecum* Railliet et Henry, 1912; *Pseudoterranova* Mozgovoy, 1951; and *Hysterothylacium* Ward et Magath, 1917, are commonly found in the viscera and musculature of many species of teleost fish (Costa *et al.,* 2003), and can infect humans causing significant clinical disease (*i.e.* anisakiasis) in a number of countries (Zhou *et al*., 2008). The fish act as intermediate or paratenic hosts, whereas amphibians, reptiles, birds and marine mammals (Whales and Dolphins) definitive host, harbor the adult stages (Nagasawa, 1990; Anderson, 1992; and Pereira, 2000).

Infection by Anisakids can affect the commercial value of fish, particularly when larvae are located in the musculature and thus represent some economical loss for the fisheries industry (Angot and Brasseur, 1995). The fish inhabiting nematode stages show a remarkable resistance to low temperature, but are destroyed readily by heating to 70 C° or freezing at -20C° for more than 24 h. The time to kill the nematodes by marinating depends on the degree of acidity, temperature and salt addition (Moller, 1991).

In Yemen Republic, there are only a few reports about the parasites of fish from the Red Sea (Al-Zubaidy, 2007). The present study report on the occurrence and infection of Anisakid larvae in the five commercial fish species in Yemen namely: *Lethrinus lentjan, L. nebulosus* (Lethrinidae); *Carangoides bajad* (Carangidae); *Rastrelleger kanagurta* (Scombridae) and *Variota louti* (Serranidae). Fishes are a common food items and in particular these species under study (especially the *Rastrelleger kanagurata*) are routinely used in the diet of the local population.

Materials and Methods

The Anisakis larvae studied are part of the material collected from five fish species belonging to four families, namely: *Lethrinus lentjan* (n=98); *Lethrinus nebulosus(*n=66); *Carangoides bajad* (n=109); *Rastreller kanagurta* (n=104) and *Variota louti (n*=94). All fish samples were collected between January 2006 to March 2007 from commercial fish market (Al-Mehwat), Hodeidah city, Yemen, (Fig. 1). Specimens of fishes were brought to the laboratory of Marine Biology and Fisheries Department, Hodeidah University.

The total length of the fish specimens varied 11.5-73 cm. Each fish species divided into five classes depending on their length (age). Fish were dissected carefully and examined thoroughly for anisakid larvae inhabiting the stomach, intestine, visceral organs, abdominal cavity, and muscles. The larvae were removed from the surrounding host tissues and counted. Larvae were relaxed in tap-water, fixed and stored in 70% ethanol. Morphological examinations were carried out on fresh and fixed larvae, using light microscope. The parasites were cleared in glycerin or lactophenol. Ecological parameters such as prevalence (percentage of infested hosts in a sample) and mean intensity (mean number of parasites per infected host) were used as recommended by Margolis *et al.,* (1982) and Bush *et al.,* (1997).

Fig. 1. Map showing the Red Sea, Hodeidah City Coast, and the area of collection samples.

Results

Ninety four marine fish specimens were identified as harboring L_3 larval nematodes. Morphological examination revealed that all larvae specimens examined belonged to the family Anisakidae. Larvae were found free in the intestine and encapsulated (coiled in a thin walled cyst) on the wall of stomach, liver, and muscles. The examined fishes showed no external visible signs of disease.

Parasitic Identification

Identification was aided by the key published by Rocka (2004) and Olson *et al.,* (1983) and Dixon (2006), and based on the assistance of Prof. Dr. Frantisek Moravec at the Institute of Parasitology, Biology centre of the Academy of Sciences of the Czech Republic. The present infection of the larvae, was identified as third-stage larvae of *Anisakis simplex* (Fig. 2).

Light Microscope

Under light microscope (description is based on 10 larvae) larvae are characterized by:

Body Size

Medium, total length 17.8±1.9mm (range 12.45-22.5mm), maximum width 0.26±0.02 mm (0.13-0.41 mm). Body thickest posteriorly, tapering gradually towards the anterior.

Cuticle

Striated transversely, irregularly wrinkled near the tail.

Esophagus

Length 1.78±0.05mm (1.302-2.098mm), anterior muscular, posterior glandular clearly discernible in live larvae. An oblong ventriculus with oblique esophago-intestinal junction. Ventriculus length 0.75±0.06 mm (0.564-0.985 mm). Distance of nerve ring from anterior extremity 0.24±0.03 (0.16-0.30 mm).

Lips

3, relatively small, inconspicuous, surrounded of mouth, with a prominent boring tooth.

Excretory Pore

Open on ventral side at anterior end, between rudimentary sub ventral lips. It situated 0.032±0.008 mm (0.026-0.044mm) a way from the anterior extremity.

Color

White to cream in live larvae.

Tail

Rounded, length 0.322±0.04mm (0.088-0.579mm), with small mucron. Mucron length 0.018 ±0.001mm (0.015-0.022mm).

Prevalence and Intensity

The prevalence and intensity values of the infection varied between the host species. This variation is most probably related to the more or less intensity of the feeding upon the crustacean intermediate hosts.

Table 1 shows the prevalence, mean intensity of *Anisakis simplex* larvae and total larval anisakis in the overall sample and in each host size group.

Table 1. The prevalence, mean intensity of *Anisakis simplex* larvae, relative to fish length.

Fish species	Length class of fish (cm)	No. exam. fish	No. Infec. fish	Prevalence (%)	No. Parasites (rang)	Mean intensity
Lethrinus lentjan	15-25	14	2.0	14.3	5.0(2-3)	2.5
	26-35	29	5.0	17.2	11(1-3)	2.2
	36-45	22	3.0	13.6	11(2-5)	3.7
	46-55	18	5.0	27.8	27(2-7)	5.4
	>56	15	7.0	46.7	59(5-14)	8.4
	Total	98	22	22.4	113(1-14)	5.1
L. nebulosus	15-25	16	1.0	6.3	1.0(1.0)	1.0
	26-35	13	1.0	7.7	3.0(1.0)	3.0
	36-45	9.0	3.0	33.3	9.0(2-4)	3.0
	46-55	21	6.0	28.6	23(3-5)	3.8
	>56	7.0	4.0	57.1	25(1-9)	6.3
	Total	66	15	22.7	61(1-9)	4.0
Carangoides bajad	15-25	12	3.0	25.0	5.0(1-2)	1.7
	26-35	28	8.0	28.6	37(1-5)	4.6
	36-45	17	5.0	29.4	34(2-8)	6.8
	46-55	20	8.0	40.0	71(3-10)	8.9
	>56	32	14	43.8	182(5-20)	13.0
	Total	109	38	34.9	329(1-20)	8.7
Rastrelleger kanagurata	<12	4	-	-	-	-
	13-15	27	1.0	3.7	1.0(1.0)	1.0
	16-18	20	1.0	5.0	1.0(1.0)	1.0
	19-21	19	3.0	15.8	5.0(1-2)	1.7
	>22	24	5.0	20.8	12(2-3)	2.4
	Total	94	10	10.6	19(1-3)	1.9
Variola louti	15-25	18	1.0	5.6	3.0(3.0)	3.0
	26-35	20	3.0	15.0	10(1-5)	3.3
	36-45	20	5.0	25.0	17(1-4)	3.4
	46-55	18	4.0	22.0	26(3-8)	6.5
	>56	28	6.0	21.4	70(5-20)	11.7
	Total	104	19	18.3	126(1-20)	6.6
Total		471	94	20	648 (1 -20)	6.9

Table 2 shows the number and prevalence of *Anisakis simplex* larvae in intestine, stomach, liver and muscles in each fish host.

Ninety four (20%) out of 471 marine fish specimens harboured *Anisakis simplex*. The prevalence of infection varied between 10.6% to 34.9% (Table 1). In *L. lentjan* and *L. nebulosus* the prevalence of infection with Anisakis larvae was 22.4%(n=98) and 22.7% (n=66) respectively. Whilst in other three host species, prevalence was 34.9%(n=109); 10.6%(n=94)and 18.3%(n=104) for *C. bajad; R. kanagurata* and *V. louti* respectively.

R. kanagurta (length <12cm, n=4) showed no infection with juveniles of Anisakis compared with other length group (13 - >22 cm) where the prevalence was 3.7% - 20.8%.

The highest prevalence of infection were shown on the fish group (length>56 cm), 46.7%; 57.1% and 43.8% for *L. lentjan, L. nebulosus* and *C. bajad* respectively. But in the *V. louti* the highest prevalence was recorded in length group 36-45 cm. In all five different host species, the prevalence of infection showed an increasing tendency with host length.

The number of larvae per fish range from 1-14 in *L. lentjan (mean* intensity = 5.1)*;* 1 -9 in *L. nebulosus (*mean intensity =4.0)*;* 1-20 in *C. bajad* (mean intensity =8.7); 1- 3 in *R. kanagurta* (mean intensity = 1.9) and 1 -20 in *V. louti* (mean intensity =6.6) (Table 1). The mean intensity of the nematode larvae depended on the length group of fish, varied between 1-13. The highest intensity was shown on the hosts with length > 56 cm (Table 1). It means the relationship between host length and intensity is positive. The total numbers of recovered worms from the different organs were 434(67%) in the intestine, 119(18.4%) in the stomach, 39 (6%) in the muscles and 56 (8.6%) in the livers (Table 2).

Table 2. Distribution of *Anisakis simplex* larvae, in the different organs of 5 Red Sea fish species. (+)positive, (-)negative, (n)number, (%)prevalence.

Fish species	Intestine	Stomach	Liver	Muscle	Total
L. lentjan	+ n=55(48.7%)	+ n=31(27.4%)	+ n=27(23.9%)	–	113
L. nebulosus	+ n=32(52.4%)	+ n=27(44.3%)	_	+ n=2.0(3.3%)	61.0
C. bajad	+ n=260(79.0%)	+ n=29(8.8%)	+ n=22(6.7%)	+ n=18(5.5%)	329
R. kanagurata	+ n=13(68.4%)	+ n=6.0(31.6%)	–	–	19.0
V. louti	+ n=74(58.7%)	+ n=26(20.6%)	+ n=7.0(5.6%)	+ n=19(15.1%)	126
Total	n=434(67%)	n=119(18.4%)	n=56(8.6%)	n=39(6.0%)	648

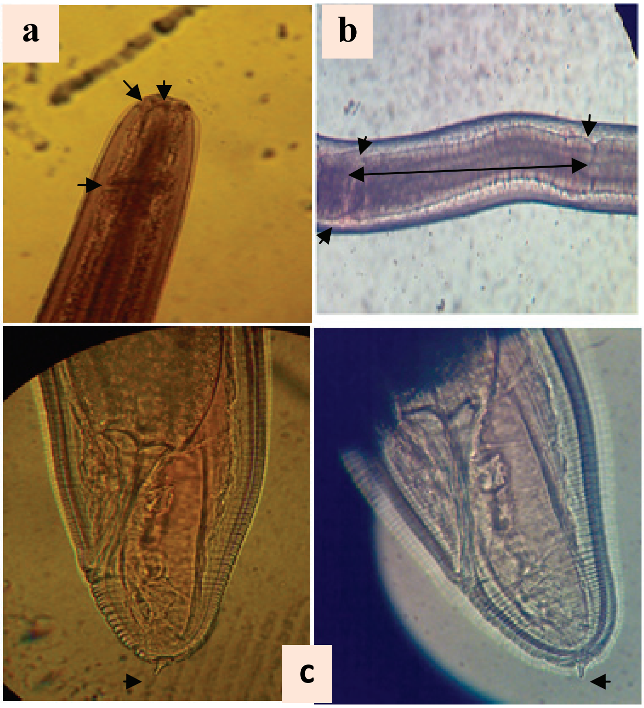

Fig. 2. Third-Stage of *Anisakis simplex.*
a- Anterior extremity with larval tooth, excretory pore and nerve ring(arrowed) (x100).
b - Ventriculus region (arrowed) (x100).
c - Tail with mucron (x400).

Discussion

Anisakid larvae of *A. simplex* have been detected world wide in a large variety of fish species, approximately 200 fish species, (Chen *et al*., 2008). Among teleosts, Gadiformes, Perciformes, Clupeiformes, Pleuronectiformes, Scorpaeniformes, Zeiformes, Bericiformes, Lophiiformes, Anguilliformes and Atheriniformes. Anisakid have been also detected in elasmobranchs and in a variety of Cephalopods, namely Octopodidae, Sepiidae, Loliginidae and Ommastrephidae. In general, it appears that specificity for the fish host on the part of anisakid larvae is low or absent and that virtually any fish that ingests either infected crustaceans or other infected fishes will become infected.

Larvae stages are commonly found in the visceral and musculature of fishes (Costa *et al.,* 2003). The fish act as intermediate or paratenic host, whereas marine mammals, definitive hosts, harbor the adult stages of species of the Anisakis, Dujardin, 1845 (Anderson, 1992). In a revision of the genus Anisakis, Davey (1971) accepted only three valid species: *A. simplex* Rudolphi, 1809; *A. physeteris* Baylis, 1923 and *A. typica* Diesing, 1860 (with 14 synonyms between them). Later, research based on allozyme markers, showed the occurrence of three reproductively isolated biological species within the morphospecies. *A. simplex: A. simplex(s.s.); A. pegreffi* Compana Rouget and Bioca, 1954 and *A. simplex* complex (Nascetti *et al.,* 1986; and Mattiucci *et al.,* 1997). In 1998, Paggi *et al.,* employing genetic markers, identified a new species of Anisakis (named: *A. ziphidarum*). Anisakid nematodes are characterized by high stability in their structural traits and very few morphological characters of taxonomic significance are so far, available (*i.e.* morphology of excretory system, number and distribution of caudal papillae), and are often applicable only to adults (Fagerholm, 1991).

Proper identification of anisakis species infecting host fishes is very important to both human health and fish disease diagnosis. The foremost problem in the identification of anisakis larvae in fishes is that L_3 larvae cannot be easily differentiated morphologically, especially between *A. simplex*(sensu stricto)(s.s)(Rudolphi, 1809) and *A. pegreffi* Campana-Rouget et Biocca, 1955 (Quiazon *et al*., 2008). For *A. simplex s.s*. the intermediate/ paratenic hosts are mainly benthic and demersal (Mattiucci *et al.,* 1997). Both *A. simplex* and *A. pegreffi* are characterized by larvae of Type I (Sensu Berland, 1961). While Type II larvae are known to belong to *A. physeteris* and *A. brevispiculata* (Mattiucci *et al.,* 2001). In addition, *A. physeteris* is typical of epipelagic intermediate/ paratenic hosts of the Mediterranean and Atlantic Ocean, while *A. brevispiculata* appears to be distributed in central and southern Atlantic waters (Costa *et al.,* 2004).

Results from this study indicate the occurrence of *Anisakis simplex* larvae in five different commercial marine fish species belonging to four families, Lethrinidae, Carangidae, Scombridae and Serranidae from the Red Sea, Coast of Hodeidah City, Yemen Republic. The larvae were morphological classified into the genus Anisakis. In the Red Sea, Egyptian coast, Abdou (2005) recorded anisakid nematodes, *Terranova* larvae from marine fishes belonging to families Carangidae, Scombridae, Lethrinidae, Scaridae and Serranidae and she mentioned that 19% were found harboring Anisakid nematodes larvae, occurrences were within the intestinal lumens of the hosts. In Mediterranean Sea fishes, Nascetti *et* *al.,* (1986) and Orecchia *et al.,* (1989) reported the Anisakis larvae from the Carangidae, Scombridae and Serranidae. Moreover, the three fish species belonging to Carangidae and Scomdridae were found harboring the Anisakis larvae (Varjabedian, 2000). Parukhin (1988) recorded the Anisakis larvae from Indian Ocean fishes belonging to family Carangidae was the highest infected fish. Out of 22 fish samples investigated, 9 (40.9%) were infected with nematodes, 6 of which (27.3%) belonged to the family Anisakidae (Pereira, 2000).

Identification of nematodes particularly to species level is not usually feasible, since the larvae lack genital system and several other features of adults which are utilized as taxonomic criteria. According to Olson *et al*., (1983), Rocka (2004) and Dixon, (2006) the third stage larvae (L_3) of *Anisakis simplex* are characterized by: Small worms, (9- 36 mm in length), with a straight anterior gut structure consisting of esophagus, ventriculus, and intestine, cuticle obviously striated transversely, irregularities, lips inconspicuous but with prominent boring tooth on anterior end, the live larvae white or cream in color and encysted in capsules of host origin, coiled like a watch- spring. All specimens of larvae in the present study showed that they have the above mentioned characters so they could be *Anisakis simplex* larvae.

The occurrence of the present sample in this study within the intestinal, (67%), stomach, (18.4%), liver, (8.6%) and muscles, (6.0%); specimens length 12.45-22.5mm, width 0.13-0.41mm. Whereas Abdou (2005) found the *Terranova* larvae only within the intestinae of the fish host, and worms length 3-5 mm. Also, findings in this study differ from observations made by Velasquez (1968) who found Anisakis larvae in the body cavity and gonads of 12 out of 47 fish species which were sold in Manila markets, and specimens length 4 -16 mm. On a survey carried out by Hendrickson and Yindeepol (1987) Anisakis larvae were reported infecting the intestine and surface of internal organs. Song and Hwang (1992) investigated 382 *Astroconger myriaster*, 259 (67.8%) harbor Anisakid larvae, (*Anisakis* sp. and *Contracaecum* sp.)*,* Anisakid larvae (*Anisakis* sp.) were obtained from 94 (24.6%), and the numbers of recovered worms by the organs were (9.4%) in the intestine, (6.0%) in the stomach, (1.0%) in the muscle, (0.7%) in the liver. Nuchjangreed *et al*., (2006) mentioned that the distribution and locality of infections by anisakid nematodes in the fish bodies showed that the majority of worms were found in the intestine, followed by the liver and stomach (80%), and other body parts such as the fins, lungs, gonads, and eggs in the uterus were also infected. Observation of wide distributions indicates the ability of these worms to migrate into different locations of marine fish organs.

The distribution of *Anisakis simplex* larvae within the fish host may be related to the feeding habits of the fish. Smith (1983) showed that the most encapsulated larvae occur in the body cavity of zooplankton-feeding fishes, but are more widely distributed throughout the tissues of piscivorous fishes. And he suggested that the zooplankton feeders are probably on the, mainstream, of the *Anisakis* life cycle involving a transfer of worms upward from euphausiid to euphausiid-feeding fish to cetaceans. Piscivorous fishes probably acquire most of their *Anisakis* from prey fishes and may not be an efficient mechanism of transfer to final hosts.

The prevalence and intensity of infection with *Anisakis simplex* larvae were positively correlated with host size, increasing with host size increasing, thus larger fish appear as more susceptible to the infection rather than the smaller one. This may be attributed to the available niches for parasite are more diverse in large hosts, also larger hosts can sustain a higher number of parasites, hence the time it takes for the species to go extinct in an individual host is reduced. Furthermore, longer fishes have lived longer and therefore, have a higher probability of encountering parasites during their life span than smaller and shorter lived fish species. Numerous studies have provided a picture of the variations in the intensity of infection that often occur among individual fish within a certain geographic area. In these studies, prevalence of worms have been associated with host age as reflected by length (Platt, 1975). Arthur *et al*., (1982) mentioned that the occurrence and abundance of the anisakids larvae varied with geographic location and with fish length (age). The increased infection levels with fish age reflects the long life span of larval anisakid nematodes, which possibly live as long as the fish host, therefore older fish, tended to be more heavily infected. The relationship between the prevalence, intensity and the host fish length presented here, agrees well with the other authors results for various areas (Arthur *et al*., 1982; Bush *et al.* 1990; Koie, 2001; Costa *et al*., 2003; Podolska and Horbowy, 2003; and Cruz and Saraiva., 2005).

The large number of *Anisakis simplex* larvae and highest prevalence with them, found in host *C. bajad* compared with the number of larvae and prevalence of infected found in the other four hosts examined (Table 1). Can be explained by the predatory voracity of *C. bajad* and its feeding strategy being non-selective. Jueco *et al.,* (1971), and Parukhin, (1988), were mentioned that high (41 to 100%) prevalence of *A. simplex* larvae in the Carangidae, *Decapterus macrosoma*. A higher prevalence of Anisakid nematode infestation depends on the availability of the final hosts in the region and the parasites' ability to complete its life cycle (Palm, 1999). It also may be related to the food ingested and to the layer of the water column inhabited (bottom versus pelagic) (Palm *et al*., 2007). The infestation dynamic is strongly fish species and area specific (Rokicki *et al*., 2009). The high loads of Anisakis found in fish host, and the fact that Anisakid larvae were seen penetrating muscles, may point to a possible health problem for consumers (Costa *et al.,* 2003).

R. kanagurta, was lowest susceptible fish to infection by Anisakid nematode larvae, and the infected fish harboured low numbers of larvae (maximum 3 per fish). The dependence of prevalence and infection intensity on host length as well as no infection in *R. kanagurta* (<12 cm). This is probably a consequence of their smaller size and feeding on small planktonic crustaceans. The level of infection of planktonic crustaceans with *A. simplex* larvae as demonstrated by Smith(1983) was generally no more than 4%. Podolska and Horbowy (2003) mentioned that the prevalence and intensity infection in *Clupea harengus* fish with *A. simplex* larvae dependence on host length, but no infection in length <19 cm. A combination of the feeding ecology of the fish species (*i.e.* predominantly zooplankton feeder versus a voracious predatory feeder) and the habitat characteristics may explain the differences in the intensity of infection with the Anisakis. Bush *et al.* (1990) mentioned that the host diet, age, sex, range are the most important determinants of distribution of nematodes. No nematode larvae were found in *R. kanagurta* below 12 cm presented here, agrees with Khalil(1969), who mentioned that the larvae of *Anisakis* sp. are scarcely found in fish below 12cm length, a steady increase in both the invasion incidence and intensity being noted above 12cm. Grabda (1974) mentioned that both the incidence and intensity of the *A. simplex* invasion in herring from the Baltic as well as from the other Seas increase with the herring body size starting from 20cm body length. Herring below this length remain unaffected. 30cm-herring group is almost entirely parasitized.

Conclusions

Marine fishes constitute an important resource group, both as a feature of ecotourism and as a food source for human consumption. Fishes are susceptible to damage caused by parasites.

Nematodes of the family Anisakidae are common parasites and of biological, medical and economic importance in marine organisms world wide, and in most of teleost fish, since they are swallowed when fish eat their prey, which are the intermediate hosts of these worms that are encapsulated in viscera or muscles. Anisakids are not host specific at the larval stage they may be found in a wide range of different available fish host species, and this may result in a higher probability of transmission (Smith, 1983; and Mattiucci *et al.,* 1997). The worms in flesh reduce the marked value of fish, and thus represent some economical loss of the fisheries industry(Angot and Brasseur, 1995). In addition nematode genera *Anisakis, Terranova,* and *Contracaecum* spp. found in fish may cause the most severe problems for human health, Anisakiasis, that humans acquire by eating fish subject to little heat treatment or fish that is smoked, soaked in vinegar, pickled with spices and other raw fish specialities (Petersen *et al.,* 1993; Beran and Steel, 1994). Anisakiasis has been reported from a large number of countries in different parts of the world (Moller, 1989), but the areas of highest prevalence are Scandinavia (from Cod livers), Japan (after eating sushi and sashimi), the Netherlands(by eating infected fermented herrings, *Maaties*), and along the Pacific Coast of South America (from eating Ceviche). It produces severe lesions in human stomach and are associated with gastric neoplasia (Mattiucci *et al.,* 1997). If larvae are loose or attached to digestive tract, they may produce irritation, inflammation and ulceration. In Yemen Republic there are no reported cases of human infection by anisakis, may be due to the inexistence of the habits of eating raw fish. However, the existence of human infections can not be ruled out, due to the lack of contact of physicians with anisakis infection symptoms.

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يرقات الطور الثالث لانيساكس سمبلكس (رودلفي، ١٨٠٩) في أسماك البحر الأحمر، الساحل اليمني

علي بناوي الزبيدي

قسم الأحياء البحرية والمصائد – كلية علوم البحار والبيئة

جامعة الحديدة – اليمن

المستخلص. المعلومات المتوفرة حول الطفيليات الخيطية في أسماك البحر الأحمر, الساحل اليمني قليلة. لذا هدفت الدراسة إلى تحديد وجود وتوزيع يرقات الأنيساكد في أسماك البحر الأحمر الساحل اليمني. فأجريت على ٤٧١ عينة من الأسماك البحرية (تعود إلى خمسة أنواع وأربعة عوائل) والتي تم الحصول عليها من سوق بيع الأسماك بمدينة الحديدة خلال المدة من يناير ٢٠٠٦ إلى مارس ٢٠٠٧م. وأوضحت نتيجة الفحص وجود تلك اليرقات في ٩٤ سمكة من مجموع الأسماك التي فحصت، وبنسبة إصابة ٢٠٪. وفي الدراسة المقارنة للصفات الخارجية ليرقات الأنيساكس المختلفة باستعمال المجهر الضوئي, تبين عدم وجود اختلافات فيما بينها. وتبعًا للصفات التي تميزت بها من حيث: تركيب المنطقة الرأسية، والكيوتكل، ولون، وحجم الجسم، صنفت إلى جنس الأنيساكد نوع سمبلكس.

كانت نسبة الإصابة في أنواع الأسماك المفحوصة، الآتي: ليثرينيا لنتجن ٤ و٢٢٪ (٩٨)؛ ليثرينيا نيبلوسيس ٧و٢٢٪ (٦٦)؛ كارانكويدس بياض ٩ و٣٤٪ (١٠٩)؛ راستريليجر كاناجيوراتا ٦ و١٠٪ (٩٤)؛ فاريولا ليوتي ٣ و١٨٪ (١٠٤). سجلت أعلى نسبة

إصابة في أسماك الكارانكويدس بياض في حين سجلت أقل نسبة إصابة في أسماك راستريليجر كاناجيوراتا.

تمت دراسة العلاقة بين نسب وجود الإصابات الطفيلية في أنواع الأسماك المختلفة تبعًا لطول السمكة المضيف. كما درست الاختلافات الكبيرة في كثافة الطفيليات بين أنواع المضيّفات الخمسة، وبتحليل النتائج تبين أن احتمالية الاختلاف تعود إلى اختلاف سلوك المضيّف وخصائص الموطن. ونظراً لعدم وجود دراسات سابقة على هذا الجنس من أسماك البحر الأحمر بالساحل اليمني, لذا تعتبر هذه الدراسة الأولى التي تم فيها تسجيل الطور اليرقي الثالث لأنيساكس سمبلكس.