

STUDIES ON DIGENETIC TREMATODES OF SOME RED SEA FISH 1. GENERAL SURVEY

By

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ABSTRACT

812 Red Sea fish, belonging to 33 species, were examined for digenetic trematodes. All species of fish were infected with one or more genera of trematodes. Out of 812 fish, 394 (48.5%) were positive. The incidence of infection varied greatly in different fish families, being lowest (5.0%) in Gerridae and highest (100%) in Platacidae and Priacanthidae. Sex differences in the incidence of infections were considered in various fish families. Six species of fish harboured one genus of trematodes, 4 species of fish had two genera while 6 species had three genera of trematodes each. The other 17 species of fish were infected with 4-14 genera of trematodes each. Host specificity at the generic level was considered; most trematode genera were found in 1-4 species of fish while some parasite genera had a wider host spectrum, being found in 5-15 species of fish. The incidence of trematode genera was correlated with the intensity of infections in various fish hosts.

INTRODUCTION

The Red Sea, an important offshoot from the Indian Ocean, has a very rich and varied fish fauna (1, 2, 3).

It is the consensus of opinion amongst world nutritionists that the pressing needs for animal protein can be only satisfied through the utilization and development of fish resources. It is almost definite that fishing and fish eating will increase in importance throughout the world.

An important implication of the interest in the marine environment as an alternative source of food would be an increase in the study of fish parasitology as well as in fish transmitted zoonotic diseases. Williams and Jones (4) reviewed the importance of the subject in view of the increasing interest among biologists, veterinary and medical parasitologists and others concerned with mariculture and fish farming.

The literature on the parasites of Red Sea fishes, particularly helminths, is relatively limited. Professor H. F. Nagaty and his coworkers published over the past forty years several papers on the trematodes of Red Sea fishes (5). Saoud (6) described a cestode from the sting ray *Taeniura lymma*. Few papers were published later, including Parukhin (7) and Saoud, Abu Sinna and Ramadan (8).

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The above studies have been concerned only with the taxonomy of the parasites. The biology of the host-parasite system, including knowledge of incidence of infection and the effect of host sex, host-specificity and the inter-relationships between members of the parasitic fauna, have been almost lacking.

The present preliminary investigation was undertaken to fill in some of the above gaps in our understanding of the biology of the host-parasite system and to augment our knowledge of the helminth parasitic fauna of fishes from the Red Sea.

MATERIALS AND METHODS

Most of the fish collected during the present investigation were collected alive by fisherman from the coastal waters at the vicinity of the Marine Biological Station at Al-Ghardaga, 340 km to the south of Suez on the western Red Sea. Occasionally, few fish were bought from the fish market of Al-Ghardaga. Fishes were examined for helminth parasites as soon as possible. Trematodes were first relaxed, then fixed in hot 70% alcohol or 5% formalin. The parasites were then stained using various carmine stains, including Grenacher's alum carmine, Gower's carmine and aceto-alum carmine.

Species of fish were identified according to Roux-Esteire and Faurmanoir (1), Roux Esteire (2); Al-Kholy (3) and Kuronuma and Abe (9). Trematodes were identified to the generic level using mostly Yamaguti (10).

RESULTS AND DISCUSSION

Altogether, 812 fishes were examined for digenetic trematodes. The examined fishes belong to 33 species, 24 genera and 16 families.

I. GENERAL SURVEY

Table (1) includes a host - parasite list of the Red Sea fishes collected and examined, including the incidence of trematode parasites in male and female fish, as well the reported trematode genera and the respective incidence in fish hosts. Table (2) includes the incidence of trematode infections arranged according to the fish families as well as the sex of the fish hosts.

1. General Incidence

All the species of fish examined were infected with one or more genera of digenetic trematodes. Out of 812 fishes, 394 (48.5%) were positive. The incidence of trematode infection varied in different fish families. In the family Gerridae, the incidence was very low (5.0%) while in Platacidae and Priacanthidae the incidence was 100%. The incidence was low (<25%) in Sparidae; moderate (25-50%) in Synodontidae, Serranidae, Lethrinidae, Acanthuridae, Balistidae and Holocentridae; high (50-75%) in Mullidae and Labridae and very high (75-100%) in Atherinidae, Lutianidae, Hemirhamphidae, Platacidae and Pricanthidae.

2. Sex Differences

In Synodontidae, Sparidae, Labridae, Balistidae and Platacidae; the incidence was higher in males than females. In Scaridae and Pricanthidae, the incidence was almost equal in both sexes. In all the other families of fish the incidence was higher in females than males.

Table 1
Incidence of Trematode Genera in Examined Fish

Hosts	Local Name	No. Examined		Infections				Trematode Infections		
		M	F	Male		Female		Genera	No.	%
				No.	%	No.	%			
1. Family Synodontidae <i>Synodus variegatus</i>	Harit	12	20	5	41.7	5	25	<i>Lecithophyllum</i>	3	9.4
								<i>Hamacreadium</i>	2	6.3
								<i>Tubulovesicula</i>	2	6.3
								<i>Dichadena</i>	2	6.3
								<i>Macradena</i>	2	6.3
								<i>Macardenina</i>	2	6.3
								<i>Botulisaccus</i>	1	3.1
								<i>Proenenterum</i>	1	3.1
<i>Mitrostoma</i>	1	3.1								
2. Family Atherinidae <i>Atherina forskalii</i>	Kashkousha	17	41	9	52.9	35	85.4	<i>Steganoderma</i>	23	39.7
								<i>Lecithaster</i>	12	20.7
								<i>Proenenterum</i>	8	13.8
								<i>Botulisaccus</i>	2	3.5
								<i>Aponurus</i>	2	3.5
								<i>Pedunculoacetabulum</i>	1	1.7
								<i>Lecithophyllum</i>	1	1.7
								3. Family Serranidae <i>Epinephelus chlorostigma</i>	Qushar Abo Ads	16
<i>Podocotyle</i>	3	12								
<i>Bucephalus</i>	2	8								
<i>Acanthocolpus</i>	1	4								
<i>Tormopsolus</i>	1	4								
<i>Opecoelus</i>	1	4								
<i>Tubulovesicula</i>	1	4								
<i>Dichadena</i>	1	4								

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Cont. Table 1

Hosts	Local Name	No. Examined		Infections				Trematode Infections		
		M	F	Male		Female		Genera	No.	%
				No.	%	No.	%			
<i>Epinephelus summana</i>	Qushar Kharna	4	9	2	50	8	88.9	<i>Hamacreadium</i>	8	61.5
								<i>Podocotyle</i>	2	15.4
								<i>Helicometra</i>	1	7.7
<i>Epinephelus diacanthus</i>	Qushar Louti	1	0	1	100	0	0	<i>Pseudoplagioporos</i>	1	100
								<i>Dichadena</i>	1	100
<i>Variola louti</i>	Qushar Sherif	1	0	1	100	0	0	<i>Plagioporos</i>	1	100
								<i>Dichadena</i>	1	100
<i>Plectropomus maculatus</i>	Qushar Nagel	2	0	1	50	0	0	<i>Hamacreadium</i>	1	50
4. Family Lutianidae										
<i>Lutianus fulviflamma</i>	Habria	15	19	11	73.3	17	89.5	<i>Dichadena</i>	23	67.6
								<i>Hamacreadium</i>	4	11.8
								<i>Acanthocolpus</i>	3	8.8
								<i>Paracryptogonimus</i>	3	8.8
								<i>Tormopsolus</i>	2	5.9
								<i>Stephanostomum</i>	2	5.9
								<i>Monorcheides</i>	1	2.9
								<i>Dihemistephanus</i>	1	2.9
								<i>Tubulovesicula</i>	1	2.9
								<i>Lecithophyllum</i>	1	2.9
<i>Lutianus bohar</i>	Bohar	2	1	1	33.3	1	33.3	<i>Metadena</i>	2	66.7
5. Family Lethrinidae										
<i>Lethrinus miniatus</i>	Dereeny	10	31	4	40	12	38.7	<i>Plagioporos</i>	8	19.5
								<i>Dichadena</i>	5	12.2
								<i>Mitrostoma</i>	1	6.2
								<i>Hamacreadium</i>	2	4.9
								<i>Tormopsolus</i>	1	2.4
								<i>Stephanostomum</i>	1	2.4
								<i>Bucephalopsis</i>	1	2.4

Cont. Table 1

Hosts	Local Name	No. Examined		Infections				Trematode Infections										
		M	F	Male		Female		Genera	No.	%								
				No.	%	No.	%											
<i>Lethrinus nebulosus</i>	Shu ura	12	23	1	91.7	13	56.5	<i>Hamacreadium</i>	13	37.1								
								<i>Acanthocolpus</i>	5	14.3								
								<i>Pseudoplagioporos</i>	4	11.4								
								<i>Tormopsolus</i>	3	8.6								
								<i>Plagioporos</i>	3	8.6								
								<i>Podocotyle</i>	1	2.9								
<i>Lethrinus mahsenoides</i>	Mehseny	2	3	0	0	3	100	<i>Tormopsolus</i>	1	20.0								
								<i>Hamacreadium</i>	1	20.0								
								<i>Pseudoplagioporos</i>	1	20.0								
<i>Lethrinus mahsena</i>	Bongos	73	51	20	27.4	23	45.1	<i>Hamacreadium</i>	22	17.7								
								<i>Acanthocolpus</i>	14	11.3								
								<i>Tormopsolus</i>	7	5.7								
								<i>Pseudoplagioporos</i>	7	5.7								
								<i>Dihemistephanus</i>	6	4.8								
								<i>Stephanostomum</i>	5	4.0								
								<i>Podocotyle</i>	2	1.6								
								<i>Lecithophyllum</i>	2	1.6								
								<i>Leptobulbus</i>	1	0.8								
								<i>Lecithaster</i>	1	0.8								
								<i>Bucephalopsis</i>	1	0.8								
								6. Family Sparidae <i>Acanthopagurus bifasciatus</i>	Rabak	5	18	1	20	5	27.8	<i>Botulisaccus</i>	3	9.1
																<i>Podocotyle</i>	2	6.1
<i>Plagioporos</i>	1	3.0																
<i>Lecithophyllum</i>	1	3.0																

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Cont. Table 1

Hosts	Local Name	No.		Infections				Trematode Infections		
		Examined		Male		Female		Genera	No.	%
		M	F	No.	%	No.	%			
<i>Pagurus haffara</i>	Haffar	10	12	3	30	4	33.3	<i>Plagioporus</i>	3	13.6
				2				<i>Proenenterum</i>	2	9.1
				1				<i>Leptobulbus</i>	1	4.5
				1				<i>Genolopa</i>	1	4.5
				1				<i>Brachyenteron</i>	1	4.5
				1				<i>Megacreadium</i>	1	4.5
<i>Argyrops spinifer</i>	Murgam	1	5	1	100	2	40	<i>Hamacreadium</i>	3	50
				1				<i>Acanthocolpus</i>	1	16.7
				1				<i>Dichadena</i>	1	16.7
<i>Sparus nockt</i>	Bottite	14	18	3	21.4	0	0	<i>Lasiotocus</i>	1	3.1
				1				<i>Proenenterum</i>	1	3.1
				1				<i>Podocotyle</i>	1	3.1
				1				<i>Lecithaster</i>	1	3.1
				1				<i>Aphanurus</i>	1	3.1
7. Family Gerridae <i>Gerres oyena</i>	Qassa	6	14	0	0	1	7.1	<i>Plagioporus</i>	1	5.0
8. Family Mullidae <i>Upeneus vittatus</i>	Anber Tina	27	26	15	55.6	19	73.1	<i>Opecoelus</i>	29	54.7
								<i>Macradena</i>	7	13.2
								<i>Lepidopeden</i>	2	3.8
								<i>Hamacreadium</i>	2	3.8
								<i>Tubulovesicula</i>	2	3.8
								<i>Spiritestis</i>	1	1.9
								<i>Hexangium</i>	1	1.9
								<i>Genolopa</i>	1	1.9
								<i>Helicometra</i>	1	1.9
								<i>Bucephalopsis</i>	1	1.9
								<i>Aponurus</i>	1	1.9

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Cont. Table 1

Hosts	Local Name	No. Examined		Infections				Trematode Infections		
		M	F	Male		Female		Genera	No.	%
				No.	%	No.	%			
<i>Mulloidichthys auriflamma</i>	Anber Baladi	5	2	3	60.0	2	100	<i>Opecoelus</i>	4	57.1
								<i>Macradena</i>	2	28.6
								<i>Aponurus</i>	1	14.3
<i>Pseudopeneus pleurospilus</i>	Anber Baha	4	3	2	50.0	2	66.7	<i>Opecoelus</i>	3	42.9
								<i>Bucephalus</i>	1	14.3
								<i>Bucephalopsis</i>	1	14.3
9. Family Labridae <i>Anampses caeruleopunctatus</i>	Mallas	39	63	25	64.1	37	58.7	<i>Plagioporus</i>	21	20.6
								<i>Hamacreadium</i>	16	15.7
								<i>Helicometra</i>	11	10.8
								<i>Botulisaccus</i>	8	7.8
								<i>Lasiotocus</i>	7	6.9
								<i>Genolopa</i>	7	6.9
								<i>Bucephalopsis</i>	3	2.9
								<i>Gyliauchen</i>	2	2.0
								<i>Pseudoplagioporus</i>	2	2.0
								<i>Dichadena</i>	2	2.0
								<i>Apharyngogyliauchen</i>	1	1.0
								<i>Podocotyle</i>	1	1.0
								<i>Metadena</i>	1	1.0
								<i>Lecithophyllum</i>	1	1.0
10. Family Acanthuridae <i>Acanthurus stellata</i>	Sigan Sheaab	13	8	0	0	2	25.0	<i>Lecithophyllum</i>	2	9.5
<i>Acanthurus oramen</i>	Sigan	11	8	8	72.7	5	62.5	<i>Hexangium</i>	13	68.4
								<i>Gyliauchen</i>	2	10.5
<i>Acanthurus sohal</i>	Sohal	4	0	3	75.0	0	0	<i>Lecithaster</i>	2	50.0
								<i>Pseudocreadium</i>	1	25.0

Cont. Table 1

Hosts	Local Name	No. Examined		Infections				Trematode Infections		
		M	F	Male		Female		Genera	No.	%
				No.	%	No.	%			
<i>Acanthurus lurida</i>	Sigan Shebeihi	4	3	3	75.0	3	100.0	<i>Gyliauchen</i>	6	85.7
11. Family Balistidae <i>Balistes aculeatus</i>	Hegman	12	10	5	41.7	1	10.0	<i>Hamacreadium</i>	13	59.1
								<i>Helicometra</i>	1	16.6
								<i>Plagioporus</i>	2	9.1
								<i>Gyliauchen</i>	1	4.5
								<i>Hexangium</i>	1	4.5
								<i>Acanthocolpus</i>	1	4.5
12. Family Holocentridae <i>Holocentrus sammara</i>	Boseili Sammara	25	17	2	8.0	9	52.9	<i>Hamacreadium</i>	8	19.1
								<i>Proeneterum</i>	2	4.8
								<i>Helicometra</i>	2	4.8
								<i>Lasiotocus</i>	1	2.4
								<i>Lecithophyllum</i>	1	2.4
13. Family Scaridae <i>Scarus bicolor</i>	Beydi	4	4	2	50	1	25	<i>Dichadena</i>	2	25.0
								<i>Hamacreadium</i>	1	12.5
								<i>Helicometra</i>	1	12.5
<i>Pseudoscarus harid</i>	Harid	5	14	3	60	9	64.3	<i>Apharyngogyliuchen</i>	9	47.4
								<i>Rhagorchis</i>	3	15.8
								<i>Benthotrema</i>	2	10.5
								<i>Hexangium</i>	1	5.3
								<i>Opecoelus</i>	1	5.3
								<i>Plagioporus</i>	1	5.3
								<i>Bucephalopsis</i>	1	5.3

Cont. Table 1

Hosts	Local Name	No. Examined		Infections				Trematode Infections		
		M	F	Male		Female		Genera	No.	%
				No.	%	No.	%			
14. Family Hemirhamphidae <i>Hemirhamphus marginatus</i>	Gambaror	2	7	1	50	7	100	<i>Spiritestis</i>	8	88.9
								<i>Schistorchis</i>	2	22.2
								<i>Lasiotocus</i>	1	11.1
								<i>Monorcheides</i>	1	11.1
15. Family Platacidae <i>Platax pinnatus</i>	Abu Sheraa	8	0	8	100	0	0	<i>Brachyenteron</i>	8	100
								<i>Genolopa</i>	1	12.5
								<i>Steganoderma</i>	1	12.5
								<i>Dichadena</i>	1	12.5
16. Family Priacanthidae <i>Priacanthus arenatus</i>	Abu-Sharara	4	3	4	100	3	100	<i>Pedunculoacetabulum</i>	7	100

Table 2
Incidence of Trematode Infections in Families of Fish

Host Families	No. Examined			Infected					
				Male		Female		Total	
	Male	Female	Total	No.	%	No.	%	No.	%
Synodontidae	12	20	32	5	41.7	5	25.0	10	31.3
Atherinidae	17	41	58	9	52.9	35	84.4	44	75.9
Serranidae	24	18	42	11	45.8	9	50.0	20	47.6
Lutianidae	17	20	37	12	70.6	18	90.0	30	81.1
Lethrinidae	97	108	205	35	36.1	51	47.2	86	41.9
Sparidae	30	53	83	8	26.7	11	20.8	19	22.9
Gerridae	6	14	20	0	0	1	7.1	1	5.0
Mullidae	36	31	67	20	55.6	23	74.2	43	64.2
Labridae	39	63	102	25	64.1	37	58.7	62	60.8
Acanthuridae	32	19	51	14	43.8	10	52.6	24	47.0
Balistidae	12	10	22	5	41.7	1	10.0	6	27.3
Holocentridae	25	17	42	2	8.0	9	52.9	11	26.2
Scaridae	9	18	27	5	55.6	10	55.6	15	55.6
Hemirhamphidae	2	7	9	1	50.0	7	100.0	8	88.9
Platacidae	8	0	8	8	100.0	0	0	8	100.0
Priacanthidae	4	3	7	4	100.0	3	100.0	7	100.0
Total	370	442	812	164	44.3	230	52.0	394	48.5

II. INFECTIONS WITH TREMATODE GENERA

Six species of fish harboured one genus of trematodes only. Four species had two genera of parasites and six species were infected with three genera of trematodes. The other 17 species of fish were infected with 4-14 genera of trematodes each. The distribution of fish hosts in single, double, triple and multiple infections with trematode genera is as follows:

1. Infections with one genus of trematodes in:
Lutianus bohar, *Gerres oyena*, *Acanthurus stellata*, *Plectropomus maculatus* and *Priacanthus arenatus*.
2. Infections with two genera of trematodes in:
Acanthurus oramen, *Acanthurus sohal*, *Epinephelus diacanthus* and *Variola louti*.
3. Infections with three genera of trematodes in:
Lethrinus mahsenoides, *Argyrops spinifer*, *Scarus bicolor*, *Mulloidichthys auriflamma*, *Pseudopeneus pleurospilos* and *Epinephelus summana*.
4. Infections with four genera of trematodes in:
Acanthopagurus bifasciatus, *Hemirhamphus marginatus* and *Platax pinnatus*.

5. Infections with five genera of trematodes in:
Sparus nockt and *Holocentrus sammara*.
6. Infections with six genera of trematodes in:
Lethrinus nebulosus, *Pagurus haffara* and *Balistes aculeatus*.
7. Infections with seven genera of trematodes in:
Atherina forskalii, *Lethrinus miniatus* and *Pseudoscarus harid*.
8. Infections with eight genera of trematodes in:
Epinephelus chlorostigma.
9. Infections with nine and ten genera of trematodes in:
Synodus variegatus and *Lutianus fulviflamma* respectively.
10. Infections with eleven trematode genera in:
Lethrinus mahsena and *Upeneus vittatus*.
11. Infections with fourteen trematode genera in:
Anampses caeruleopunctatus.

III. THE QUESTION OF HOST SPECIFICITY

Host specificity at the generic level was considered from the parasite/host list given in Table (3) which includes digenetic trematodes encountered in different host fish together with the number of worms per infected fish.

1. Host-Specificity and fish species

Most of trematode genera were found in 1-4 species of fish while some genera were found in 5-15 species of fish.

Each of the following nine trematode genera were recorded only in one species of fish: *Benthotrema*, *Pseudocreadium*, *Rhagorthis*, *Lepidapedon*, *Schistorchis*, *Megacreadium*, *Paracryptogonimus*, *Aphanurus* and *Macradenina*.

Each of the following 11 genera of trematodes were found in two species of fish: *Spiritestis*, *Leptobulbus*, *Apharyngogyliashen*, *Monorcheides*, *Steganoderma*, *Brachyenteron*, *Dihemistephanus*, *Pedunculacetabulum*, *Bucephalus*, *Metadena* and *Mitrostoma*.

Only three genera of trematodes were reported from three species of fish; these included: *Stephanostomum*, *Aponurus* and *Macradena*.

7 genera of trematodes were reported from 4 species of fish. These included: *Gyliachen*, *Hexangium*, *Lasiotocus*, *Genolopa*, *Botulisaccus*, *Tubulovesicula* and *Lecithaster*.

The other 12 genera of trematodes were recorded from 5-15 species of fish. It is worth-mentioning that the genus *Dichadena* was reported from 10 species of fish while the genus *Hamacreadium* was found in 15 species of fish.

Table 3

List of Digenetic Trematodes in Different Host Fish Together with Incidence and Intensity of Infections

Tramatoes	Hosts	Infections			
		Incidence %	No. of Worms per Fish		
			Range	Mean	
1. Family Waretrematidae Srivastava, 1937 Subfamily Megasoleninae Manter, 1935, Genus <i>Spiritestis</i> Nagaty, 1948.	<i>Hemirhamphus marginatus</i>	88.9	10-102	38.1	
	<i>Upeneus vittatus</i>	1.9	3	3.0	
2. Family Gyliuachenidae Ozaki, 1933 a. Subfamily Gyliuacheninae Fukui, 1929 Genus <i>Gyliuachen</i> Nicoll, 1915 Genus <i>Leptobulbus</i> Manter and Pritchard, 1962 b. Subfamily Apharyngogyliuacheninae Yamaguti, 1958 Genus <i>Apharyngogyliuachen</i> Yamaguti, 1942	<i>Acanthurus lurida</i>	85.7	2-184	68.8	
	<i>Acanthurus oramen</i>	10.5	2-40	21.0	
	<i>Balistes aculeatus</i>	4.0	4	4.0	
	<i>Anampses caeruleopunctatus</i>	2.0	2-7	4.5	
	<i>Pagurus haffara</i>	4.5	1	1.0	
	<i>Lethrinus mahsena</i>	0.8	2	2.0	
	<i>Pseudoscarus harid</i>	47.4	2-16	7.1	
	<i>Anampses caeruleopunctatus</i>	1.0	3	3.0	
	3. Family Angiodictyidae Looss, 1902 Subfamily Hexangiinae Yamaguti, 1958 Genus <i>Hexangium</i> Goto and Ozaki, 1929	<i>Acanthurus oramen</i>	68.4	2-20	4.7
		<i>Pseudoscarus harid</i>	5.3	7	7.0
<i>Balistes aculeatus</i>		4.5	1	1.0	
<i>Upeneus vittatus</i>		1.9	9	9.0	

Cont. Table 3

Trematodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
4. Family Fellodistomidae Nicoll, 1913 Subfamily Fellodistominae Nicoll, 1909 Genus <i>Benthotrema</i> Manter, 1934	<i>Pseudoscarus harid</i>	10.5	3.5	4.0
5. Family Monorchidae Odhner, 1911				
a. Subfamily Monorchinae (Odhner, 1911) Nicoll, 1915 Genus <i>Monorcheides</i> Odhner, 1905	<i>Hemirhamphus marginatus</i>	11.1	2	2.0
	<i>Lutianus fulviflamma</i>	2.9	2	2.0
b. Subfamily Lasiotocinae Yamaguti, 1958 Genus <i>Lasiotocus</i> Looss, 1907	<i>Hemirhamphus marginatus</i>	11.1	1	1
	<i>Anampses caeruleopunctatus</i>	6.9	1-10	8.4
	<i>Sparus nockt</i>	3.1	1	1.0
	<i>Holocentrus sammara</i>	2.4	1	1.0
Genus <i>Genolopa</i> Linton, 1910	<i>Platax pinnatus</i>	12.5	4	4.0
	<i>Anampses caeruleopunctatus</i>	6.9	1-8	11.6
	<i>Pagurus haffara</i>	4.5	5	5.0
	<i>Upeneus vittatus</i>	1.9	2	2.0
6. Family Zoogonidae Odhner, 1911 Subfamily Steganodermatinae (Yamaguti, 1934) Skrjabin, 1957 Genus <i>Steganoderma</i> Stafford, 1904	<i>Atherina forskalii</i>	39.7	1-10	2.5
	<i>Platax pinnatus</i>	12.5	2	2.0

Cont. Table 3

Trematodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
Genus <i>Brachyenteron</i> Manter, 1934	<i>Platax pinnatus</i>	100.0	7-35	24.4
	<i>Pagurus haffara</i>	4.5	2	2.0
Genus <i>Botulisaccus</i> Caballero, Bravo Hollis and Grocott, 1955	<i>Acanthopagurus bifasciatus</i>	9.1	1-3	2.0
	<i>Anampses caeruleopunctatus</i>	7.8	1-5	3.8
	<i>Atherina forskalii</i>	3.5	1-3	2.0
	<i>Synodus variegatus</i>	3.1	2	2.0
7. Family Acanthocolpidae Luhe, 1909				
a. Subfamily Acanthocolpinae Luhe, 1906				
Genus <i>Acanthocolpus</i> Luhe, 1906	<i>Lethrinus nebulosus</i>	14.3	1-4	1.8
	<i>Lethrinus mahsena</i>	11.3	1-4	1.9
	<i>Lutianus fulviflamma</i>	8.8	1-4	2.7
	<i>Balistes aculeatus</i>	4.5	8	8.0
	<i>Epinephelus chlorostigma</i>	4.0	1	1.0
	<i>Argyrops spinifer</i>	16.7	2	2.0
Genus <i>Tormopsolus</i> Poche, 1926	<i>Lethrinus mehseoides</i>	20.0	2	2.0
	<i>Lethrinus nebulosus</i>	8.6	1-6	4.3
	<i>Lutianus fulviflamma</i>	5.9	2	2.0
	<i>Lethrinus mahsena</i>	5.7	1-2	1.4
	<i>Epinephelus chlorostigma</i>	4.0	1	1.0
	<i>Lethrinus miniatus</i>	2.4	2	2.0
b. Subfamily Stephanostominae Yamaguti, 1958				
Genus <i>Stephanostomum</i> Looss, 1899	<i>Lutianus fulviflamma</i>	5.9	1-4	2.5
	<i>Lethrinus mahsena</i>	4.0	1-3	1.8
	<i>Lethrinus miniatus</i>	2.4	1	1.0

Cont. Table 3

Tramatodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
8. Family Lepocreadiidae(Odhner, 1905) Nicoll, 1935				
a. Subfamily Lepocreadiinae Odhner, 1905 Genus <i>Pseudocreadium</i> Layman, 1930	<i>Acanthurus sohal</i>	25.0	10	10.0
b. Subfamily Dihemistephaninae Yamaguti, 1971 Genus <i>Dihemistephanus</i> Looss, 1901	<i>Lethrinus mahsena</i> <i>Lutianus fulviflamma</i>	4.8 2.9	1-3 1	1.8 1.0
c. Subfamily Folliorchiinae Yamaguti, 1954 Genus <i>Rhagorchis</i> Manter, 1931	<i>Pseudoscarus harid</i>	15.8	2-7	3.0
d. Subfamily Lepidapedinae Yamaguti, 1958 Genus <i>Lepidapedon</i> Stafford, 1904	<i>Upeneus vittatus</i>	3.8	1-3	2.0
9. Family Opecoelidae Ozaki, 1925				
a. Subfamily Opecoelinae Stunkard, 1931 Genus <i>Opecoelus</i> Ozaki, 1925	<i>Mulloidichthyes auriflamma</i> <i>Upeneus vittatus</i> <i>Pseudopeneus pleurospilos</i> <i>Pseudoscarus harid</i> <i>Epinephelus chlorostigma</i>	57.1 54.7 42.9 5.3 4.0	1-6 1-25 1-7 1 2	2.5 6.5 3.3 1.0 2.0
Genus <i>Proenenterum</i> Manter, 1954	<i>Atherina forskalii</i> <i>Pagurus haffara</i> <i>Holocentrus sammara</i> <i>Synodus variegatus</i> <i>Sparus nockt</i>	13.8 9.1 4.8 3.1 3.1	1-7 1 2 2 1	3.5 1.0 2.0 2.0 1.0

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Cont. Table 3

Trematodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
b. Subfamily Plagioporinae Manter, 1947 Genus <i>Plagioporus</i> Stafford, 1904	<i>Variola louti</i>	100	1	1.0
	<i>Anampses caeruleopunctatus</i>	20.6	1-46	9.1
	<i>Lethrinus miniatus</i>	19.5	1	1.5
	<i>Pagurus haffara</i>	13.6	1-2	1.3
	<i>Balistes aculeatus</i>	9.1	1-20	14.5
	<i>Lethrinus nebulosus</i>	8.6	2-6	3.7
	<i>Pseudoscarus harid</i>	5.3	1	1.0
	<i>Gerres oyena</i>	5.0	1	1.0
	<i>Acanthopagurus bifasciatus</i>	3.0	3	3.0
	Genus <i>Hamacreadium</i> Linton, 1910	<i>Epinephelus summana</i>	61.5	1-13
<i>Balistes aculeatus</i>		59.1	1-6	2.0
<i>Plectropomus maculatus</i>		50.0	5	5.0
<i>Argyrops spinifer</i>		50.0	2-5	3.5
<i>Lethrinus nebulosus</i>		37.1	1-6	2.5
<i>Epinephelus chlorostigma</i>		24.0	1-5	2.5
<i>Lethrinus mahsenoides</i>		20.0	5	5.0
<i>Holcentrus sammara</i>		19.1	1-6	2.0
<i>Lethrinus mahsena</i>		17.7	1-10	2.4
<i>Anampses caeruleopunctatus</i>		15.7	1-18	6.4
<i>Scarus bicolor</i>		12.5	1	1.0
<i>Lutianus fulviflamma</i>		11.8	3.5	3.8
<i>Synodus variegatus</i>		6.3	2-6	4.0
<i>Lethrinus miniatus</i>		3.8	1	1.0
<i>Upeneus vittatus</i>	3.8	1-2	1.5	

Cont. Table 3

Tramatores	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
Genus <i>Helicometra</i> Odhner, 1902	<i>Scarus bicolor</i>	12.5	1	1.0
	<i>Anampses caeruleopunctatus</i>	10.8	1-35	7.2
	<i>Epinephelus summana</i>	7.7	3	3.0
	<i>Holocentrus sammara</i>	4.8	1-3	2.0
	<i>Upeneus vittatus</i>	1.9	2	2.0
	<i>Balistes aculeatus</i>	16.6	2	2.0
Genus <i>Pedunculoacetabulum</i> Yamaguti, 1934	<i>Priacanthus arenatus</i>	100	1-7	3.1
	<i>Atherina forskalii</i>	1.7	1	1.0
Genus <i>Podocotyle</i> (Dujardin, 1845)	<i>Epinephelus summana</i>	15.4	1	1.0
	<i>Epinephelus chlorostigma</i>	12.0	2-7	4.0
	<i>Acanthopagurus bifasciatus</i>	6.1	1-3	2.0
	<i>Sparus nockt</i>	3.1	1	1.0
	<i>Lethrinus nebulosus</i>	2.9	2	2.0
	<i>Lethrinus mahsena</i>	1.6	2	2.0
	<i>Anampses caeruleopunctatus</i>	1.0	8	8.0
c. Subfamily Sphaerostomatinae Poche, 1926				
Genus <i>Pseudoplagiopus</i> Yamaguti, 1938	<i>Epinephelus diacanthus</i>	100	7	7.0
	<i>Lethrinus mahsenoides</i>	20	1	1.0
	<i>Lethrinus nebulosus</i>	11.4	1-2	1.5
	<i>Lethrinus mahsena</i>	5.7	1-4	2.3
	<i>Anampses caeruleopunctatus</i>	2.0	4-10	7.0
10. Family Schistorchiidae Yamaguti, 1942				
Genus <i>Schistorchis</i> Luhe, 1906	<i>Hemirhamphus marginatus</i>	22.2	9-33	21.0
	<i>Pagurus haffara</i>	4.5	3	3.0

Cont. Table 3

Trematodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
11. Family Bucephalidae Poche, 1907 Subfamily Bucephalinae Nicoll, 1914 Genus <i>Bucephalus</i> Baer, 1826 b. Subfamily Proisorhynchinae Nicoll, 1914 Genus <i>Bucephalopsis</i> (Diesing, 1855)	<i>Pseudopeneus pleurospilos</i>	14.3	1	1.0
	<i>Epinephelus chlorostigma</i>	8.0	5	5.0
	<i>Pseudopeneus pleurospilos</i>	14.3	3	3.0
	<i>Pseudoscarus harid</i>	5.3	2	2.0
	<i>Lethrinus miniatus</i>	2.4	1	1.0
	<i>Anampses caeruleopunctatus</i>	2.9	1-6	3.0
	<i>Upeneus vittatus</i>	1.9	2	2.0
	<i>Lethrinus mahsena</i>	0.8	1	1.0
12. Family Cryptogonimidae (Ward, 1917) Cirurea, 1933 a. Subfamily Metadeninae Yamaguti, 1958 Genus <i>Metadena</i> Linton, 1910 b. Subfamily Neochasminae Van Cleave and Mueller, 1932 Genus <i>Paracryptogonimus</i> Yamaguti, 1934	<i>Lutianus bohar</i>	66.7	4-48	26.0
	<i>Anampses caeruleopunctatus</i>	1.0	2	2.0
	<i>Lutianus fulviflamma</i>	8.8	1-3	2.0
13. Family Hemiuridae Lühe, 1901 a. Subfamily Dinurinae Looss, 1907 Genus <i>Tubulovesicula</i> Yamaguti, 1934	<i>Synodus variegatus</i>	6.3	1	1.0
	<i>Epinephelus chlorostigma</i>	4.0	1	1.0
	<i>Upeneus vittatus</i>	3.8	1-2	1.5
	<i>Lutianus fulviflamma</i>	2.9	3	3.0

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Cont. Table 3

Tramatodes	Hosts	Infections			
		Incidence %	No. of Worms per Fish		
			Range	Mean	
b. Subfamily Hysteroleucithinae Yamaguti, 1958 Genus <i>Aponurus</i> Looss, 1907	<i>Mulloidichthys auriflamma</i>	14.3	1	1.0	
	<i>Atherina forskalii</i>	3.5	1-2	1.5	
	<i>Upeneus vittatus</i>	1.9	1	1.0	
c. Subfamily Lecithasterinae Odhner, 1905 Genus <i>Lecithaster</i> Luhe, 1901	<i>Acanthurus sohal</i>	50.0	1-13	7.0	
	<i>Atherina forskalii</i>	20.7	1-2	1.5	
	<i>Sparus nockt</i>	3.1	1	1.0	
	<i>Lethrinus mahsena</i>	0.8	1	1.0	
	Genus <i>Aphanurus</i> Looss, 1907	<i>Sparus nockt</i>	3.1	3	3.0
	Genus <i>Dichadena</i> Linton, 1910	<i>Epinephelus dicanthus</i>	100	1	1.0
<i>Variola louti</i>		100	1	1.0	
<i>Lutianus fulviflamma</i>		67.6	1-7	3.5	
<i>Scarus bicolor</i>		25.0	1	1.0	
<i>Argyrops spinifer</i>		16.7	1	1.0	
<i>Platax pinnatus</i>		12.5	2	2.0	
<i>Lethrinus miniatus</i>		12.2	1-3	1.2	
<i>Synodus variegatus</i>		6.3	1-2	1.5	
<i>Epinephelus chlorostigma</i>		4.0	1	1.0	
<i>Anampses caeruleopunctatus</i>		2.0	1	1.0	
Genus <i>Macradena</i> Linton, 1910	<i>Mulloidichthys auriflamma</i>	28.6	1	1.0	
	<i>Upeneus vittatus</i>	13.2	1-5	3.0	
	<i>Synodus variegatus</i>	6.3	1-6	3.5	

Cont. Table 3

Trematodes	Hosts	Infections		
		Incidence %	No. of Worms per Fish	
			Range	Mean
Genus <i>Mitrostoma</i> Manter, 1954	<i>Lethrinus miniatus</i>	6.2	1	1.0
d. Subfamily Lecithophyllinae Skrjabin and Guschanskaja, 1954 Genus <i>Lecithophyllum</i> Odhner, 1905	<i>Synodus variegatus</i>	3.1	1	1.0
	<i>Synodus variegatus</i>	9.4	1-8	3.7
	<i>Acanthopagurus bifasciatus</i>	3.0	1	1.0
	<i>Lutianus fulviflamma</i>	2.9	1	1.0
	<i>Holocentrus sammara</i>	2.4	1	1.0
	<i>Atherina forskalii</i>	1.7	1	1.0
	<i>Lethrinus mahsena</i>	1.6	1-2	1.5
	<i>Anampses caeruleopunctatus</i>	1.0	2	2.0
e. Subfamily Macradeninae Skrjabin and Guschanskaja, 1954 Genus <i>Macradenina</i> Manter, 1947	<i>Synodus variegatus</i>	6.3	1	1.0

2. Correlation between The Incidence of Trematodes Genera and the Intensity of Infection.

In some cases there is a significant correlation between the incidence of trematodes genera in fish and the intensity of infection with these parasites in their hosts and this can be taken as an indication of a certain aspect of host specificity. In these cases, the highest incidence of a trematodes genus in a fish species was correlated with the heaviest worm load in that fish. The genus *Gyliaunchen*, for example, was recorded in four species of fish, the highest incidence (85.7%) was in *Acanthurus lurida*, while its incidence was much lower in *Acanthurus oramen*, *Balistes aculeatus* and *Anampses caeruleopunctatus* being 10.5, 4.0 and 2.0% respectively. It was significant to note that the highest incidence of this trematode genus in *Acanthurus lurida* was correlated with the highest intensity of infection in this species of fish (68.8 worms per fish) compared with the other three species being 21.0, 4.0 and 4.5 worms per fish respectively. Another example was *Brachyenteron* whose incidence was highest (100.0%) in *Platax pinnatus* and lowest in *Pagurus haffara* (4.5%). The corresponding intensities of infections were 24.2 per fish in *P. pinnatus* and only 2.0 per fish in *P. haffara*. Similarly, *Metadena* occurred more frequently in *Lutianus bohar* (66.7%) and very rarely in *Anampses caeruleopunctatus* (1.0%); the corresponding intensities of infection were 26.0 worms per fish in the former and 2.0 worms per fish in the latter. It is the opinion of the present authors that taking into consideration the population strength of these fish species, it may be possible to assume that populations of fish with the highest incidence of infection with a certain trematodes genus associated with the highest intensity of infection are the most important hosts in the maintenance of the life cycle of these parasites, while other species of fish play a less important role in the maintenance of these parasites in nature.

3. Trematode Infections in Related Hosts

It has been always assumed that related hosts are infected with related parasites (11). The validity of this assumption has been tested in fish families Lethrinidae and Sparidae from which fairly large numbers of the various species have been examined, thus making plausible conclusions possible. Tables (4) and (5) show a comparison between the incidence of trematode genera in species of fish belonging to the two families.

It is clear from Table (4) that although 14 genera of trematodes are recorded from three species of fish belonging to family Lethrinidae yet only two genera, viz. *Hamacreadium* and *Tormopsolus* are present in all the three species, while the other 12 genera are found in one or two species of fish. Moreover, if the infections with trematode genera are arranged in the order of their incidence, a distinct picture is obtained in each species of fish as follows:

Table 4
Infections with Trematode Genera in Family Lethrinidae*

Trematode Genera \ Fish Hosts	<i>Lethrinus miniatus</i>	<i>Lethrinus nebulosus</i>	<i>Lethrinus mahsena</i>
<i>Plagioporus</i>	**+(19.5%)	+ (8.6%)	***—
<i>Dichadena</i>	+(12.2%)	—	—
<i>Mitrostoma</i>	+(6.2%)	—	—
<i>Hamacreadium</i>	+(4.9%)	+(37.1%)	+(17.7%)
<i>Tormopsolus</i>	+(2.4%)	+(8.6%)	+(5.7%)
<i>Stephanostomum</i>	+(2.4%)	—	+(4.0%)
<i>Bucephalopsis</i>	+(2.4%)	—	+(0.8%)
<i>Acanthocolpus</i>	—	+(14.3%)	+(11.3%)
<i>Pseudoplagioporus</i>	—	+(11.4%)	+(5.7%)
<i>Podocotyle</i>	—	+(2.9%)	+(1.6%)
<i>Dihemistephanus</i>	—	—	+(4.8%)
<i>Lecithophyllum</i>	—	—	+(1.6%)
<i>Leptobulbus</i>	—	—	+(0.8%)
<i>Lecithaster</i>	—	—	+(0.8%)

a. *Lethrinus miniatus*:

Plagioporus > *Dichadena* > *Mitrostoma* > *Hamacreadium* >
Tormopsolus = *Stephanostomum* = *Bucephalopsis*.

b. *Lethrinus nebulosus*:

Hamacreadium > *Acanthocolpus* > *Pseudoplagioporus* >
Plagioporus = *Tormopsolus* > *Podocotyle*.

**Lethrinus mahsenoides* is excluded since only few specimens have been examined.

**+ This symbol indicates that the genus is recorded in the corresponding fish species. The incidence is included between brackets.

***— This symbol indicates that the trematode is not recorded in the fish.

c. *Lethrinus mahsena*:

Hamacreadium > *Acanthocolpus* > *Tormopsolus* = *Pseudoplagioporos* > *Dihemistephanus* > *Stephanostomum* > *Podocotyle* = *Lecithophyllum* > *Bucephalopsis* = *Leptobulbus* = *Lecithaster*.

In family Sparidae, 12 genera of trematodes are recorded from these species of fish (Table 5). None of the trematode genera is common to the three species. Only three trematode genera (*Plagioporos*, *Proenenterum* and *Podocotyle*) are present in two species; while the other 9 trematodes occur in one of the three species of fish. When the infections with trematode genera are arranged in the order of their incidence, a distinct picture is obtained in each species of fish as follows:

Table 5
Infections with Trematode Genera in Family Sparidae*

Trematode Genera \ Fish Hosts	<i>Acanthopagurus bifasciatus</i>	<i>Pagurus haffara</i>	<i>Sparus nokt</i>
<i>Boultaisaccus</i>	**+(9.1%)	***—	—
<i>Podocotyle</i>	+(6.1%)	—	+(3.1%)
<i>Plagioporos</i>	+(3.0%)	+(13.6%)	—
<i>Lecithophyllum</i>	+(3.0%)	—	—
<i>Proenenterum</i>	—	+(9.1%)	+(3.1%)
<i>Leptobulbus</i>	—	+(4.5%)	—
<i>Genolopa</i>	—	+(4.5%)	—
<i>Brachyenteron</i>	—	+(4.5%)	—
<i>Megacreadium</i>	—	+(4.5%)	—
<i>Aphanurus</i>	—	—	+(3.1%)
<i>Lasiotocus</i>	—	—	+(3.1%)
<i>Leciaster</i>	—	—	+(3.1%)

**Argyrops spinifer* is excluded since only few specimens have been examined.

**+ This symbol indicates that the genus is present in the corresponding fish species. The incidence is included between brackets.

***— This symbol indicates that the trematode is not recorded in the fish.

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a. *Acanthopagurus bifasciatus*:

Botulisaccus > *Podocotyle* > *Plagioporus* = *Lecithophyllum*.

b. *Pagurus haffara*:

Plagioporus > *Proenenterum* > *Leptobulbus* = *Genolopa* = *Brachyenteron* = *Megacreadium*.

c. *Sparus nockt*:

Podocotyle = *Proenenterum* = *Aphanurus* = *Lasiotocus* = *Lecithaster*.

The above pattern indicates that although host specificity may not be a marked feature of trematode infections in fish, yet there is a definite preference of a certain genus of trematodes to parasitize a particular species of hosts more than the others. A similar pattern was recognised in trematode infections of bats (12).

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وقد عرض المؤلفان ظاهرة تحديد العائل في أسماك البحر الأحمر المصابة بالديدان الطفيلية ، كما تمت مناقشة العلاقة بين نسب وكثافة الاصابة في أنواع الأسماك المختلفة ، وكذلك الاصابات الطفيلية في الأسماك التي تتبع أنواعاً متقاربة في وضعها التصنيفي .

دراسات على التريماتودات ثنائية العائل في بعض أسماك البحر الأحمر

(١) تقص عام

محمد فتحي عبد الفتاح سعود ، مصطفى محمود رمضان

تمت الدراسة الحالية لحصر أجناس الديدان الطفيلية من التريماتودات ثنائية العائل في بعض أنواع الأسماك الشائعة في البحر الأحمر . وقد فحصت ٨١٢ عينة من الأسماك تتبع ثلاثة وثلاثين نوعاً ، وسجلت الإصابات الطفيلية في كل أنواع الأسماك التي فحصت ، وتبين أن نسب الإصابة بالديدان الطفيلية تختلف في فصائل الأسماك المختلفة ، فاقل نسب الإصابة (٥٪) سجل في فصيلة الجريدي ، وأعلاها (١٠٠٪) سجل في أنواع الأسماك التابعة لفصيلة بلاتاسيدي وبريكانثيدي .

وقد اتضح من تحليل نتائج الدراسة الحالية أن نسب الإصابة كانت أعلى في الذكور منها في الإناث من فصائل سينودونثيدي وسباريدي ولا بريدي وباليسيتيدي وبلاتاسيدي ، بينما كانت نسب الإصابة متساوية تقريباً في الذكور والإناث من فصيلة سكاريدي وبريكانثيدي ، أما في باقي الفصائل فكانت نسب الإصابة أعلى في الإناث منها في الذكور .

وفي ستة أنواع من الأسماك سجل جنس واحد من الطفيليات ، ومن أربعة أنواع من الأسماك سجل جنسان من التريماتودا ومن ستة أنواع أخرى من الأسماك سجلت ثلاثة أجناس من الطفيليات ، أما السبعة عشر نوعاً الباقية من الأسماك فقد سجل في كل منها عدد يتراوح بين ٤ - ١٤ جنساً من الطفيليات .