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Host-specificity of metazoan parasites infecting mullets of Kerala, India

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ABSTRACT

Eight species of mullets occurring in the estuarine habitats of Kerala, India, were examined for the presence of metazoan parasites. Of the 50 species of metazoan parasites encountered, 18 (36%) were oioxenic and 6 (12%) euryxenic; 48% of the parasites infected two to four host species and 4%, more than four host species. Among monogeneans, one species (16.7%) was restricted to a single host species and one species was seen to infect all the eight host species. Of the 12 digeneans, 3 (25%) infected a single host species and two (16.7%) were found on all the eight species of hosts. Among the 25 species of copepods, 12 (48%) were restricted to one host species and two (8%) infected all the host species. The overall picture forthcoming from the study is that the metazoan parasites of the mullets of Kerala waters showed varied levels of specificity with respect to their hosts; about 1/3 of them are highly host-specific, whereas, only 1/8 of them is distributed in all the host species.

Keywords: Brackishwater, Host specificity, Kerala, Metazoan parasites, Mullets

Introduction

Many workers have studied the taxonomy of metazoan parasites of mullets of the Indian waters, mostly from the east coast of India. Studies on the digenean fauna of these fishes primarily off the Visakhapatnam coast (Madhavi, 1979; Rekharani and Madhavi, 1983; 1985a,b; Gnanamani, 1989; Rao, 1990; Shameem and Madhavi, 1991), digenetic trematodes of mullets off the Goa coast (Ahmad, 1985a, b; 1986, 1987) and the crustacean parasites of some species of mullets off the west coast of India (Rangnekar, 1955; Pillai, 1985; Pillai and Jayasree, 1978; Chatterji *et al.*, 1982; Ho *et al.*, 1992) are the noteworthy contributions in this regard. Though Kerala waters support eight species of mullets, any attempt at collecting comprehensive information on their parasites is as yet lacking.

By virtue of their very close morphological similarities, mullets are often reckoned as a phylogenetically close group. Stiassny (1990) proposed Mugilimorpha (which includes mullets) as a monophyletic group, with Atherinomorpha and Percomorpha as its sister groups; all the three are believed to have evolved from a common actinopterygian ancestor. But the same author in 1993 expressed doubts over the phylogeny of this group and stated that additional data on morphology, reproductive and developmental biology and molecular systematic analyses, would be required to verify the phylogenetic relations of this commercially very important group of fishes. According to Manter (1947) and Dogiel *et al.* (1958), the phylogenetic closeness of the hosts is a major reason for the similarity in their parasite fauna. Further, the component parasite communities of host species are determined by the phylogenetic similarity of hosts and parasites as well as the physiology, behaviour and food habits of the hosts (Holmes, 1990). Considering the prevailing uncertainty on mugilid phylogeny and the bearing of parasitological data on host phylogeny, it was thought worthwhile to analyze the host-specificity of the metazoan parasites of mullets of Kerala waters in the hope that the information emerging might serve as additional data as envisaged by Stiassny (1993). Moreover, appropriate integration of taxonomic data would be useful in the context of the increasing concern over biodiversity. To the best of the knowledge of the authors, the present study is the first attempt from India towards analyzing the host-specificity of metazoan parasites of a family of fishes.

Materials and methods

Specimens of mullets were collected from the Ashtamudi estuary, the second largest estuarine system of Kerala (between 8° 53' and 9° 02' N lat. and between 76° 31' and 76° 41' E long.); the largest landings of mullets in Kerala State are from this estuarine system. A few collections were made from the Veli lake also, which is a brackishwater body located along the south-west coast of India (8° 28' N lat. and 76° 57' E long.).

One thousand seven hundred and sixty-two specimens belonging to eight species and three genera were examined for the presence of metazoan parasites following the methods suggested by Kennedy (1979). The fishes examined were (numbers in brackets indicate number examined): *Liza macrolepis* (Smith) (349), *Liza parsia* (Ham. and Buch.) (368), *Liza subviridis* (Val.) (340), *Mugil cephalus* L. (115), *Valamugil buchanani* (Bleeker) (71), *Valamugil cunnesius* (Val.) (364), *Valamugil seheli* (Forsskal) (85), *Valamugil speigleri* (Bleeker) (70).

Host-specificity indices based on parasite density $S_{i(density)}$, prevalence $S_{i(prevalence)}$ and probability $S_{i(1\text{-}Pij)}$ were calculated by the methods suggested by Rohde (1980).

1. $S_{i(density)} = \sum (x_{ij} \div n_j h_{ij}) \div \sum (x_{ij} \div n_j)$

   where, S_i = host-specificity index of i^{th} parasite species, x_{ij} = number of parasite individuals of i^{th} parasite species in j^{th} host species, n_j = number of host individuals of j^{th} species examined, h_{ij} = rank of host species j based on density of infection, $x_{ij} \div n_j$ (species with greatest density has rank 1).

2. $S_{i(prevalence)}$ calculated by the previous formula where, x_{ij} = number of host individuals of j^{th} species infected with parasite species i, n_j = number of host individuals of j^{th} species examined, h_{ij} = rank of host species based on frequency of infection (species with the highest frequency has rank 1).

3. $S_{i(1\text{-}Pij)}$, where $P_{ij} = (n_i \div n_j)$, $S_i = 1 \div (P_{ij} / n_j)$

   where, n_i = number of host species infected with parasite species i, n_j = number of host species examined.

The probability of not finding a host species infected by i^{th} parasite, among the entire host species examined was calculated as $(1\text{-}P_{ij})$.

Results

The results of the analysis of host-specificity of parasites based on intensity of infection [$Si_{(density)}$], on prevalence [$Si_{(frequency)}$] and based on probability theory [(1-Pij)] are presented in Table 1.

Of the 50 species of metazoan parasites collected, 18 (36%) were oioxenic and 6 (12%) euryxenic; 48% of the parasites infected two to four host species and 4.0%, more than four host species. Among monogeneans, one species (17%) was restricted to a single host species and one species was seen to infect all the eight host species. Of the 12 digeneans, 3 (25%) infected a single host species and 2 (17%) were found on all the eight species of hosts. Among the 25 species of copepods, 12 (48%) were restricted to one host species and 2 (8%) infected all the host species.

The three major taxa of metazoan parasites encountered in mullets were, Monogenea - 6 species, Digenea - 12 species and Copepoda - 25 species. Among monogeneans, one species (17%) was restricted to a single host species and one species was seen to infect all the eight host species. Of the 12 digeneans, 3 (25%) infected a single host species and 2 (17%) were found on all the eight species of hosts. Among the 25 species of copepods, 12 (48%) were restricted to one host species and 2 (8%) infected all the host species. Monogeneans, digeneans, cestodes and copepods were encountered in all the eight species of hosts examined and acanthocephalans, isopods and amphipods, in four host species. Only one nematode parasite was encountered during the present study and it was restricted to a single host species.

The overall picture forthcoming from the present study is that the metazoan parasites of the mullets of Kerala waters showed varied levels of specificity with respect to their hosts; about 1/3 of them are highly host-specific (restricted to a single host species), whereas, only 1/8 of them is distributed in all the host species.

Discussion

Of the 50 metazoan parasites obtained from eight species of mullets, 36% were oioxenic forms; 52% were stenoxenic and 12% euryxenic. Digeneans were the least host-specific and copepods, the most. The least host specificity of digeneans could be linked with the parasite's life-cycle. Digeneans being heteroxenous in nature, the uncertainty over the transmission could be overcome by adopting a wide host-range. On the contrary, copepods for which the mode of transmission is direct can restrict to a specific host, as the uncertainity in seeking various hosts is not involved in their life cycle (Dr. I. Rajendran, pers. comm.). In freshwater fishes, the parasitic communities are stochastic assemblages determined by chance introduction of parasites into a region and chance colonisation and extinction events (Esch *et al*., 1988; Hartvigsen and Kennedy, 1993; Kennedy, 1993). The local parasite fauna (compound community) is determined by the local environmental features, both natural and man-made, as also the composition of host species at a given time. In this regard, the compound community of parasites of the mullets of Kerala, with 26 new additions to the known mullet parasite fauna, is justifiable. However, the infra- and component parasite communities, which are determined by interaction among parasite species, phylogenetic similarities of both host and parasites and the physiology, behaviour and food habits of the hosts of mullets noted during the present study suggest that, in spite of the closeness in physiology, behaviour and food habits of the hosts (Stiassny, 1990; 1993) their parasite fauna are not similar thereby adding further evidence to the possible phylogenetic dissimilarity of mugilids suspected by Stiassny (1993).

Table 1. Species specificity of different parasites from mullets of Kerala

Parasite species		No. of host species infected	$Si_{(density)}$	$Si_{(frequency)}$	$Si_{(1-pij)}$
Monogenea	*Ligophorus* sp. 1	8	0.518	0.384	0.000
	Ligophorus sp. 2	4	0.620	0.537	0.500
	Ligophorus sp. 3	3	0.672	0.653	0.625
	Ligophorus sp. 4	4	0.680	0.614	0.500
	Ancyrocephalinae (n.sp., n.gen.)	2	0.826	0.781	0.750
	Metamicrocotyla n. sp.	1	1.000	1.000	0.875
Digenea	*Transversotrema patialense*	4	0.688	0.611	0.500
	Haploporus indicus	1	1.000	1.000	0.875
	Saccocoelioides martini	8	0.435	0.425	0.000
	Haplosplanchnus purii	2	0.751	0.823	0.750
	Schikobalotrema elongatum	3	0.771	0.693	0.625
	Saturnius segmentatus	1	1.000	1.000	0.875
	Saturnis valamugilis	1	1.000	1.000	0.875
	Bucephalus sp.	2	0.751	0.751	0.750
	Prosorhynchus (Metacercaria)	5	0.587	0.644	0.375
	Centrocestus formosanus	4	0.647	0.653	0.500
	Cryptogonimid (Metacercaria 1)	8	0.604	0.394	0.000
	Cryptogonimid (Metacercaria 2)	3	0.676	0.772	0.625
Cestoda					
Plerocercoid larva		8	0.478	0.474	0.000
Nematoda					
	Philometra cephalus	1	1.000	1.000	0.875
Acanthocephala					
	Neoechinorhynchus chilkaensis	4	0.580	0.574	0.500
Copepoda	*Nothobomolochus* n. sp.	1	1.000	1.000	0.875
	Orbitacolax n. sp.	2	0.751	0.784	0.750
	Dermoergasilus amplectens	1	1.000	1.000	0.875
	Dermoergasilus varicoleus	4	0.659	0.632	0.500
	Dermoergasilus n. sp. 1	4	0.682	0.597	0.500
	Dermoergasilus n. sp. 2	3	0.683	0.638	0.625
	Dermoergasilus n. sp. 3	1	1.000	1.000	0.875
	Dermoergasilus n. sp. 4	1	1.000	1.000	0.875
	Dermoergasilus n. sp. 5	1	1.000	1.000	0.875
	Diergasilus n. sp.	1	1.000	1.000	0.875
	Ergasilus rostralis	8	0.546	0.425	0.000
	Ergasilus n. sp.	1	1.000	1.000	0.875
	Ergasilidae (n. gen., n. sp. 1)	2	0.772	0.803	0.750
	Ergasilidae (n. gen., n. sp. 1)	1	1.000	1.000	0.875
	Mugilicola bulbosa	3	0.727	0.699	0.625
	Nipergasilus bora	5	0.814	0.702	0.375
	Nipergasilus n. sp.	1	1.000	1.000	0.875
	Paraergasilus sp. 1	4	0.720	0.679	0.500
	Paraergasilus sp. 2	1	1.000	1.000	0.875
	Caligus epidemicus	3	0.629	0.678	0.625
	Caligus pelagicus	3	0.666	0.634	0.625
	Caligus rotundigenitalis	8	0.484	0.486	0.000
	Lernanthropus mugilis	1	1.000	1.000	0.875
	Colobomatus sp.	1	1.000	1.000	0.875
	Tisbe sp.	4	0.631	0.611	0.500
Isopoda	Isopoda (sp. 1)	3	0.712	0.747	0.625
	Isopoda (sp. 2)	2	0.751	0.500	0.750
	Isopoda (sp. 3)	1	1.000	1.000	0.875
Amphipoda					
	Lafystius sp.	4	0.577	0.552	0.500

$Si_{(density)}$ = Specificity based on intensity of infestation
$Si_{(frequency)}$ = Specificity based on prevalence of infestation
$Si_{(1-Pij)}$ = Specificity based on prevalence of infestation

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