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Marine Parasites of Omani Waters: State of knowledge

Volodymyr K Machkevskyi*, Sarah H Al-Jufaili, Ridah S Khalfan, Nashwa AM Al-Mazrooei

Fishery Quality Control Center of Ministry of Agriculture & Fisheries Wealth of Sultanate of Oman

Abstract

Parasitological studies of marine fish inhabiting the Sultanate of Oman began in the late sixties of the twentieth century and continued through '82. These studies revealed a total of 154 marine parasite species belonging to ten taxonomic groups.These included myxosporeans, microsporidia, helminths, parasitic crustaceans and leeches. New species were described, some of which were categorized as harmful to public health and some were found to have an impact on the quality and marketability of their hosts. The geographical distribution of the recorded parasites will be pointed out in the current paper. In addittion, the distribution patterns of the reported parasites will be analyzed and discussed according to the ecology of the perspective hosts of each parasite. Six groups of parasites can be suggested; Pelagic (3,1%), Demersal (58,4%), Benthic (23%), Pelagic-Demersal (7,5%, Demersal-Benthic (5,6%) and Pelagic-Demersal-Benthic (2,5%). Demersal parasites were the most abundant and least abundant were Pelagic-Demersal-Benthic and Pelagic ecological groups of parasites. In addition, some parasites were categorized as potential threats to future development of aquaculture industry in the country.

Keywords: Marine Parasites; Fisheries; Aquaculture; Seafood quality; Oman

Introduction: The Sultanate of Oman has a long coastline of approximately 3165 km in fine scale, which accommodate a high diversity of marine animals. The richness of marine life in Oman is due to the unique nature of its water bodies, fueled with nutrients and warm waters and its suitable geographical location. So far a total of 1178 fish species belonging to 140 families were recorded from Omani waters including cartilaginous and teleost marine species [1]. Due it is long coastal line and geographical location, many locals in Oman benefit from the fisheries sector, and many marine species are considered as commercially important both locally and internationally. The country is engaged in fishing of about 34 thousand families of marine fish making the fisheries sector as the country's second provider to the national gross domestic after oil and gas. The fishery sector brings annually an average of 134000 metric tons of different fishes [1].. Furthermore, in order to meet the country's high protein demand and to protect the local fish stocks the country is set to establish mariculture industry, which is promising to be a successful approach due the availability of favorable conditions for aquaculture. It is well known that parasites are one of the major factors affecting the profitability of fisheries especially those which are related to seafood safety and quality [2-4]. Also, parasites can prohibit the successful development of aqua farms through their negative effect on the cultured objects [5-7]. They represent about 80% of the infectious agents in tropical fish farms causative high mortality rates and sever losses to the industry. Thus the aim of this work was to describe the structure and composition of marine parasite fauna of omani fishes on the basis of data obtained from previous literature data. Also, the recorded parasites will e categorized into groups according to their practical and scientific interest. In the end we will outline the future trends for future parasitological investigations in Oman. The first parasitological research off the coasts of Oman were initiated in 1969 and continued until 1982 on board the fishing research vessel "Skif" by famous Russian parasitologist AM Paruchin [8,9]*.

Work was carried out mainly in the central part of Omani shelf in Sowqirah Bay, Masirah Bay, Kuria-Muria Bay. Parasitological investigations were conducted on the vessel within the work tasks of the main commercial scouting for new places and new facilities for fishing. Since the research of AM Paruchin was conducted on a trawler fleet, parasitological studies were mostly accidental. Nevertheless, AM Paruhin was able to investigate pelagic, demersal and deep-water fish species. They had a large collection of parasites, which includes 107 species belonging to the trematodes, monogeneans, cestodes, acanthocephalans and nematodes. [Table 1 shown as supplementary file].

*- The most of publications of AM Paruchin were in Russian. In submitted paper all parasites and fish scientific names are given as in originals of AM Paruchin.

Material and Methods

In this paper previous literature from Paruchin in addition to our on data were used. For our data, host sampling took place in different parts of the coasts of Sultanate of Oman. Freshly dead fish were collected from local fish markets and landing sites. In some cases samples were obtained from trained fishermen on fishing field trips. The geographical coordinates of the obtained samples as well as samples obtained by AM Paruchin samplings are: Muscat Area (23°63'N, 58°57'E), Masirah Bay (20°11'N, 58°12'E), Al Lakbi Area (18°16'N, 56°55'E), Sawqirah Bay (18°55'N, 56°95'E), Kuria-Murya (Hallaniyat) Archipelago (17°51'N, 55°92'E), Shuweimyyiah Area (17°54′N, 55°55′E), Sharbitat Area (17°39′N, 56°32′E), Salalah Area: Marbat (16°99'N, 54°69'E), Raysut (16°57'N, 053°59'E), Dalkut (16°42'N, 053°15'E). Each host sample contained about 10-15 specimens, fresh fish were bought from landing sites or local fish markets and were immediately kept in cool bags and transported to the Laboratory of Aquatic Parasitology (Ministry of Agriculture and Fisheries Wealth, Oman). Fish were either freshly examined, kept in fridge during examination for at least 48 hrs or immediately frozen at -47°C for longer duration.The examination of fish and preparation of total mounts was carried out following the method of complete parasitological dissection and modified method of staining with acetic carmine [10,11]. Skin, gills, fins, abdominal organs,

***Corresponding author:** Volodymyr K Machkevskyi, Fishery Quality Control Center of Ministry of Agriculture & Fisheries Wealth of Sultanate of Oman, Oman, Tel: +96895273089; E-mail: vladmachkevsky@gmail.com

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bits of muscles were removed, placed in seawater (or saline solution) and checked for parasites under a Zeiss Stemi 2000-C dissecting microscope. Measurements and light micrographs were taken using a Zeiss AxioScope A1 K fitted with an AxioCam Rc digital camera using AxioVision Rel. 4.8.2 (K. Zeiss Application Software), at magnifications of ×100, ×200, ×400 and ×2,000, and an Olympus BX63 motorized microscope fitted with DIC optics and a DP73 Olympus digital camera using CellSens Standard software (Olympus Application Software), at magnifications of × 600 and ×1,000. The figures were made from a series of photos using the scalable vector graphics editor in the program Inkscape 0.48.2.-1 (http://www.inkscape.org) for the complete morphological description and taxonomic identification of parasites. When analyzing new and literary parasitological data, convectional classification of ecological groups of parasites were applied, which will be explained in detail in the results and discussion section. Definition of fish and analysis of their ecological characteristics was performed using the following literature [1,12,13,] In matters relating to marine parasites which has an impact on seafood safety we emphasized on their possible pathogenicity to man, deteriorating commercial properties of commercial objects and pathogenicity against cultured aquatic organisms.

Results and Discussion

The parasites species composition

The total number of targeted aquatic hosts for parasitological investigations in Oman is 78 species of fish belonging to 34 families. The selected objects of study were largely an accident, but most species were objects that were intentionally harvested. Research work of AM Paruchin explored different taxa of marine parasites ranging from Helminths to Hirudinea and parasitic Crustaceans. Of the recorded parasites 47 were new geographical record to Oman, including more than 10 species probably are new to science. Further investigation on the collected parasites and detailed morphological analysis will be used to describe new species. Currently, the parasites fauna of Omani fish is comprised of 161 species divided into, 9 myxosporean species, 5 Microsporidia species, 80 Trematoda species, 20 Monogenea species, 8 Cestoda species, 12 Acanthocephala species, 17 Nematoda species, 2 Hirudinea species, 6 parasitic Copepoda species and 2 parasitic Isopoda species (Table 1). Among these, 12 new to science species are described in Oman. Obviously, among the identified marine parasites Oman abundance of species is clearly dominated by trematodes, monogenic occupied second place, the third most abundant marine parasites were Nematodes, acanthocephalans came in fourth place, myxosporeans were fifth in the list, followed by Cestodes which were proceeded by microsporidians while eighth and ninth places were divided between copepods and isopods. The least abundant marine parasites were leeche which came tenth in the list. This data is however not real representative of the reality of marine parasite fauna of the sultanate of Oman because the number of examined hosts is much smaller compared to the total number of marine fish inhabiting Omani waters. To date, we have relatively little data, which cover a very small number of objects and limited regions. Development and deepening of research initiated in the future promises many new discoveries.

Environmental aspect

There are several ecological zones in the offshore part of the ocean. These include Pelagic, Demersal and Benthic. Each of these zones corresponds to a complex combination of abiotic and biotic factors that can influence the parasites biology. Abiotic factors such as light, temperature, pressure, oxygen and a number of other physical and chemical factors can directly influence the ectoparasites and endoparasites dispersing stages, motivating the development of their populations or on e contrary inhibiting them. By biotic factors, first and foremost, this is the presence of suitable hosts with a set of physiological and behavioral parameters, allowing the parasite to form parasite biosystems [14]. In the second place are hydrobionts which use dispersing larvae stages of parasites as food. Both of these factors are also able to efficiently regulate the species composition and abundance of parasites in different ecological zones. The consequence of the impact of these factors is the confinement of a parasite to a certain area, which combines a specific set that is inherent from its environmental properties. According to the ecological division of space into zones, we have identified the following groups of parasites: Pelagic, Demersal and Benthic. Assuming that some of the parasites may be simultaneously in several areas, we have added two intermediate groups of parasites: Palagic-Demersal and Demersal-Benthic. After analyzing the parasite fauna in relation to the species composition of fish hosts, according to the above scheme, we saw that the pelagic group of parasites makes up 3.1%; Demersal was 58, 4%, Benthic was 23%; Pelagic - Demersal was7.5% and Demersal-Benthic was 5.6%. However, it was found that 2.5% of parasites were recorded in fish living in Pelagic, Demersal and Benthic zones. So we had identified for four species of parasites six Pelagic-Demersal-Bentic group. From this it follows that the vast majority (84.5%) of the listed parasites exhibit a sufficiently strong specificity for three zones. The greatest biodiversity of parasites found was in demersal zone. There are several reasons behind this phenomenon. First, border surface, such as water-stone, water-sand, etc. an increase in the biodiversity [15], in this case biodiversity of hosts and their parasites. Second, it can be explained solely on the sampling methods whether it was random or more specific (i.e. focusing on one zone other than the rest). Only about 15% of the identified species of parasites demonstrated certain ecological plasticity. This can be explained that the definitive hosts of these parasites themselves are pretty plastic in their choice of habitat, making in ocean space the fodder and spawning migrations, etc. However, it is possible that some of these species exhibit their life cycle in the demersal zone, but their host-fish were caught in the moment of their daily migration in the space of pelagic zone.

Practical aspect

In matters relating to marine parasites, seafood safety and quality, we most frequently emphasized on the following aspects, pathogenicity to man, deteriorating of consumer properties of commercial objects and pathogenicity for cultured aquatic organisms.

Zoonosises

Among the registered in the Omani waters fish parasites that are known as harmful to human were recorded, these belong to the Anisakidae family (Table 1). Larvae of 6 anisakids species were recorded in 5 fish species. However, this is a very incomplete data because about 21 species of Cetaceans are found in Omani waters [16], including 3 species of Baleen Whales, which can eat small fish, 18 species of Toothed Whales (sperm whales, killer whales) and dolphins which mostly feed on fish that are known as potential definitive hosts of Anisakid nematodes and acanthocephalans of family Polymorphidae both of which have larval stages which infect marine fish. That is why it is planned to conduct an in-depth study of these parasites with a maximum extension of the number of host species commercial fish. It is well known that many locals indulge in several local dishes which involve preparing fish in ways that doesn't allow the

complete inactivation of some zoonotic parasites. Moreover, there is an increasing trend to eat raw fish in the Sultanate of Oman, hence it is essential to know the current status of distribution of zoonotic parasites in Omani fish. This will be greatly helpful especially once guidelines and data bases are established to increase consumer awareness about such cases.

Aquaculture

Involves multiple increase in fish density per unit volume of the environment, which in nature is extremely rare and short in time. This situation creates very favorable conditions in marine farms for distribution of harmful disease agents within local populations of reared fish. In normal conditions, pathogenic agents are usually controlled through genetic quality (gene pool) and the number of natural populations of free living aquatic organisms, and are in turn under pressure from the controlling inmates of biocenosis. In culture conditions however, these parasites multiply and expand in the habitat and significantly reduced the control over their numbers from the outside biocenosis. This may be the cause of epizootic, mass deaths of fish and economic losses in marine farms. Among the most recognized parasites that are harmful to aquaculture are myxosporeans (9 species), microsporidia (5 species), monogeneans (20 species), parasitic crustaceans (8 species) and leeches (2 species). The obtained results will help to obtain the first information about the representatives of Oman the above groups of parasites (Table 1), and these studies are expected to expand as the Government of Oman headed for the widespread introduction of aquaculture in the production of quality seafood and fish conservation of natural resources.

Damaged seafood

To number of parasites which make repulsive condition of seafood are the microsporidia, myxosporeans, plerocercoids of cestodes of order Trypanorhyncha and larvae of many families of nematodes. These parasites are usually localized in the muscles or abdominal organs (liver, gonads and kidney) as a different size lumps or cysts, or causing a condition known as mycoliquification to the muscle fibers, they give seafood repulsive appearance and drastically reduce the marketability of the infected host by the consumers. These parasites can affect many pelagic, demersal and benthic fish.

Conclusion

It should be noted that the data obtained are very preliminary. Of the more than one thousand species of fish parasitology analysis covered only 78 species in 10 areas of Omani coast. There is almost not studied the life cycles of parasites and their circulation path in ecosystems, and hence the operation of parasite systems. The data obtained, in fact, reflect only the "top of the iceberg" of the investigated problem. Therefore, wider coverage of parasitological research fish fauna in Omani waters, expanding the geography of research will allow us to increase the amount of data to correct our preliminary conclusions and make them more reasonable.

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