Metazoan parasites of the Indian mackerel, *Rastrelliger kanagurta* (Scombridae) of Visakhapatnam coast, Bay of Bengal

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Abstract The metazoan parasite fauna of the Indian mackerel *Rastrelliger kanagurta* of Visakhapatnam coast, Bay of Bengal comprised 15 species including three species of Monogenea, seven species of Digenea and five species of Crustacea. Digeneans were the dominant members in the parasite spectrum while infections with ectoparasitic monogeneans and crustaceans were rare. The digeneans *Opechona bacillaris* and *Lecithocladium angustiovum* which occurred with high prevalence and mean intensity are the typical parasites of the mackerel. The parasitic fauna in general is found to be a reflection of the planktonivorous diet of the host. Except for two species of digeneans, *Lecithocladium angustiovum* and *Aponurus laguncula*, all the remaining species of metazoans showed narrow specificity to *R. kanagurta*, indicating a high degree of host specialization. The parasitological data may prove useful for differentiating stocks of *R. kanagurta*.

Keywords Metazoan parasites · Indian mackerel · *Rastrelliger kanagurta* · Visakhapatnam coast · Bay of Bengal

Introduction

The Indian mackerel *Rastrelliger kanagurta* (Cuvier) forms an important fishery along east and west coasts of India appearing in line and trawler catches almost throughout the year. Especially during the months February to May, it dominates the fish landings along these coasts. Vast

information is available on the biology of this fish including food and feeding habits (Bhimachar and George 1952; Rao and Rao 1957; Kuthalingam 1959; Venkataraman 1961; Luther 1973; Sivadas and Bhaskaran 2009), reproductive biology (Pradhan 1956) and population biology (Jayasankar et al. 2004).

Despite its common occurrence in the Indian waters, the parasite fauna has not been subjected to any detailed study. The available information deals with descriptions or reports of single or few parasite species belonging to Monogenea (Tripathi 1954; Unnithan 1964; Gupta and Krishna 1977; Raju and Rao 1978; Muruges 1995), Digenea (Madhavi 1972, 1977, 1982; Gupta and Govind 1981; Gupta and Puri 1981; Gupta and Ahmad 1976; Madhavi et al. 1986; Gupta and Gupta 1987); Crustacea (Gnanamuthu 1951; Pillai 1961, 1962, 1965, 1967; Tripathi 1962; Bennet 1967) and Isopoda (Ravichandran et al. 2009; Ramesh Kumar and Ravichandran 2010). Rohde (1989) published a comprehensive account on Monogenea of *Rastrelliger* sp. collected from different geographic areas.

During our studies on metazoan parasite communities of marine fishes of Visakhapatnam coast, an analysis was made on the species composition of metazoan parasites of *Rastrelliger kanagurta*. This paper deals with the various parasite species found in *Rastrelliger kanagurta* of Visakhapatnam coast of Bay of Bengal and discusses the role of the mackerel as a host for various metazoan parasites.

Materials and methods

One hundred and eighty-four individuals of *R. kanagurta* ranging in size from 120 to 240 mm and collected between January 2006 and January 2007 from fish landings at Fishing Harbour of Visakhapatnam were examined.

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Standard methods were followed for collection, fixation and identification of parasites. Monogeneans and digeneans were fixed in AFA, stained with alum carmine and mounted in balsam. Copepods were fixed in 10% formalin, cleared in lactic acid and dissected using fine needles. Diagrams were drawn with the help of a camera lucida. For each species data on prevalence and mean intensity to infection were recorded. The definitions for ecological terms were followed from Bush et al. (1997).

Results

Fifteen species of metazoan parasites including three species of Monogenea, seven species of Digenea and five species of Copepoda were found infecting the fish (Table 1). Infections

Table 1 List of metazoan parasite species found in *Rastrelliger kanagurta* and their site of infection in the host

Name of the parasite	Site
MONOGENEA	
Family Gastrocotylidae	
<i>Eyelavera typica</i> Unnithan, 1968	Gills
Family: Mazocraeidae	
<i>Pseudanthocotyle jagannath</i> (Tripathi, 1954)	Gills
<i>Khunia sprostonae</i> Price, 1961	Gills
DIGENEA	
Family Lepocreadiidae	
<i>Opechona bacillaris</i> (Mollin, 1859)	Pyloric caeca
Dollfus, 1927	and Intestine
<i>Prodistomum waltirensis</i> (Madhavi, 1972)	Intestine
Bray and Gibson,	
<i>Prodistomum orientalis</i> (Layman, 1930)	Pyloric caeca
Bray and Gibson,	and Intestine
Family Gorgoderidae	
<i>Phyllodistomum</i> sp.	Urinary bladder
Family Didymozoidae,	
<i>Renodidymocystis yamagutii</i> Madhavi, 1982	Blood vessels
Family Hemiuridae (Looss, 1899) Luhe, 1901	
<i>Lecithocladium angustiovum</i> Yamaguti, 1953	Stomach
Family Lecithasteridae Odhner, 1905	
<i>Aponurus laguncula</i> Looss, 1906	Gills and stomach
COPEPODA	
Family Bomolochidae	
<i>Orbitocolax aculeatus</i> Pillai, 1967	Gills
<i>Nothobomolochus kanagurta</i> Pillai, 1965	Gills
Family Caligidae	
<i>Caligus kanagurta</i> Pillai, 1961	Gills
Family Anthosomatidae	
<i>Lernanthropus kanagurta</i> Tripathi, 1962	Gills
Family Lernaeceridae	
<i>Peniculus scomberi</i> Gnanamuthu, 1951	Fin rays

with cestodes and acanthocephalans were not found. The few Larval cestodes and nematodes found were not included here because of their rare occurrence.

Monogenea

Family GASTROCOTYLIDAE

Eyelavera typica Unnithan, 1968

Syn: *E. parukhini* Lebedev, 1980

Remarks Genus *Eyelavera* was erected by Unnithan (1968) with *E. typica* Unnithan, 1968 from the gills of *R. kanagurta* from the coast of Trivandrum (Arabian sea) as the type species. Rohde (1989) provided a redescription of *E. typica* based on material collected from *Rastrelliger* spp from different localities in Indo-Pacific and considered *E. parukhini* Lebedev, 1980 described from *Scomber japonicus* from the Red Sea as a junior synonym of *E. typica*. Muruges (1995) reported the species from *R. kanagurta* from Visakhapatnam coast (Bay of Bengal). During the present study, infections with the species were noted in *R. kanagurta*, however with low prevalence of 5.4% and mean intensity of 1.2.

Family MAZOCRAEIDAE

Pseudanthocotyle jagannath (Tripathi, 1957) Price, 1961

Syn: *Indomazocraes jagannath* Tripathi, 1957; *Scomberocola eyela* Unnithan, 1964

Remarks Tripathi (1954) erected the genus *Indomazocraes* to include *I. jagannath* from *R. kanagurta* from the coast of Trivandrum (Arabian sea). Price (1961) synonymised the genus *Indomazocraes* Tripathi, 1959 with *Pseudanthocotyle* Bychowsky and Nagibina, 1954 thus *I. jagannath* Tripathi, 1959 became *P. jagannath* (Tripathi, 1959). Subsequently Rohde (1989) and Muruges (1995) reported the species from *Rastrelliger* spp but referred the species under the genus *Indomazocraes*.

In the present locality infections with *P. jagannath* occurred frequently the prevalence and mean intensity to infection were 17.9% and 1.9 respectively.

Kuhnia sprostonae Price, 1961

Synonyms: *Khunia indica* Tripathi, 1959; *K. minorchis* Raju and Rao, 1978; *K. microlepidotusi* Gupta and Krishna, 1977; *K. minor* of Rohde, 1980

Remarks Four species of the genus *Kuhnia* have been recorded from Scombrid fishes of India: *Kuhnia indica* Tripathi, 1959, *K. microlepidotusi* Gupta and Krishna, 1977, *K. pricei* Gupta and Krishna, 1979 and *K. minorchis* Raju and Rao, 1977. Muruges (1995) reported *K. microlepidotusi* from *R. kanagurta* from Visakhapatnam coast. It

is also reported from the same host from Arabian Sea (Mamaev and Parukhin 1986). Rohde (1989) based on a study of specimens collected from *Rastrelliger* spp from different geographic areas considered *K. microlepidotusi* as a synonym of *K. sprostonae*. Muruges (1995) considered *K. minorchis* as a synonym of *K. microlepidotusi*.

The present specimens possessed all the characteristic features of *K. sprostonae*. Infections occurred with a prevalence of 16.3% and mean intensity of 2.3.

Digenea

Family LEPOCREADIIDAE

Opechona bacillaris (Molin, 1859) Dollfus, 1927 (Fig. 1)

Synonyms: *Distomum bacillare* Molin, 1859; *Distomum* (*Dicrocoelium*) *bacillare* of Barbagallo and Drago (1903); *Pharyngora bacillaris* (Molin, 1859) Nicoll, 1910; *Distomum increscens* Olsson, 1868; *Pharyngora retractilis* Lebour, 1908; *Distomum* sp. Nicoll, 1909; *Pharyngora olssoni* Yamaguti, 1934; *Neopechona olssoni* (Yamaguti, 1934); *Lepidapedon elongatum* Chernyshenko, 1949; *Opechona* sp., Mackenzie, 1974; *Lepocreadium guptai* Gupta and Gupta, 1987.

Remarks *O. bacillaris* has earlier been reported from *R. kanagurta* of Visakhapatnam and Kalingapatnam coasts (Bay of Bengal) by Madhavi (1972) and Madhavi et al. (1986). The species is characterized by somewhat elongated body narrowed anteriorly, presence of eye-spot pigment, infundibuliform oral sucker, small ventral sucker, pseudo-oesophagus shorter than oesophagus, gonads in posterior third of the body, vitellarium follicles extending to near the posterior border of ventral sucker, post testicular space 348–742 long and eggs measuring 78–80 by 36–40.

O. bacillaris is cosmopolitan in distribution. Bray and Gibson (1990) have furnished details of hosts, geographic distribution and synonyms of *O. bacillaris* and provided a key for separation of valid species of the genus *Opechona* Looss, 1907. They considered *Lepocreadium guptai* Gupta and Gupta, 1987 as a synonym of *O. bacillaris* and regarded many Indian species of the genus namely *O. siddiqui* Ahmad, 1984 from *R. kanagurta*, *O. ahmadi* Gaevskaya, 1990 from *Pomadys maculatus*, *O. moshina* Ahmad, 1984 from *Scomberoides tala*, *O. vinodae* Ahmad, 1984 from *Pampus argenteus* and *O. travassosi* Ahmad, 1991 from *Fistularia villosa* as *species inquirendae*, since clarification is required as to the presence or absence of a uroproct, an important character used for the separation of *Prodistomum* spp from *Opechona* spp.

Fig. 1 *Opechona bacillaris*

During the present study several specimens of *O. bacillaris* were collected from *R. kanagurta* the prevalence and mean intensity to infection were 33% and 3.4 respectively. The specimens agreed in all details with the description provided by Bray and Gibson (1990) for the species from North-East Atlantic region except for the following differences: Body is narrow anteriorly where as in N-E Atlantic forms it is more or less of uniform width. External seminal vesicle is surrounded by numerous prostatic gland cells, their presence not reported in N-E Atlantic forms. Vitellarian follicles are less dense and extended anteriorly only up to the base of cirrus sac rather than just posterior to ventral sucker as reported for N-E Atlantic forms. Testes are more anteriorly located and are contiguous.

Prodistomum waltirensis (Madhavi, 1972) Bray and Gibson, 1990.

Synonym: *Opechona waltirensis* Madhavi, 1972.

Remarks This species was originally described as *O. waltirensis* by Madhavi (1972) but Bray and Gibson (1990) included it under the genus *Prodistomum* Linton, 1910 on the basis of the absence of a uroproct.

P. waltirensis is characterized by the long slender body, sub-equal suckers, pre-pharynx and oesophagus more or less of equal size, lobed gonads, vitellarium extending to the level of bifurcation and excretory vesicle to the level of pharynx. It closely resembles *P. hynnodi* Yamaguti, 1938, but differs mainly in having lobed gonads. *Prodistomum orientalis* (Layman, 1930) Bray and Gibson, 1990 (Fig. 2).

Synonyms: *Pharyngora orientalis* (Layman, 1930); *Opechona orientalis* (Layman, 1930); *Opechona scomberi* (Yamaguti, 1938); *Lepocreadium puriensis* Gupta and Gupta, 1987.

Fig. 2 *Prodistomum orientalis*

This species originally included under the genus *Opechona* has been transferred to *Prodistomum* as *P. orientalis* by Bray and Gibson (1990) based on the absence of an uroproct.

Bray and Gibson (1990) furnished details of the synonyms, the hosts and geographic distribution as well as the characteristic features of the species. The present specimens agreed fully with the description given by Bray and Gibson. A few prostatic cells that occurred surrounding external seminal vesicle were not reported by Bray and Gibson. The present specimens also keyed to *P. orientalis* in the key provided by Raychard et al. (2008) for differentiation of species of the genus *Prodistomum*.

P. orientalis has been recorded from *R. kanagurta* from Aden (Indian Ocean) by Parukhin (1976). Records from the related hosts include those from Sulawesi (N-W Pacific ocean) by Yamaguti (1953) and North-west Australia by Korotaeva (1974) and Bay of Bengal by Zhukov (1960). Taking into consideration the preference to scombrid hosts and also the morphological features, Bray and Gibson considered *Lepocreadium puriensis* Gupta and Gupta, 1987 from *R. brachysoma* from Puri coast, Bay of Bengal as a synonym of *P. orientalis*.

Family GORGODERIDAE

Phyllodistomum sp.

Remarks Fairly large sluggish flukes measuring 4–6 mm, appearing deep brown in colour and the gut engorged with blood were found in the kidneys of *R. kanagurta* during the months of Nov–Jan. Only 5 out of 184 fish examined showed the infection each infected fish harbored two flukes, giving a prevalence of 2.7% and mean intensity of 2.0. The organization of the body suggested the genus *Phyllodistomum*. The species is yet to be identified.

Family DIDYMOZOIDAE

Renodidymocystis yamagutii Madhavi, 1982

Remarks The genus *Renodidymocystis* was erected by Madhavi (1982) with *R. yamagutii* from the kidneys of *R. kanagurta*, Bay of Bengal as the type species. During the present study, infections with the didymozoid occurred in the kidneys and also blood vessels, the prevalence of infection were fairly high being 45.6%. The forms agreed fully with the original description, except that the eggs were 12 by 6–8 μ m rather than 8–10 by 4 μ m in the type specimens.

Family HEMIURIDAE

Lecithocladium angustiovum Yamaguti, 1953 (Fig. 3).

Fig. 3 *Lecithocladium angustiovum*

Synonyms: *L. scomberi* Yamaguti, 1953; *L. bulbolabrum* Reid et al., 1966; *L. indicum* Gupta and Gupta, 1981; *L. manteri* Gupta and Puri, 1982; *L. microlepidotusi* Gupta and Govind, 1981; *L. siddiqui* Gupta and Gupta, 1987; *L. tewari* Gupta and Gupta, 1987; *L. unibulbolabrum* Fischthal and Thomas, 1997; *L. cibium* Gupta and Jain, 1992. *Clupenurus thynensis* Bilqees et Knight, 1985; *Clupenurus scomberomori* Wang, 1982; *L. jagannath* Ahmad, 1981.

Remarks In the genus *Lecithocladium* as many as 32 species were recorded from marine fish of Indian region. Most of these are not well defined and many of them may not be valid species. Gibson and Bray (1986) in an attempt to clear the confusion reduced the number of species recorded from Indo-Malayan region from 40 to 6. Further, it is also felt that some of the hemiurid genera erected from Indian region such as *Clefticolletta* Sahai and Srivastava, 1978; *Bengalotrema* Malhotra, Nanda, Mukherjee, Ghosh, Sukul and Capoor, 1989 may be synonymous to *Lecithocladium* (see Gibson 2002).

L. angustiovum is the most dominant digenean found in *R. kanagurta* in the present locality, occurring with a prevalence of 88.5%.

Family LECITHASTERIDAE

Aponurus laguncula Looss, 1907 (Fig. 4)

Synonyms: *Aponurus* spp. of Linton, 1940; *A. trachinoti* Manter, 1940; *A. trachinoti* (Yamaguti, 1971); *A. elongatus* Siddiqui and Cable, 1960; *A. orientalis* Ahmad, 1981; *A. waltirensis* Hussain, Rao and Shyamasundari, 1985.

Fig. 4 *Aponurus laguncula*

Bray and Mackenzie (1990) furnished details of the hosts, geographic distribution and earlier reports of *A. laguncula*. This species is highly polyxenic and has a wide geographic distribution. A notable feature of the species is the wide range in egg size, $24\text{--}42 \times 10\text{--}21$. The egg shape is also considered distinctive with narrow more or less pointed anopercular end.

In view of the wide variation in egg size and the euryxenic nature, Bray and Mackenzie (1990) expressed the view that many of the species reported under genus *Aponurus* would fall synonyms to *A. laguncula*. They examined the validity of the various species reported under the genus and discussed the characters used for separating them from *A. laguncula*. The most significant features for separation of species are considered to be the size of sinus sac, sucker proportions and the alignment of gonads.

Four species of *Aponurus* have been recorded from marine fishes of India, *A. breviformis* Srivastava, 1939, *A. bengalensis* Srivastava, 1939, *A. orientalis* Ahmad, 1981 and *A. waltirensis* Hussain, Rao and Shyama Sundari, 1984. Bray and Mackenzie expressed the view that all these four species may be synonymous to *A. laguncula*. During the present study infections with *A. laguncula* are noted in *R. kanagurta* as well as in other marine fish hosts such as carangids, lutianids, polynemids, *Arius* spp, *Terapon* spp and *Nemipterus* sp., thus confirming the euryxenic nature of *A. laguncula*. The flukes occurred attached to buccal cavity or anterior part of stomach and appeared in small numbers in gill washings. The prevalence of infection is 16.8%.

Copepoda

Family BOMOLOCHIDAE

Orbitocolax aculeatus (Pillai, 1962) Pillai, 1967

Synonym: *Bomolochus aculeatus* Pillai, 1962

Remarks Pillai (1962) described *Bomolochus aculeatus* from *R. kanagurta* from Arabian sea. Later he (Pillai, 1967) considered this species under the genus *Orbitocolax* Shen, 1957.

The present specimens agreed with the description given by Pillai (1967) in all characters including the host. The prevalence and mean intensity of *O. aculeatus* were low and the infection was found only in the months of January and September.

Nothobomolochus kanagurta (Pillai, 1965) Pillai, 1967

Synonym: *Bomolochus kanagurta* Pillai, 1965

Remarks Pillai (1961) reported the species as *Bomolochus kanagurta* Pillai, 1965 based on material collected from *R. kanagurta* from Kerala. Later he (Pillai, 1967) placed it under the genus *Nothobomolochus*. During present study infection was found only in the month of May 06,

in one out of 39 fish examined and two individuals of the parasite were obtained. Lin and Ho (2004) reported the species from *R. kanagurta* from Taiwan.

Family CALIGIDAE

Caligus kanagurta Pillai, 1961

Remarks *Caligus kanagurta* was described by Pillai (1961) and Silas and Ummerkutty (1967), from *R. kanagurta* from Kerala, Arabian sea. Ho et al. (2000) reported this species off from *Decapterus kurroides* from Taiwan.

In the present locality, infections with the species occurred sporadically only during certain months of the year, both prevalence and mean intensity to infection were low (4.3 and 1.25 respectively).

Family ANTHOSOMATIDAE

Lernanthropus kanagurta Tripathi, 1962

Remarks *L. kanagurta* was first described by Tripathi (1962) from *R. kanagurta* and *Megalaspis cordyla* from India. Later it was described by Silas and Ummerkutty (1967) from scombrid hosts including *R. kanagurta* from India. Cressey and Cressey (1980) reported a single specimen of the parasite from *R. brachyura* from Borneo. They mentioned that this may be a rare parasite of *Rastrelliger* spp. and *Megalaspis* spp. Pillai (1985) regarded this species as a synonym of *L. corniger* Yamaguti, 1954.

In the present study this species occurred with low prevalence (0.54%) and intensity (1.0). *R. kanagurta* may be an accidental host for the species.

Family LERNAEOCERIDAE

Peniculus scomberi Gnanamuthu, 1951

Remarks *P. scomberi* was described by Gnanamuthu (1951) from *R. kanagurta* from Madras coast, Bay of Bengal. Only four individuals of this species were obtained during the present study. The specimens agreed with the description of *P. scomberi* given by Gnanamuthu (1951) in all characters. Specific characters include: the trunk is six and half times longer than broad and the width of the fourth segment is four and half times to the width of the trunk, cephalothorax is uniformly swollen, slightly twisted and asymmetrical.

Discussion

The study based on examination of 184 *R. kanagurta* collected as monthly samples from Visakhapatnam coast, Bay

of Bengal revealed the metazoan parasite fauna of the scombrid fish to be fairly rich comprising of 15 species of parasites including three species of monogeneans, seven species of digeneans and five species of copepods. Cestodes, nematodes and acanthocephalans were not found. The parasite fauna of *R. kanagurta* is dominated by digeneans belonging to Hemiuridae and Lepocreadiidae and this situation would be related to the feeding behaviour of *R. kanagurta* which comprises planktonic organisms, crustaceans etc. Information available on the life cycles of *Lecithocladium* spp. and *Aponurus* spp. indicates that planktonic organisms such as medusae and copepods serve as intermediate hosts (Koie 1991). Similarly the life cycle of *O. bacillaris* also involves medusae as second intermediate hosts (Koie 1975). Although the complete life cycle of didymozoids is still not known, the available knowledge indicates that the copepods serve as second intermediate hosts (Cable and Nahhas 1962 and Madhavi 1968). Thus the parasite fauna of *R. kanagurta* is a clear reflection of its planktonivorous diet. The scarcity of larval cestode and nematode infections suggests that *R. kanagurta* might be occupying the peak trophic level in the food web and may not constitute an important food item for the larger carnivorous fish. Examples such as these indicate the importance of the status of the fish in the food web as a determinant of species richness and diversity of parasites in the marine ecosystem (Marcogliese 2001).

Some of the parasite species like *L. angustiovum*, *O. bacillaris*, *Prodistomum* spp. and *R. yamagutii* that occurred with high prevalence and mean intensity are to be regarded as typical parasites of this fish. In general the parasite fauna exhibited a high degree of host specificity. Except for *A. laguncula* which is found to be polyxenic, all the other species showed specificity to *R. kanagurta* or other species of scombrid fish. The low number of generalist parasites observed may reflect the reduced exchange of parasites between *R. kanagurta* and other marine fish. A high degree of adaptability, both physiological and ecological, is thus seen between the host *R. kanagurta* and its parasite fauna.

The three species of monogeneans and five species of copepods occurred with low prevalence and intensity indicating that *R. kanagurta* from this locality is not a suitable host for these ectoparasites. Out of the five species, three species *Orbitocolax aculeatus*, *Nothobomolochus kanagurta*, and *Peniculus scomberi* are specific to *R. kanagurta*. *Caligus kanagurta* and *Lernanthropus kanagurta* occurred not only on *Rastrelliger* but also on carangid fish.

The parasite fauna of *R. kanagurta* also shows a distribution parallel to the host distribution. Rohde (1989) undertook a detailed study of monogenean fauna of *Rastrelliger* spp. and reported all the three species of monogeneans recorded during the present study. Four of the

seven species of digeneans reported during the present study namely *O. bacillaris*, *P. orientalis*, *L. angustiovum* and *A. laguncula* were also recorded from other parts of Indo-Pacific region. Further *P. waltirensis* is closely related to *Prodistomum hynnodi* Yamaguti, 1938 recorded from scombrid fish from off the coast of Japan. Three out of five species of parasitic copepods have also been recorded from the other regions of Indo-Pacific region especially off the coast of China and Taiwan. It is evident that the lack of endemism, the high degree of host specificity and probably also the high degree of predictability are characteristic features of the parasite fauna of *R. kanagurta*.

The preliminary studies carried out by earlier workers on biology and genetic population structure of *R. kanagurta* from different geographical areas revealed the possibility of existence of different stocks (Jones and Silas 1962; Luther 1973; Menezes et al. 1993; Jayasankar et al. 2004). The stock from Andaman coast for instance differs significantly from the stock at Arabian sea in details of the seasonal breeding cycle. The genetic studies also revealed the occurrence of different stocks in *R. kanagurta* (Jayasankar et al. 2004). Parasites are now increasingly used as indicators for the differentiation of stocks in marine fish (Mckenzie 2002). Although qualitative differences may not exist in the parasite fauna of *R. kanagurta* from different regions there is a possibility that quantitative differences exist in the occurrence of various species of parasites. For example Rohde (1989) provided data on the prevalence of monogenean species on *R. kanagurta* off the coast of Penang and a comparison with the present data collected at Bay of Bengal, revealed that the prevalence of infection with various monogeneans at Penang is very low (Rohde 1989) as compared to the situation prevailing in the present locality. The data suggests that the monogeneans are better adapted to warm tropical waters of Bay of Bengal. A detailed study of the parasite fauna of this fish from different geographical areas would be expected to provide valuable information.

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