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POPULATION DYNAMICS OF METAZOAN PARASITES OF MARINE THREADFIN FISH, *POLYDACTYLUS SEXTARIUS* (BLOCH AND SCHNEIDER, 1801) FROM VISAKHAPATNAM COAST, BAY OF BENGAL

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ABSTRACT
Population dynamics of metazoan parasites of marine threadfin fish, *Polydactylus sextarius* have been studied for two consecutive years 2005-2006 and 2006-2007 from Visakhapatnam (17.67°'N and 83.32°'E), in the coastal zone of Bay of Bengal, Andhra Pradesh. A total of 676 host species were examined, of which 563 hosts were found to be infected. 24 species of metazoan parasites were collected, comprising 2 monogenetic trematodes, 11 digenetic trematodes, 2 cestode larvae, 1 nematode, 4 Acanthocephalans, 3 copepods and 1 isopod. The ecological parameters like prevalence, mean intensity and mean abundance were calculated to determine the abundance of parasitic species. This study was carried for both overall and groupwise parasitizations. The larval cestodes dominate the parasitic community and the digenetic trematodes occupy the second position. Seasonal variation on parasitization, the relationship between host size and prevalence of infection were studied but the host sex was not taken into consideration due to protandrous nature of the host.

INTRODUCTION

Parasites are small players with crucial role in ecological theatres is well said by Marcogliese (2004) as they serve as imperative tools in providing information on population structure, evolutionary hypotheses, environmental stressors, trophic interactions, biodiversity and climatic conditions. Aquatic parasites have acquired booming interest from an ecological viewpoint due to interaction with their hosts and their environment. They can also be used as 'biological tags' because of their conservative tendency *i.e.,* slower morphological evolution than their hosts (Ayala and Hutching, 1974; Klassen, 1992; Ferrer-Castello *et al*., 2007; McCelland and Melendy, 2007 and Timi, 2007). A number of scientists reviewed the possible use of parasites as bioindicators- Mackenzie *et al*. (1995), Kennedy (1997), Lafferty (1997), Overstreet (1997), Sures *et al*. (1997 and 1999), Valtonen *et al*. (1997), Lafferty and Kuris (1999) and Sures (2001). Williams *et al*. (1992) claimed that parasite tags are superior over artificial tags and to use them as biological indicators. But unfortunately, relentless fishing and environmental disturbances lead to reducing fish populations, which inturn may reduce parasite populations. Indirect evidence also suggests a decrease in parasites in commercially fished species over the past three decades (Lafferty, 2008). In addition, environmental degradation can affect fish parasites. For these reasons, parasites in fishes may serve as sensitive probes to monitor environmental factors (Mackenzie *et al*., 1995; Lafferty, 1997, Lafferty, 2008 and Vidal-Martinez *et al*., 2010). This has stimulated studies in fish ecology: the species present and fish seasonal population dynamics. Parasitic diseases of fish are very common throughout the world and are of particular importance in the tropics (Moyo, 2009). Marine fish serve as definitive and/or intermediate hosts in the life cycles of many helminth parasites. Parasites affect fish health, growth and survival. The Polynemidae or threadfin fishes present a good model to study parasite communities in Visakhapatnam coast as they form a closely related group with varying feeding habits, and they are widely distributed. Data on the helminth parasites of polynemid fish are limited. No consequential work has been carried out on helminth parasites of polynemid fish in Visakhapatnam coast inspite of their nutritive value and availability as an economic sea food to the local communities. Despite the extensive information available on the ecology and biology of Polynemid fishes, there is a vast lacuna prevailing on the studies of the population dynamics and structure of parasite communities of polynemids. The aim of the present study was to determine the status of the parasite communities (prevalence, standard deviation, mean intensity and abundance) and seasonal influence on helminth parasite fauna of *Polydactylus sextarius* Bloch and Schneider, 1801 which is available at this coast throughout the year.

MATERIALS AND METHODS

Study area: For the present study, marine threadfin fishes were collected from Visakhapatnam (17.67°'N and 83.32°'E), along the east coast of Bay of Bengal, Andhra Pradesh. About six species of Polynemid fishes occur along this coast. But *P. sextarius* (Schneider), *P. plebeius* (Broussonet) and *E. tetradactylum* (Shaw) were of common occurrence throughout the year, where as *F. heptadactyla* (Cuvier), *L. indicum* (Shaw) and *P. sexfilis* (Valenciennes) occur seasonally. To minimize the inconsistent results the present study has been conducted for two consecutive years from July 2005 to June 2007. Records pertaining to the date and seasons were maintained. Total samples of 1166 fish were examined; out of these 676 were *P. sextarius*. Different biostatistical parameters were applied for qualitative and quantitative analysis of the data. Biostatistical books by the Snedecor and Cochran (1967), Sundara Rao and Richard (1996), Daniel (1998) and formulae from Sokal and Rohlf (2000) were followed for statistical analysis. The ecological terminology was taken from Margolis *et al*. (1982), Grabda-Kazubski *et al*. (1987) and Bush *et al*. (1997). Standard statistical computations (mean intensity, standard deviation, prevalence and abundance) were carried out using Microsoft Excel Office, 2007.

Prevalence: Prevalence is the number of individuals of the hosts infected with particular parasite species (or) with total parasites divided by the number of hosts examined. Prevalence is expressed in terms of percentage (%).

$$\text{Prevalence (expressed in \%)} = \frac{\text{No. of individuals of a host species infected with a total parasite species x 100}}{\text{No. of hosts examined}}$$

Or

$$\frac{\text{No. of individuals of a host infected with a particular parasite species x 100}}{\text{No. of hosts examined}}$$

Mean Intensity: Mean intensity is the average intensity of total number of individuals of particular parasite species in a sample of host species or total number of individuals of all parasites found in a sample of host species divided by the number of hosts infected with that parasite or the total number of parasites.

$$\text{Mean intensity} = \frac{\text{Total number of individuals of all parasites in a sample of host species}}{\text{Number of hosts infected with that parasites or total number of parasites}}$$

Or

$$\frac{\text{Total number of individuals of a particular parasite species in a sample of host species}}{\text{Number of hosts infected with that parasites or total number of parasites}}$$

Mean Abundance: Mean abundance is the total number of individuals of a particular parasite species in a sample of particular host species divided by the total number of hosts of that species examined (including both infected and uninfected hosts).

To study the seasonal influence of the infection, each annual cycle is divided into three seasons: Rainy, winter and summer. A Chi-square test was calculated for testing the significance between the season and prevalence for each host species. To test the relationship between size of the host and prevalence, all hosts were categorized into 4 or 5 groups according to their length and weight. Coefficient of correlation was carried out for relation between host size and infection.

$$\text{Mean abundance} = \frac{\text{Total number of individuals of all parasites in a sample of host species}}{\text{Total number of individuals of the host s examined (infected and uninfected)}}$$

Or

$$\frac{\text{Total number of individuals of particular parasites in a sample of host species}}{\text{Total number of individuals of the hosts examined (infected and uninfected)}}$$

RESULTS

Total 676 host species were examined, out of which 563 hosts were found to be infected. 24 species of metazoan

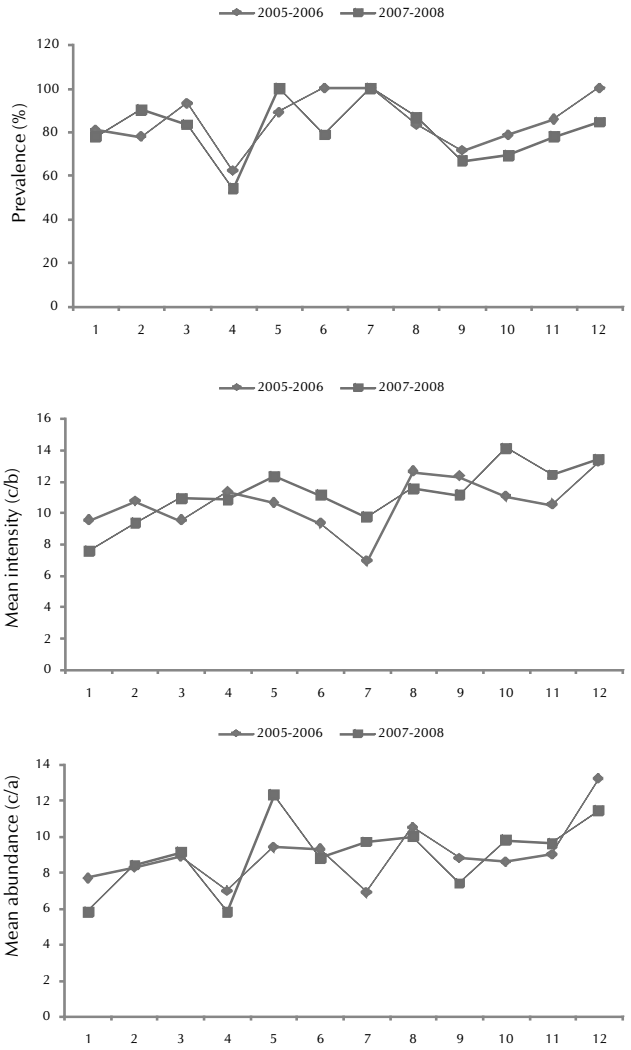
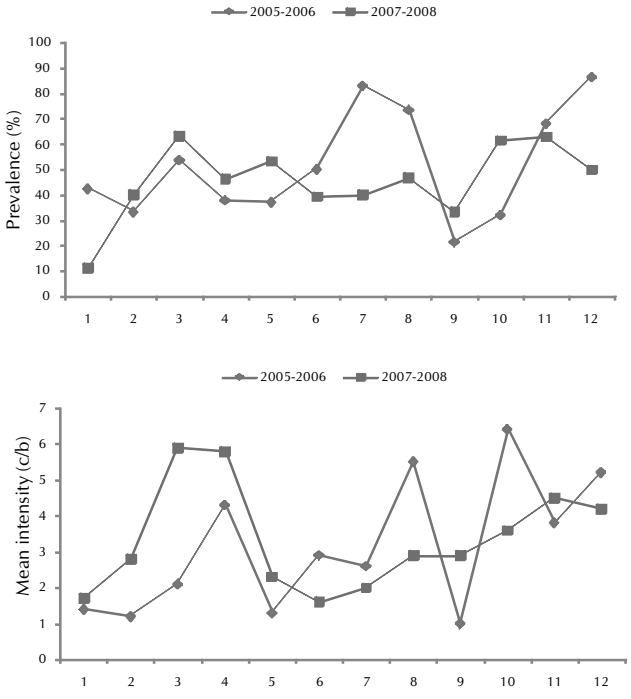


Figure 1: Seasonal population dynamics of total parasites of *P. sextarius* (1 to 12 = July to Jun)

Table 1: Metazoan parasites of *Polydactylus sextarius*

Name of the host	Name of the parasite	No. of parasites collected
Polydactylus sextarius (Bloch and Schneider,1801)	*Choricotyle polynemi* Mamaev, 1972	38
	Polynemicola sextariusi n. sp.,	24
	Lecithochirium polynemi Chauhan, 1945	28
	Lecithocladium glandulum Chauhan, 1945	119
	Erilepturus hamati Yamaguti, (1934) Manter, 1947	89
	Aponurus lagunculus Looss, 1907	14
	Metacercariae of *Prosorhynchus*	553
	Didymozoid sp's	58
	Didymozoid larvae	80
	Timonia caballeroi Madhavi, 1977	112
	Opisthodiplomonorchis elongatus Madhavi,1974	90
	Helicometrina nimia Linton, 1910	8
	Allopodocotyle argyropsi Madhavi, 1975	14
	Scolex pleuronectis Mueller, 1788	3511
	Trypanorhynchid larva	4
	Camallanus cotti Fujita,1927	246
	Neoechinorhynchus topseyi Podder,1937	26
	Raorhynchus polynemi Tripathi,1959	453
	Gorgorhynchoides indicus Bhattacharya and Banerjee,2003	54
	Serrasentis sagittifer(Linton,1889) Linton,1932	3
	Caligus phipsoni Bassett-Smith, 1898	254
	Caligus laticaudus Shiino, 1960	18
	Developmental stages of *Caligus polynemi* n.sp.,	106
	Gnathia maxillaris Sars	9



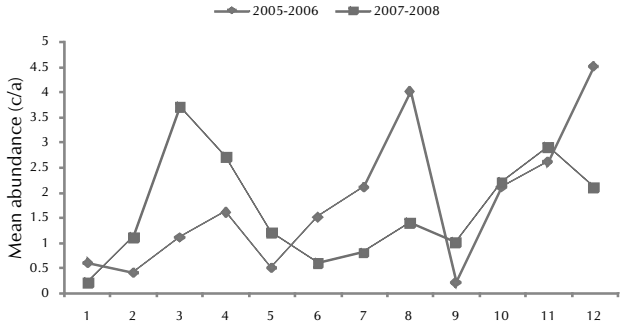


Figure 2: Seasonal population dynamics of *P. sextarius* (Digeneans) (1 to 12 = July to Jun)

parasites were collected, comprising 2 monogenetic trematodes, 11 digenetic trematodes, 2 cestode larvae, 1 nematode, 4 Acanthocephalans, 3 copepods and 1 isopod (Table 1).

Seasonal population dynamics of total number of metazoan parasites in *P. sextarius*: Moderate values of prevalence, mean intensity and mean abundance were noticed (Fig. 1).

Seasonal population dynamics of individual parasitic species

Monogenetic trematodes: The occurrence of monogeneans in this fish is very less. Total number of parasites occurred in the present study for two years is only 62 which is very negligible number when compared to the number of parasites collected in other groups. Population dynamics of these parasites were not analyzed; they were not taken into consideration for calculation.

Digenetic trematodes: March of 2005-06 cycle and July of 2006-07 cycle exhibited lower prevalence values. January, February, May and June of 2005-06 cycle shows higher values when compared to other values whereas the next cycle has not much variation in the values except for its lower value in July. There is no uniformity of Mean intensity for both the cycles. Mean abundance was also not uniform for the two years (Fig. 2).

Nematodes: The prevalence of infection was moderate in the first annual cycle except for the low values of March and April. The second annual cycle resembles the first cycle to some extent. Moderate values of mean intensity were observed in both the cycles throughout the year except for March of 2005-2006 where nil value is seen. Mean abundance is less similar for both the years. Both the cycles vary in their values (Fig. 3).

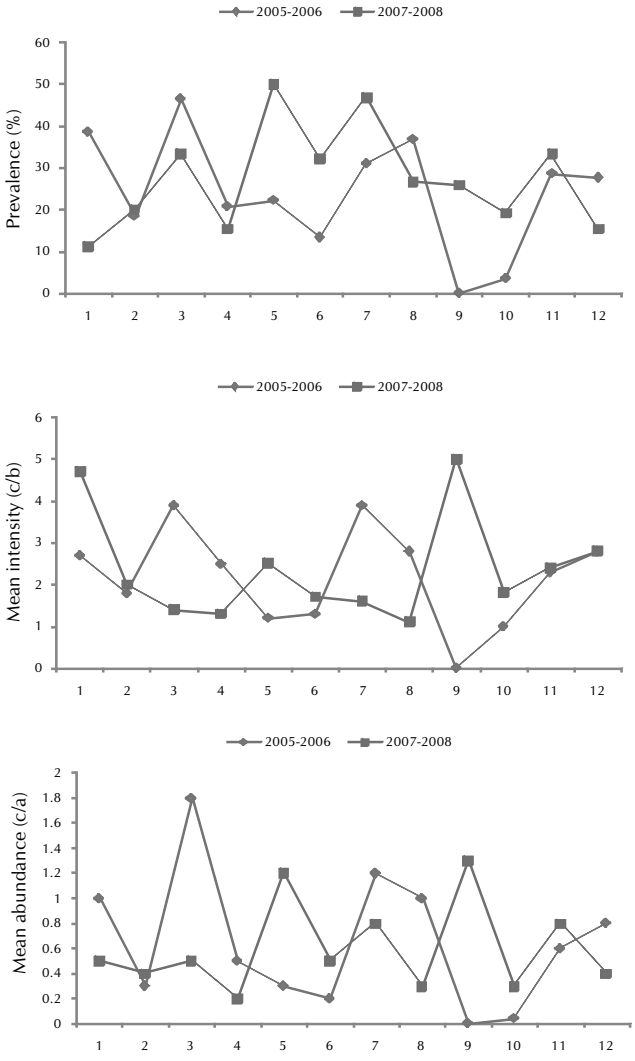


Figure 3: Seasonal population dynamics of *P. sextarius* (nematodes) (1 to 12 = July to Jun)

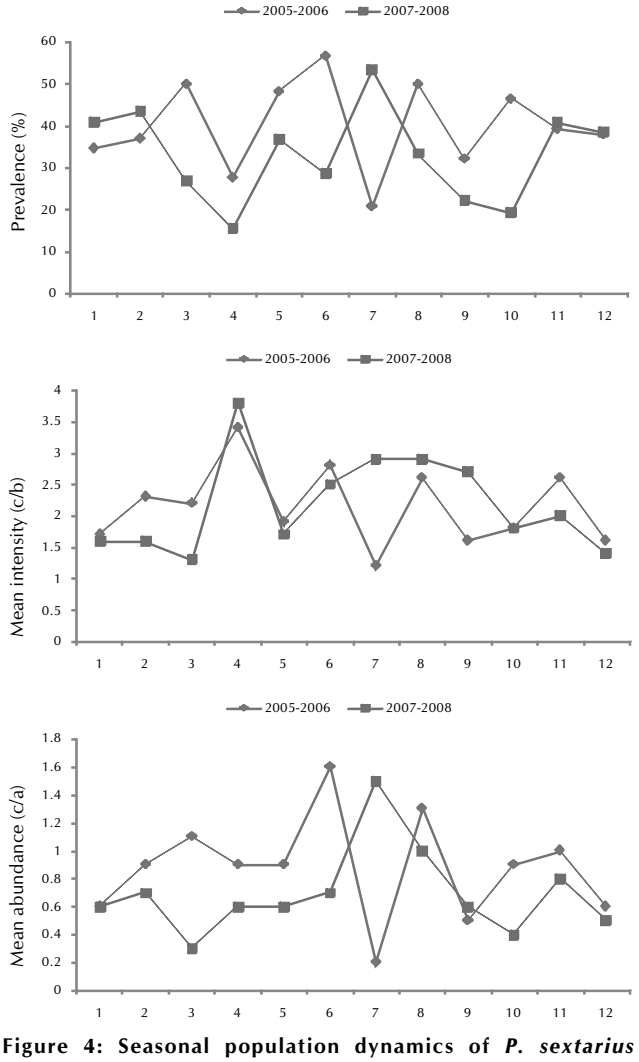


Figure 4: Seasonal population dynamics of *P. sextarius* (Acanthocephalans) (1 to 12 = July to Jun)

Acanthocephalans: Though month of January was showing opposite values of prevalence in the two cycles, overall coherence is good. Mean intensity of 2005-06 cycle shows alternate ups and downs throughout the year with moderate values. In 2006-07 cycle, low values were noticed in the first three months and last three months of the cycle. Remaining months showed moderate values. In both the cycles October is the highly infected month. Mean abundance was uniform for the two years to some extent (Fig. 4).

Copepods: Prevalence was moderate during both the periods. Mean intensity was also not uniform for both the years. Mean abundance shows low values. In 2005-06 cycle except for December, February and June infection rate is quite low. 2006-07 cycle also shows lower values than the first cycle throughout the year (Fig. 5).

Table 2: Correlation coefficient (r) between size and parasitic number in *P.sextarius*

S.N.	Size groups	Class interval	No. of parasites	Coefficient of correlation (r)
1	Group-1	6.0-10.0	20	0.14
2	Group-2	10.1-15.0	2290	
3	Group-3	15.1-20.0	3562	
4	Group-4	20.1-25.0	218	

Seasonal influence: Chi-square test was applied to reveal the significance in the rate of parasitization during different seasons - Rainy, winter and summer. Seasons are not showing significant effect on parasitism in *P. sextarius*. The calculated value of chi-square is 1.86 for the year 2005-06, based on a benchmark of 0.05 alpha, the estimated p-value of 0.3950 suggests that there is not a statistically significant association between the comparison variables. For the year 2006-2007 the chi-square value is 3.23 and the estimated p-value of 0.1990 suggests no significant association. Histograms drawn for prevalence, mean intensity and mean abundance against the seasons for the two cycles of host-species show not much uniformity (Fig. 6).

Size: During the present study, an attempt has been made to find out the possible relationship between the host size and total parasitic infection. For this purpose, correlation coefficient

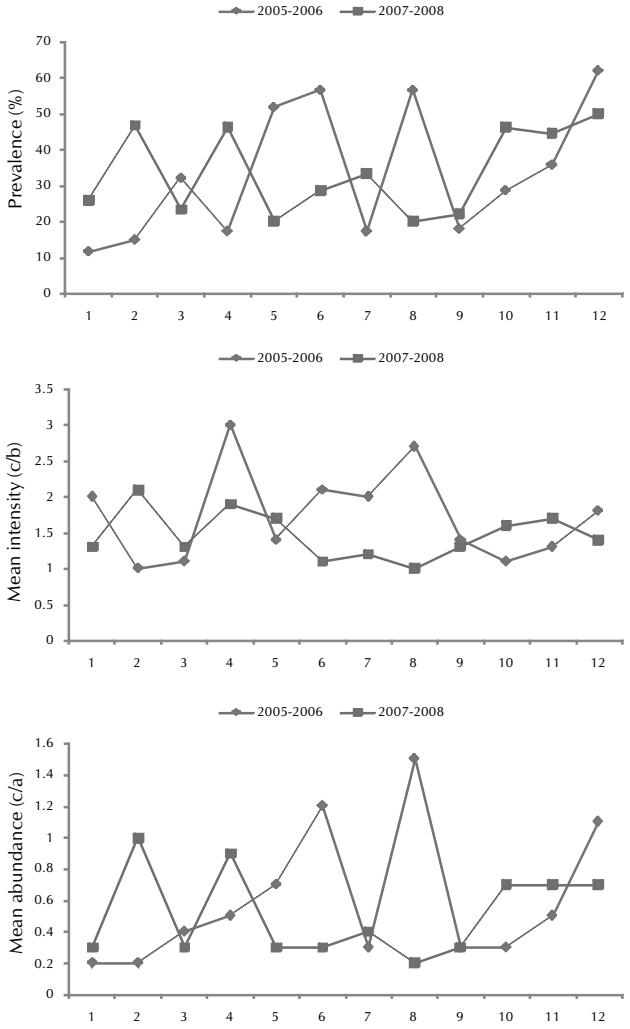


Figure 5: Seasonal population dynamics of *P. sextarius* (Copepods) (1 to 12 = July to Jun)

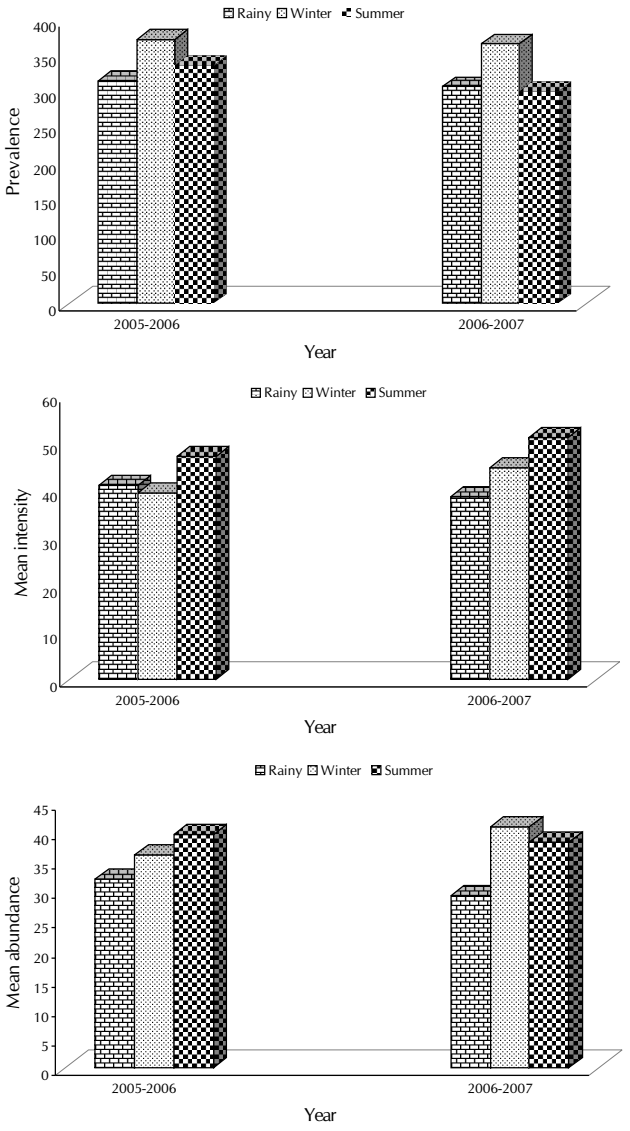


Figure 6: Seasonal changes in prevalence, mean intensity and mean abundance of infection

'r' was calculated for parasites encountered in *P. sextarius*. The calculated values of 'r' 0.14 for *P. sextarius* show the positive correlation, but it is very meager. The overall parastization was high in fish belonging to Group– III in *P. sextarius,* but very few number of fish belonging to Group – I were found to be infected (Table 2).

Sex: Host sex was not taken into consideration due to protandrous nature of the host – host sex changing from juvenile to hermaphrodite, then to a female with growth.

DISCUSSION

The overall prevalence, mean intensity and mean abundance showed good similarity during the two years cycle, the slight deviation appearing was not very significant. The variations in general depended on factors such as density of the host population and its stage and maturity. Hedgepeth (1957), Hopkins (1959), Chubb (1963), Awachie (1966), Manter (1966), Kennedy (1971, 1975, 1977a, 1977b, 1997c), Muralidhar (1989), Rohde (1993), Rodrigues and Saraiva (1996), Chapman *et al*., (2000), Turner (2000), Wang *et al.,* (2001) and Mouritsen and Poulin (2002) already insisted on the importance of temperature as one of the factors in controlling the parasitic infections. Kennedy (1977a, 1977b, 1997) says temperature is a major controlling factor of seasonal periodicity of infection. Rohde (1993) also expressed the same view that infections are more in warm seas than in colder ones. The present study also supports the role of temperature in controlling the parasitic fauna either directly or indirectly. The overall prevalence, mean intensity and mean abundance showed good similarity during the two years cycle, the slight deviation appearing was not very significant. The variations in general depended on factors such as density of the host population and its stage and maturity. Statistically there is no significant association between the seasons and prevalence of infection. But parasitization is high during winter months than in other months. The environmental conditions of tropical waters are quite favorable in winter months. These waters are warm but not ice cold in winter. At these moderate

temperatures, zooplankton, invertebrate and smaller vertebrate fauna may be rich when compared to high temperature of summer months in tropical waters. The sea is calm and there may not be any disturbance during this season. This naturally corresponds to the peak in feeding activities of the fish. Recruitment of infection may take place after summer and reach their peak in winter months. There is a meager positive correlation between the host size and total parasitic infection. The impact of diet and feeding habits on the parasitic infection in the fish hosts were carried out by Pearson (1968), Kuperman (1973), Cannon (1977), Williams and Jones (1994), Luque *et al*. (1996) and Johnson *et al*. (2004). In the present study impact of food and feeding habits of the host can be considered as one of the prime causes of larval parasitic abudance as *P. sexatarius* is carnivorous and its diet constitutes crustaceans, molluscs, snails and shrimps which act as primary intermediate hosts for the most of the digeneans and cestodes. The variation in infection with age group may be because of younger fish have less capacity of feeding whereas older fish may be resistant and therefore do not allow new extra parasite burdens (Lo *et al*., 1998; Zelmer and Arai, 1998 and Johnson *et al*., 2004). At the same time, the parasite life span also plays its role with number of parasites diminishing in the host with increasing age. Thus less feeding capacity, immunity and parasite life span may be the main reasons for low parasite burden in the small and old fish when compared to the medium sized fish. Thus, abundance of parasite population is attributed to feeding capacity of the host which is governed by biotic and abiotic factors like temperature, water currents etc. The present study holds good with the views of Holmes (1990) which suggests that fish as intermediate hosts have rich parasite fauna since they harbour both adults and larval helminths.

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