A REVIEW ON HOST-PARASITE RELATIONSHIPS OF MARINE FISH HELMINTHES

By

Dayhoum A. M. Al-Bassel
Department of Zoology, Faculty of Science,
Cairo University, Fayoum Branch

2000

INTRODUCTION

Several phyla belonging to the animal kingdom are parasitic on fish. The number of species of fish parasites is measured in thousands and many more remain to be discovered. Helminth parasites and marine fishes are engaged in a continuous battle to take advantage of each other. Helminth parasites attempt to gain entrance into a fish and utilize its resources, and their fishes - inturn- attempt to prevent infection, get rid of the invaders or limit the damage done by them. Mechanisms employed by the fishes for this purpose are behavioural, or they are immunity and tissue reactions. In Egypt, the study of the helminth parasites of marine fish has received a good deal of attention from parasitologists such as Saoud and Hassan (1983), Saoud and Ramadan (1983), Saoud et al (1990), Al-Bassel (1990) and Al-Bassel (1997).

In a real sense the fish is the environment of the parasite, especially of internal ones. The physical and chemical conditions surrounding the parasite are those of the host s body its food is that of the host or the host s body itself, its shelter is the body of the host, and it depends on the host for transport. Where there is more than one host species in the life cycle, one host may be the means of transferal to another one.

(1) Parasitism and other associations:

Parasitism is a close association between two organisms, one of which, the parasite, depends on the other, the host, deriving some benefit from it without necessarily damaging it. A parasite is usually smaller than its host (Rohde, 1993).

Types of associations, which are related to parasitism, are phoresis, commensalism, mutualism, symbiosis and predation. Caullary (1952) discussed such associations in the marine environment. In phoresis (phoresy), one organism uses another as a means of transport without establishing a close association. In commensalism, one organism uses food supplied in the external or internal environment of a host (e.g the lumen of its intestine) without affecting it in any way. In mutulism, two organisms live together and each of them derives a benefit from the association, however the association is not compulsory. In symbiosis, two organisms derive benefit from the association, and they cannot live without each other. In a wider sense, the term symbiosis is sometimes used to describe all kinds of associations between organisms, including parasitism. In perdition, one organism, usually the larger one, kills and eats another.

However, strict borderlines cannot be drown between the various types of associations. For instance, a parasite may become a predator by killing its host, or it may be of some benefit to the host species, that is the relationship may become mutualistic. A commensal may affect host and some-times damage it and thus become a parasitic.

Intraspecific parasitism is an association of two individuals of the same species, for instance a male parasitizing a female of its own species. Latent parasitism is parasitism which has no obvious effects on the host.

(2) Types of parasites and hosts:

There are different types of parasites can be distinguished. An obligatory parasite is a parasite which cannot survive without its host. A facultative parasite is a parasite for which a host is optional. Ectoparasites live on the surface of the host, while endoparasites live in its interior. A permanent parasite is a parasite which is associated with a host for prolonged periods. A temporary parasites lives in or on a host only for short periods. Larval parasites are those parasites which are parasitic during one or several larval stages. Adult parasites live on or in a host during part or the whole of their mature phase. Periodic parasites visit their hosts at intervals. A hyperparasite is a parasite on or in anther parasite, and there may be hyperparasites of the first, second, third or even fourth degree.

There are different types of hosts, intermediate, definitive or final, paratenic and vectors. The intermediate host is a host which harbours the developing but sexually immature or larval stage of a parasite. The definitive or final host is a host which horbours the sexually mature parasite. The paratenic or transport host is a host which serves for dispersing the parasite species, but in which there is no development of the parasite. The vector is a very wide term which applies to hosts which carry an infective stage of a parasite.

THE TYPES OF MARINE FISH HELMINTHES

1- PLATYHELMINTHES:

a) Turbellaria:

cannon and Lester (1988) described two turbellarians encysted in the skin or gills of marine fishes and provided a list of Turbellaria recorded from vertebrate hosts.

b) Aspidogastrea:

The small group Aspidogastrea characterized by having a simple life cycle and a large ventral adhesive disk with numerous alveoli or a row of suckers.

Rohde (1973)described the life cycle of *Lobatostoma manteri* (Aspidogastrea) from marine fish *Trachinotus blochi* from the Great Barrier Reef.

c) Digenea:

Degenea are the much larger trematode group which typically have two suckers and complex life cycle.

Most Digenea are endoparasitic in the digestive tract and in various organs of marine fishes, but some species are ectoparasitic. *Transversotrema* (Digenitic trematode) lives under the scales of marine fishes. Marine fishes often harbour the metacercarial stage of trematodes, but these stages may sometimes be progenetic, that is have fully developed reproductive organs and produce sperm and eggs.

d) Monogenea:

Most monogenea are ectoparasites of fish and frequently of marine fish. They commonly live on the gills, skin or fins.

Attachment is by hooks, clamps, suckers, friction and surface spines. The genus *Gotocotyla* infect gills of various marine fishes (Rohde, 1993).

e) <u>Cestoda</u>:

Sakanari and Moser (1989) redescribed the life cycle of *Lacistorhynchus dollfusi* (Trypanorhyncha) from the spiral valves of sharks *Triakis semifasciata* (marine fish) experimentally.

2- NEMATODA:

Many of Nematodes parasites in marine fishes. The life cycle of *Thynnascaris aduncum* (Nematoda) was redescribed from marine fishes (Rohde, 1993).

3- ACANTHOCEPHALA:

Tadros et al (1979) described two immature female of *Serrasentis sidaros* (Acanthocephala) from a Red Sea fish *Saurus tumbil* out of 20.

4- HIRUDINEA:

Khan (1982) described the biology of *Johanssonia arctica* (Hirudinea). This species feed on the blood of various marine fishes and deposits its egg, cocoons on a crab.

ADAPTATION OF HELMINTHS FOR INFETION

Jennings and Calow (1975) reported that free living flatworms have a high energy content but produce few eggs, although ectocommensal flatworms have a slightly lesser energy content and produce rather more eggs. Moreover ectoparasitic flatworms are even poorer energy and produce even more eggs, and endoparasitic flatworms (Trematodes and cestodes) are producing very large numbers of eggs and containing little energy. In addition the number of offspring is increased by parthenogenetic or asexual multiplication of the larvae, for overcome the hazards implicit in the life cycle which depend on finding a host.

Other adaptation is dispersal, which more important for survival of any species because the population of helminth parasites is restricted to one small area risks becoming extinct, if conditions become unfavorable, and because dispersal reduces inbreeding and the loss of evolutionary adaptability. It also prevents over infection of hosts. For example, several handred crecariae of *Bucephaloides gracilescens*, which are not active swimmers, are forcibly discharged at the same time by their mollusc host *Abra abra*. This assists in their dispersal but it probably also enhances the chances of coming into contact with their next hosts, marine fishes. Sometimes dispersal depends entirely on the host (Mothews, 1974).

Survival of helminth parasites depends on their success in infecting the right hosts. Infection takes place by contact transfer, ingestion of paratenic hosts which carry infective larvae or by ingestion of eggs or by free living larvae. For example, *Entobdella soleae* (monogenea) adult and Juneniles of which can move from one host marine fish to another, at least in aquaria (Rohde, 1993). Sometimes, chances of infecting a host are enhanced by host behavior. For example, the monogeneus *Gastrocotyle trachuri* infect their host *Trachurns trachurus* (marine fish) near the Sea bottom. In summer, the fish disappear from the sea bottom to feed on plankeon. The parasites have adapted themselves to this by ceasing to produce larvae in anticipation of the summer migration (Llewellyn, 1962).

HOST-PARASITE INTERACTIONS

Marine fishes employ various behavioural method to free themselves of ectoparasites for example fish may Jump out of the water, dive rapidly or swim erratically, apparently to remove ectoparasites (Rohde, 1993).

Rohde (1984) briefly discussed the three aspects, host parasite environment, in relation to helminth infections of marine fishes. Hosts respond to infection by immune and tissue reactions, and parasites may affect hosts in four ways, that is by mechanical action, withdrawal of substances toxic effects and facilitation of entrance of pathogenic microorganisms.

In Egypt, many studies carried out on the host-parasite relationships of marine fish helminthes from the inland lakes, Red Sea and Mediterranean Sea. Moravec and Libosvarsky (1975) (Table1) reported that, a total of 31 *Mugil cephalus* and 49 *M. capito* examined were collected from lake Borullus, 20 specimens of *M. capito* caught from the adjacent coastal waters of the Mediterranean Sea were examined for comparison. The results revealed that no qualitative differences in the parasite fauna of *M. capito* from Lake Borullus and from the Mediterranean Sea. However, the differences in the incidence and intensity of infection with the trematodes *Haplosplanchnus pachysoma* and *Saccocoelium obesum* suggest that the fishes acquire these parasites in the sea and lose them gradually after migration into the lake.

Other studies in Egypt carried out by Tadros et al (1979) on the intestinal cestodes of marine fishes *Saurus tumbil* from the Red Sea. The results revealed that the incidence of infection 10% with *Serrasentis sidaros zakiae* (Acanthocephala). Histopathological examination of the intestine of marine fishes infected revealed that shortening and thickening of the villi at the site of attachment of the worm.

Saoud and Hassan (1983) studies the helminth parasites of some elasmobrachs from the Egyptian coastal waters of the Mediterranean and the Red Sea (Table. 2). The results revealed as follows: 1151 elasmobranchs belonging to, three suborders, five families, six genera and seven species were examined. 410 fish were found positive for helminth parasites of which 289 were positive for cestodes only, 38 harboured nematodes only, and 83 had double infections of both cestodes and nematodes. No trematodes, however, were found in any of the examined elasmobranchs. Thus, infections with cestodes were much more frequent than with nematodes. Helminth parasites were found in *Rhinobattus geanulatus, Taeniura lymma, Dasyatis uarnak, D. sephen* and *Raja circularis,* their incidence 39.49%, 67.10%, 37.83%, 45.71% and 31.81% respectively. There are no helminth infections recorded in *Aetobattus narinari* and *Torpedo panthera.* The highest incidence of pure cestode infection, 55.26%, in *Taeniura lymma,* and the lowest 13.64% in *Raja circularis*. Pure infections with nematodes were reported in *Rhinobattus granulatus, Dasyatis sephen* and *Raja* *circularis,* with incidence 5.08%, 17.14%, and 6.06% respectively. Double infections with both cestodes and nematodes were reported in the infected five species of fish, with incidence varying from 6.93% - 12.12%. It might be worthmentioning that nematodes were found in both *Toeniura lymma* and *Dasyatis uarmak* only in the presence of cestodes in double infections. Seven genera of cestodes were reported from the fish positive. The genus *Acantobothrium* reported from *Rhinobothus granulatus* and *Dasyatis sephen,* their incidence 96.26% and 100% respectively. The genus *Anthobothrium* reported from *Taeniura lymma* and *Dasyatis uarnak their incidence 19.6%* and 37.84% respectively. The genus *Rhinebothrium* reported only from *Dasyatis uarnak* their incidence 62.16%, while the genus *Echinobothrium* reported from *Rhinobattus granulattus* and *Taeniura lymma,* their incidence 3.74% and 27.22% respectively. The two genera *Tetragonocephalum* and *Polypocephalum* reported from *Taeniura lymma* their incidence 19.79% and 35.37% respectively, while the genus *Discobothrium* reported from *Raga circularis* only their incidence 100%. The intensity of cestode infections in fish was generally low and varied slightly in different fish hosts from 5-9.15 cestodes/fish. From Saoud and studies we nots that the combinations of cestode genera includes single, double and triple infections. In *Rhinobatus granulatus* single infections are much more common than double infections. However, in *Taeniura lymma* and *Dasyatis* uarnak, single infections are less common than both double and triple infections. They also studies the effect of host sex on the intensity of infections and revealed that the intensity of infections is more common in male than female. Finally

Saoud and Hassan's studies revealed that the smaller fish harboured lower worm loads, while large fish had higher worm loads.

Other studies in Egypt, carried out by, Soaud and Ramadan (1983) on digenetic trematodes of some Red Sea fishes (Table 2). These studies summarized as follows:

812 Red Sea fish, belonging to 33 species, 24 genera and 16 families were examined for digenetic trematodes. The results revealed that, all fishes 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. The infections are more common in female than male. The highest incidence (100%) is recorded in female fishes, *Priacanthus arenatus, Hemirhamphus marginatus, Acanthurus lurido, Mulloidichthys auriflamma* and *Lethrinus mahsenoides* and in male fishes *Priacanthus arenetvs, Platax pinnatus, Argyrops spinifer, Variola louti* and *Epinephelus diacanthus*. The lowest incidence (7.1%) is recorded in female fish *Gerres oyena.*

6 species of fish harboured one genus of trematodes, 4 species of fish had 2 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. 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. For example the genus *Dichadena* was reported from 10 species of fish while the genus *Hamacreadium* was found in 15 species of fish. On the other hand each of the nine trematode genera *Benthotrema, Pseudocreadium, Rhagorchis,*

Lepidapedon, *Schistorchis*, *Megacreadium*, *Paracryptogonimus*, *Aphanurus* and *Macradenina* were reported only in one species of fish (Host specificity).

There are correlation between the incidence of trematode genera and the intensity of infection, for example the highest incidence of trematode genus *Brachyenteron* (100%) was recorded in *Platax pinnatus* and the lowest (4.5%) in *Pagurus haffara*. The corresponding intensities of infections were 24.2 per fish in *P. pinnatus* and only 2.0 per fish in *P. haffara*.

Moreover, in Egypt Saoud et al (1990) (Table. 1) reported digenetic trematodes from *Mugil spp*. Caught from high saline water of lake Qarun at Fayoum Governorate. It is worth mentioning that *Mugil spp*. Were transferred to the lake Qarun from the Mediterranean Sea. Six genera of digenetic trematodes were recorded in *Mugil spp*. Caught from lake Qarun. It is interesting to note that all these genera of trematodes are known from mullets in the Mediterranean Sea. Moravec and Libosvarsky (1975) outlined that the mullet lose gradually their intestinal trematodes after migration from the Mediterranean Sea into the lake Borullus in Egypt. It is worth mentioning that, lake Qarun is closed and have salinity more than the opened lake Borullus. The incidence of infection is highest in *Mugil capito* and lowest in *Mugil cephalus*, with that of *M. chelo* in between. The genera *Saccocoelium*, *Haploporus* and *Haplosplanchnus* follow a similar pattern in 3 mullet *Mugil cephalus*, *M. capito* and *M. chelo*. In *Mugil cephalus and M. capito* no single or double infections with trematode genera were reported. However, combinations of simultaneous triple and quadruple infections were present, while in *Mugil saliens* only single infections with the trematode genus *Haplosplanchnus* were encountered. It has been always assumed that related hosts are infected with related members of the parasitocoenosis (Dogiel, 1962). The validity of this assumption has been verified in certain species of fish from the red Sea (Saoud and Ramadan, 1983). The above mentioned qualitative similarities between the parasitocoenosis of three species of *Mugil* from Lake Qarun is also another proof of the validity of this assumption.

Al-Bassel (1990) (Table 1) reported trematodes and nematodes parasites from *Mugil spp. and Morone labrax* respectively, these fishes collected from Lake Qarun and Lake Edku respectively in Egypt. The incidence of infections with trematodes in *Mugil cephalus* are (65.33%) and (82%) from Lake Qarun and Lake Edku respectively, while the incidence in *M. capito* (72%) and (86%) from Lake Qarun an Lake Edku respectively. The incidence of infections with trematodes (56%) and nematodes (2%) in *Morone labrax* from Lake Edku. From the above, the incidence of infections with trematodes in *Mugil* spp *(Mugil cephalus* and *M. capito)* from Lake Edku is higher than that from Lake Qarun, and the incidence in *Mugil capito* is higher than that in *Mugil cephalus.* He also reported that the highest incidence with trematodes in the two *Mugil spp.* from Lake Qarun in spring and the lowest in Autumn with that in winter in between. There are no single infection with one genus of trematodes is recorded in *Mugil spp.* from both lakes. There are no quadruple infections with trematodes recorded in *mugil cephalus* from both lakes. On the other hand, double, triple, and quadruple infections are recorded in *Mugil capito* from both lakes, while, double and triple infections are recorded in *Mugil cephalus* from both lakes. This study is considered another proof of the validity of parasitocoensis

Other studies on the parasites and diseases of mullets reported by Paperna and Overstreet (1981) some monogenea such as *Benedenia monticelli* infests gills of mullets from the Gulfs of Elat and Suez in the Red Sea. In the northern gulfs of the Red Sea, it infests *Liza carinata* and other mullets and normally attach to the oral mucosa. In fish with typical infections, the lips and oral mucosa display signs of irritation with extensive submucosol hemorrhaging. Death of fish resulting from infestations of *B. monticelli* also occur naturally in the Gulf of Suez.

Mullets act as intermediate hosts for numerous digenetic trematodes and as final hosts for over 200 species of flukes. Mullets have been exemplified as ecological bridges spreading haploporids termatode from marine to fresh-water hosts (Manter, 1957). Adult trematodes probably minimally harm mullets in natural habitats, but become harmful in fish farms.

Mullets act as intermediate hosts of *Heterophyes heterophyes* in the east in Mediterranean waters. As with most helminth infections with digeneans debilitate young fish much more readily than their adult counter parts. The intensity of metacecarriae of *H. heterophyes* from the muscles of *Mugil capito* in the Bordawil lagoon about 6000 cysts/g of muscle tissue (Paperna, 1975).

Mullets, usually not infected with adult tapeworms, but act as intermediate and paratenic hosts of several plerocercoid larvae. The only known adult cestodes, *Gyrometra, mngilitaenia* described from the body cavity of *Mugil sp.* from a fish market at Pakistan by Parveen (1971). The helminth parasitic fauna of marine fish such as mullet undergoes a dynamic change in relationship to many different variables. One variable often considered is age of host. Changes in the parasitofauna correspond with new diets and new habitats. The most profound change accurs when young fish discontinue feeding on plankton in offshore waters. The fish migrate to coastal areas and gradually enter inland waters. During this period, they gradually lose larval parasites, tetraphyllidean cestodes, nematodes and trematode larvae. These parasites are replaced by different ones originating from the new habitat.

The alterations in the parasitic composition begin in mullet of 15-20mm long, their size upon arriving in coastal waters. The change is mostly completed by a month or two when the fish reach 50-70mm in length. Those sizes especially characterize mullet entering estuarine and inland waters. Once mullet leave the open Sea, they acquire new infections.

Blood fluke infections in marine fish can cause mortalities. *Cardicola davisi* infects the gill blood vessels of *Salmo clarki* and damages their gills. Developing miracidia caused a degeneration in gill tissues and often heavy mortality among infected fingerlings (Davis et al, 1961). Adults of the blood fluke *Pearsonellum corventum* in the heart of *Plectropomus leopardus* from the Great Barrier Reef evoked a detectable response, but the continual production of their eggs induced a more significant response including an abundance of melanomacrophage centers and granuloma formation in the ventride as well as in other visceral organs (Overstreet and Thulin, 1989).

Few internal helminths cause mortality in their normal hosts when those hosts are Juveniles or adult inhabiting their natural environment. As indicated earlier, when fish are in stages of larva to fry, they are especially vulnerable to helminth parasites diseases (Overstreet, 1993). The digeneans produce hyperplasia of gills, encapsulation of eggs in the gills and ventricle, and papillae formation associated with endothelial proliferation in the afferent branchial arteries.

Different parasites and different condition induce different types of harmful effects on their hosts. For example, adigenean not related to blood flukes also affects blood flow. Metacercariae of *Apatemon gracilis* within the pericardial cavity of its salmonid intermediate host reduce the cardiac output of that fish host. (Overstreet, 1993).

Al-Bassel (1997) (Table 2) reported helminth parasites from 9 species (*Serranus scriba, labrus bergylata, Mullus surmuletus, Trachurus mediterraneus, Galeorhinus galeus, Boops boops, pagrus coeruleostictus, Spondyliosoma cantharus and Liza ramada*) of marine fishes from the Mediterranean Sea. 465 fishes belonging to 7 families and 9 genera were examined, 330 (70.96%) fishes were found positive. Helminth parasites were found in all genera of fish examined. Trematode infections were found in all species of fishes except *Galeorhinus galeus,* their incidence (30.75%). Nematode infections (34.40%) were found in some species of fishes except *Galeorhinus galeus and Liza ramada*Cestode infections (21.72) were found in most species of fishes except *Liza ramada* and *Pagrus coeruleostictus*. The highest intensity of infection 50-100 trematodes/ fish was recorded in *Liza ramada* and the lowest 3-7 cestodes/fish in *Labrus bergylata*. He also found that the incidence of infection in marine fish families from the Mediterranean is higher than that the same fish from the Red Sea.

Poulin, (1995) reported that positive correlations between the number of hosts sampled and mean species richness of the parasite community of each genus. In fish, richness increased with increases in the proportion of animal food in the host diet. Marine fish had richer gastrointestinal parasite communities than freshwater fish. The richness of ectoparasite communities on fish should no association with any of the ecological variables investigated.

Al-Ghais, and Kardousha, (1994) reported helminth parasites larvae from 4 species of marine fishes from west and east coasts in the Arabian Gulf. They found, when a comparison was made between the west and east coasts, the total prevalence of helminth infection in the fish species found on the east coast (42.7%) was markedly higher than that noted on the west coast (29.4%).

Akram, (1994) reported that, a vast majority of commercially valued marine fishes along the coast of Sindh in Pakistan are very resistant against the infections and infestation by the cucullanid nematode parasites.

Faliex and Biagianti (1987) reported a comparative analysis of the effect of *Labratrma minimus* metaceracriae in the liver of different species of marine fishes, which suffer gradual natural parasitosis. They found the effect is high in *Atherina boyeri* fish, moderate in *Mugil* and low in *Sparun aurata.* Castillo-Sanchez et al (1997) reported eight species of helminth parasites from *Euthynnus lineatus* (marine fish) from Mexico. They outlined that, trematodes were the better represented group with five species. Feeding habits are the factor that determine the presence of a wide variety of helminth parasites in this fish species.

Rohde et al (1998) studies the relationship between the assembages of parasites and the size, abundance, species richness and prevalence of infection in marine fishes. They found no significant differences in the number of nested assemblages and the sample size or abundance but prevalence of infection and species richness are correlated with nestedness.

Sasal et al (1997) reported that, parasite species richness of monogenea was positively correlated with host body size and negatively correlated with host species abundance. The positive relationship between fish body size and number of parasite species (richness) was attributed to the hypothesis that larger host body size increases host vagility which in turn enhances exposure to more parasite species. The results disagree with previous studies. Geets and Ollevier (1996) reported that, 22 adult *Siganus sutor* (marine fish) from kenyan coast were examined for helminth parasites. All fishes were infected and three were no single species infections records. All the helminth species showed a high prevalence, ranging from 68.18% - 100%. The intensity of infection with *Gyliauchen papillatus* (Digenea) was highest (201/fish). The relationship between host size and parasite burden showed that smaller fish were more heavily infected. Infection with *Opisthogonoporoides* *hanumanthai* and *Hexangium sigani* (Digenea) decreased significantly with host length. The intensities of infection with the three digenea were significantly positively correlated.

Caro et al (1997) reported that, Mongenean richness of marine fish is highly variable among host families and species. Many attempts was made to find associations between parasite richness and various characters of fishes. No clear correlation was found with maximal size, although the smallest species (less than 10 cm) seem to never harbour monogeneans. Correlations were found with nectonic, migrating and gregarious behaviours. However, taxonomy of fish appears to be extremely important as a determinant of monogenean richness.

Zander et al (1999) reported 36 species of helminth parasites in 10 marine fishes species from German coast of the Baltic Sea. The most abundant being Digenea (15 species), cestoda (7 species) and nematoda (6 species). Species with high levels of prevalence includes: *Podocotyle atomon, Cryptocotyle concavum, C. lingua, Diplotomum spathaceum* and *Acanthostomum balthicum.*

Sometimes the parasites are benefit to their hosts for example ascaridoid nematodes in the stomach of marine fishes may mechanically loosen and break up large food particles, permitting the digestive fluids to seep into the core quickly. Such action could be important in digestion, because many fishes ingest their food whole or in large chunks (Berland, 1980).

Special defence mechanisms may be active on the body surface. For example, fish continually shed a mucoid material from the skin even if uninfected, but the density of the slough increases when monogenean are present, and the parasites are removed with the slough (Lester and Adams, 1974).

Manter (1966) studies the coevolution of hosts and parasites, for example, he examined many specimens of the marine fish genus *Kupbosus* from various zoogeographical regions. Six of the 11 species of *Kypbosus* occur in the Indo-Pacific, and only two in the Caribbean and the same two in west Africa. 21 species of trematodes are known, and most trematode genera are limited to *Kypbosus*. Manter found that three or four species of trematodes of *Kypbosus* from the Great Barrier Reef in northeastern Australia and from the Caribbean are identical, a similarity greater than that between any other two regions. Furthermore, one acanthocephalan is more or less identical with a species in the Gulf of Mexico, and one monogenean is also similar to a species in that region.

On the other hand, the species *Kypbosus sydneyanus* extending from southern Australia almost to the Great Barrier Reef has four trematode genera and species of which only one is like those from the Reef. Manter (1967) interprets this as meaning that : (i) hosts and parasites have originated in the Indopacific (because of the large number of species there); (ii) there was an early dispersal to south Australia, where isolation has been rather complete for a large time (indicated by the different parasite fauna and also by the remarkably distinct trematode fauna of marine fish in general), and (iii) there has been some broad main dispersal route to the Caribbean.

SOME ASPECTS OF HOST-PARASITES INTERACTIONS

Host specificity and Host range:

Host specificity is the restriction of parasites to certain host species. Monogenea have the highest degree of host specificity among parasites of marine fishes (Table 3). For example, 435 species of Monogenea from various Sea, 340 (78%) are restricted to one host species, 388 (89%) to one genus, 420 (96%) to one family and 429 (98%) to one order (Rohde, 1978). It may be useful to distinguish host specificity from host range. Host range is the number of host species found to be infected by a certain parasitic species.

Microhabitats:

The parasite occupy certain site of their host for live. For example, parasites in the digestive tract of marine fishes occupy more or less restricted microhabitats, and they are never randomly distributed along the whole tract (Williams, 1968). The blood fluke *Aporocotyle macfarlani* lives in the lumen of the afferent branchial arteries, the ventral aorta and a parts of heart of marine fish *Sebastes spp.* on the North American Pacific coast.

Macrohabitats:

Some helminth parasites prefer some parts of the Sea for infection of marine fishes. For example, Cannon (1977) found nine distinct larval types of four ascaridoid genera in 47 of 123 marine fish species in Southeastern Queensland, Australia as follows: one genus, *Anisakis* is restricted to open water fish, anther, *Contracaecum*, to in shore Sallow water fish, and the remaining two *Pseudoterranova* and *Thynnascaris* have intermediate distributions.

Sex of Host:

Mongenean parasites sometimes preferred one sex of the host. Paling (1965) found that a particular population of the monogenean *Disocotyle sagittata* on marine fish *Salmo trutta* affects 5-7 year old males more heavily than female, and according to Williams (1965) *Calicotyle kroyeri* is never present in gravid female rays, *Raja radiata*, although non gravid female may be infected.

Age of Host:

Llewellyn (1962) showed that *Gostrocotyle trachuri* and *Psendaxine trachuri* are most common on young fish and much less frequent on 2 and 3 year old fish (*Trachurus trachurus*) and probably even rarer on still older fish. For *Discocotyle sagittata,* paling (1965) found an increase in infection, intensity and frequency with the age of its host *Salmo trutta.*

Food of the parasites:

Among the indoparasites, many trematodes ingest food particles in the lumen of the host s intestine, and cestodes absorb food from the lumen of the intestine through their tegument. According to Rohde, 1984, Polyopisthocotylea (monogenea) feed on blood and molecular organic compounds from water, while Monopisthocotylea feed on Mucus, epithelial cells of marine fishes. Also Nematodes feed on gut contents, host tissue and blood, while Acanthocephala feed on gut contents and tissue liquid.

Table (1): The results of some survies carried out on mullets helminthes from some inland lakes in Egypt.

Mugil spp.	Authors	Locality	Total No.exam	No. infec.	%	No. of helm. Species	Incidence of infections							
							Tre.		Ces.		Nema.		Acantho.	
							No.	%	No.	%	No.	%	No.	%
Mugil cephalus	Moravec and libosvarsky, 1975	Lake Borullus (different parts)	31	-	10-30	2	-	30	-	-	-	-	-	10-18.2
		Mediterranean	20	-	40-90	2	-	40-90	-	-	-	-	-	5
	Sahlab, 1982	Lake Manzala	100	10	10	2	7	-	-	-	3	-	-	-
	Saoud et al, 1990	Lake Qarun	134	36	26.8	5	36	26.8	0	0	0	0	0	0
		Lake wadi Al-Rayan	50	10	20	1	10	20	0	0	0	0	0	0
	Al-Bassel, 1990	Lake Qarun	150	98	65.33	4	98	65.3	-	-	-	-	-	-
		Lake Edku	50	41	82	4	41	82	-	-	-	-	-	6
Mugil capito	Moravec and Libosvarsky, 1975	Lake Borullus	49	-	15-45	3	-	15-90	-	-	-	-	-	5-8
	Saoud et al, 1990	Lake Qarun	100	45	45	5	45	45	-	-	-	-	-	-
Morone labrax	Al-Bassel, 1990	Lake Qarun	150	108	72	6	108	72	-	-	-	-	-	-
		Lake Edku	50	43	86	4	43	86	-	-	-	-	-	-
	Al-Bassel, 1996	Lake Edku	50	29	58	3	28	56	-	-	1	2	-	-

Table (2): The results of some survies reported on marine fish helminthes.

Authors	Localities	Total of fish specimens			No. of fish species	No. of helminth species	Incidence of infections in fish					
		Examined	Infected	%			Trematoda		Cestoda		Nematoda	
							No.	%	No.	%	No	%
Ramadan, 1979	Red Sea	1003	-	-	70	34	30	-	4	-	0	0
Saoud and Hassan, 1983	Mediterranean and Red Sea	1151	410	35.62	5	7	0	0	119	27.48	22	5.08
Saoud and Ramadan, 1983	Red Sea	812	394	48.5	33	45	394	48.5	-	-	-	-
Manter, 1955	Red Sea	-	-	-	-	44	44	-	-	-	-	-
Manter, 1955	Mediterranean	-	-	-	-	107	107	-	-	-	-	-
Al-Bassel, 1997	Mediterranean	465	330	70.96	9	-	143	30.75	101	21.72	160	34.40

Table (3): Host specificity of helminth parasites of marine fish in Barents Sea (Data from Rohde, 1993).

Parasitic groups	Number of species	% Percentage of Species			
		In 1 host species	In 1 genus	In 1 family	In several families
Monogenea	21	52.4	9.5	4.8	0
Digenea	37	2.8	11.1	16.7	44.4
Cestoda	19	12.5	6.2	25.0	31.4
Nematoda	12	9.1	0	9.1	36.4
Acanthocephala	3	0	0	0	100

SUMMARY

In the present review, I can summarized the different aspects of host-parasites relationships in marine fish as follows:

1- Trematodes are more common in marine bony fishes than cestodes, nemtodes and acanthocephala, but in Elasmobranch cestodes more commen than other groups of helminth parasite.

2- Some marine fishes such as *Mugil capito* infected with related trematode genera *Haplosplanchnus* and *Saccocoelium* in the Mediterranean and lose the infection gradually after migration into the open lake Borullus, but the same species of fish maintain their parasites after transferred to the closed lake Qarun.

3- The incidence of infection with Acanthocephala parasites in marine fish is lower than that in fresh water fishes.

4- The single infection with one genus of cestodes is more common in certain species of elasmobrachs, on the other hand, double and triple infections are more common in other species.

5- The intensity of infection with cestode genera in elasmobranchs are more common in male than female fishes, while the incidence of infection with trematode genera are more common in female than male fishes.

6- Some families of marine fishes are more susceptible to infections with trematode genera than other families. Most of marine fish species are infected with 4 genera of trematodes, while few genera are infected with one, two or three genera of trematodes.

7- Some trematode genera had a wider host spectrum, on the other hand some trematode genera had host specificity (Saoud and Ramadan, 1983).

8- There are correlation between the incidence of trematode genera and the intensity of infection.

9- In general, the incidence of infection with trematode genera is highest in *Mugil capito* and lowest in *Mugil cephalus,* with that of *M. chelo* in between (Saoud et al, 1990).

10- Single infection with one genus of trematode was recorded in *Mugil saliens* from lake Qarun, while triple and quadruple infections were recorded in *Mugil cephalus* and *M. capito* from the same locality.

11- Related hosts are infected with related members of the parasitocoenosis (Dogiel, 1962). This assumption has been verified in *Mugil cephalus, M. capito* and *M. chelo* from lake Qarun, because the 3 mullets species are infected with the same species of trematode parasites.

12- In general, the incidence of infections with trematode genera in mullets from lake Edku is higher than that from lake Qarun, and the incidence in *Mugil capito* is higher than that in *Mugil cephalus* moreover, the highest incidence was recorded in spring and the lowest in Autumn with that in winter in between. Quadruple infections with trematode genera are recorded only in *Mugil cephalus,* but double and triple infections are recorded in both mullets from both lakes (Saoud et al, 1990)

13- Adult trematodes probably minimally harm mullets in natural habitats, but become harmful in fish farms. On the other hand