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AGGRESSION OF CESTODE, *POLYONCHOBOTHRIUM YAMUNICA* SP. IN ENHANCED BODY SIZE OF FRESHWATER EEL, *MASTACEMBELUS ARMATUS* IN RIVER YAMUNA, INDIA

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ABSTRACT
Animals vary markedly in the number of parasites they harbour - most have just a few, but some have many. Parasites become more concern under the current issue of biohazard. *M. armatus* is one of the food stuff fish of Gangetic plain of India and also found in Pakistan to Viet Nam and Indonasia.The infection prevalence of *P. yamunica* sp. and the effect of parasite on the size and sex of *M. armatus* were studied. The overall infection was observed 13.63-32.31% with a mean intensity of 1.23-2.17 from May 2007-April 2009 in river Yamuna at Allahabad. The trend of infection prevalence was observed positive to host body size in both the sexes during both years of investigations (May 2007 to April 2009). The infection was found highly significant in male body size (2007-2008: $r=0.998$, $P<0.001$; 2008-2009: $r=0.999$, $P<0.001$). Sex wise polarity of infection prevalence was observed in the year of May 2008 to April 2009. But the enhanced mean intensity of worm was found in larger body size of female fish whereas it was negative to the male. The aggression of *P. yamunica* sp. in larger weight class (30.1cm- >45.0) of *M. armatus* emphasized its susceptibility to its infection that would be continued generation per generation in ecosystem. The findings, aggression of parasite in larger body size of fish is become very highly concern due to its economy and servility in natural habited. Less overall mean intensity explained that the host has acquired immunity against the parasite to carry along its life cycle for nutrition. Parasites become serious to our food stuff fishes in spite of economy due to their infection and debilitated host health.

KEY WORDS: *Polyonchobothrium yamunica*, *Mastacembelus armatus*, River Yamuna, Allahabad.

INTRODUCTION

Allahabad is endowed with rich and varied aquatic resources amenable for fisheries and aquaculture being the confluent of river Ganges and river Yamuna in the Gangetic plain of India. The seeds of Helminthology were sown by Dr. W. F. N. Woodland (1912-1922) in the department of Zoology, University of Allahabad and it was propagated by eminent parasitologists Prof. Mehra, Prof. and Emritus V. N. Capoor and Late Dr. Shohan Lal Mishra who has contributed to taxonomy by discovering new genera and species of helminthes. Prof. Sandeep K. Malhotra has engraved the ecology of parasites in this fauna and still now, he is endeavoring to shape this discipline for the department.

Parasites represent an important component of natural community (Preston and Johnson 2010). Parasites (viruses, protozoans, helminthes, nematodes, annelids, mollusks, crusteceans, acanthocephalan, isopoda, cyclostomes) are also found in fishes and make effect on their population size and dynamics by mortality of the fish etc. Generally high fish mortality occurs in river, ponds, lakes etc. in spite of closed ecosystem system due to heavy accumulation of parasitic infection thereby decreasing the aqua resource production (Shah, Singh, Saikia, Paswan 2012). Environmental factors also influence the fish health in response of their parasite (Plumb, Grizzle and Figueiredo 1988, Shresta, 1990). They become serious to our food stuff fishes in spite of economy due to their infection and debilitated host health (Ogbulie, Nwigwe and Anyadoh 2011). Host-parasite systems are naturally occurring in nature. Anderson and May (1978), May and Anderson (1978) emphasized that parasites seem more important in ecology as a selection pressure (Poulin, 1993) and regulator of hosts. Perhaps their association can be apparently emphasized by ecologist (Dobson, Lafferty and Every, 2005). But parasitic population dynamics never follow a single model to survive in their hosts. Hence even today, they are the successor of life at every tropics level of ecosystem. Aggression of parasite in a model at a definite age of host is adaptive model to make sure to its establishment in ecosystem. Aggression of parasite in host body can influence the population dynamics (Anderson and May 1991). Hudson and Dodson (1995) suggested, the parasite transmission and host mortality can often be obtained by analyzing pattern of age - prevalence and age intensity *i.e.* the size of fish. Parasite aggregation has important implications for the population and evolutionary dynamics of the parasite and its host. In the case of macroparasites, the host death due to the mortality and morbidity lead to be dose-dependent for the dispersal of infective stages in other hosts. Thus, a central theme of macroparasite studies over the years has been the development of a theoretical and empirical understanding of the stabilizing role of aggregation in the population dynamics of parasitic helminthes and their hosts (Anderson and May 1978, Anderson and May 1982). The proportional availability of parasite in host can explain its population dynamics. Therefore the naturally occurring in fresh water, food stuff fish, *M. armatus* of Gangetic plain of India was studied and found the enhanced aggression of *P. yamunica* in larger size class (30.1cm - >45.0) of *M. armatus* fish emphasized its susceptibility to infection that would be continued generation per generation in that ecosystem (Barber 2005). Parasites depend on host-derived energy for growth and development, and so are potentially affected by the host's ability to acquire nutrients under competitive foraging. Although parasites might be expected to grow faster in hosts that are better at acquiring nutrients from natural ecosystems, it is also possible that the most competitive hosts are better at countering infections, if they have an improved immune response or are able to limit the availability of nutrients to parasites. Therefore, less overall mean intensity (1.23 - 2.17, Table 1.1) explain that *M. armatus* has acquired immunity against the parasite to carry along its life cycle for nutrition. A scientific opinion of European Food Safety Authority promotes the present discussion under the scenario of risk assessment of parasites in fisheries products. (EFSA 2010).

MATERIALS AND METHODS

The present data collection was made during 2007-2009 of unpublished thesis work (Kumar, 2012) under the University of Allahabad. The freshwater eel, *M. armatus* (Lecepede) naturly occurring in river Yamuna were caught by netting and angling method at around Kakraha Gat (25^{o} 24' 58.57''N; 81^{o}49'12.79"E, MSL, 266 ft; Google, 2012), Sadiyapur, Allahabad, Uttar Pradesh, India. *M. armatus* are also found in Pakistan to Viet Nam and Indonesia. The total number of 646 eels, *M. armatus* was examined during the two years of investigations (2007-2009). Captured eels were transported to the lab in a natural water containing tank. These were scarified in tank by applied over dose of clove oil (3-5drops/liters). These were measured by body length in centimeter. Fish were dissected longitudinally to the body in the laboratory. The cestode worms were taken out from the G. I. tracts after dissecting the intestine longitudinally. Sex differentiation of the sampled eel was recorded on occurring of testes or ovary/eggs in the body cavity. The occurrence of cestode *P. yamunica* sp. (kumar, Jaiswal, Malhotra and Capoor 2007) were counted per individual eel and recorded. The month wise and season wise collection of data were maintained. The present body length data (Table 1.1 and 1.2) are derived from the recorded month wise data. The examined length of the eel were divided into three class <30.0cm, 30.1-45.0cm and >45.1 of length of each year. The infection prevalence and mean intensity calculated according to the occurrence of cestodes in each class of length after Malhotra, Dixit and Capoor (1981), formulae are given below –

Mean Intensity

$$\text{M.I.} = \frac{\text{Number of parasites}}{\text{Number of infected hosts}}$$

Prevalence of infection

$$\text{I.P.} = \frac{\text{Total number of infected hosts}}{\text{Total number of examined hosts}} \times 100$$

The Linear regression and ANOVA were analyzed by software, Systat 11 **(**Wilkinson 1982) The whole worms were washed with lukewarm water, and then sacrificed after counting. These were kept in record after staining for taxometric analysis.

RESULTS

The total number of 136 infected fish was found with a total number of 212 cestodes, *P. yamunica* in river Yamuna.The findings of infection prevalence and mean intensity of different body length classes are present year wise in Table 1.1 and 1.2. The overall infection prevalence (13.63-32.31%) of *P. yamunica* sp. in *M. armatus* were found heavier infections associated with larger body size (Table 1.1 and 1.2) during the investigating year 2007-2009 (<30.0cm: 2007-2008: male- IP, 18.42%, MI, 1.43; female- IP, 21.30%, MI, 1.23; 2008-2009: male-IP, 13.63, MI, 2.17; female- IP, 14.28, MI, 1.33; >30.1cm: 2007-2008: male- IP 22.22-32.31%, MI, 1.25- 1.67, female- IP, 21.42-30.56%, MI, 1.55-1.67; 2008-2009: male- IP, 23.53-27.45%, MI, 1.38-1.56; female- IP, 14.81-17.74%, MI, 1.64-2.0; Table 1.1and1.2) with enhanced mean intensity in female than male fish.

Table 1.1 Trends of infection of *P. yamunica* sp.by different body size classes of *M. armatus* during 2007-2009.

	Host Examined			Infection Prevalence (%)		Mean Intensity	
Length(cm)	Male Fish	Female Fish	Total Fish	Male Fish	Female Fish	Male Fish	Female Fish
				2007-2008			
< 30.0	114	61	175	18.42	21.30	1.43	1.23
30.1- 45.0	65	36	101	32.31	30.56	1.60	1.55
> 45.1	18	14	32	22.22	21.42	1.25	1.67
				2008-2009			
< 30.0	88	42	130	13.63	14.28	2.17	1.33
30.1- 45.0	68	62	130	23.53	17.74	1.38	1.64
>45.1	51	27	78	27.45	14.81	1.56	2.00

TABLE 1.2 Linear regression and Poisson distribution values of infection and mean intensity of *yamunica* sp. in size of *M. armatus* during 2007-2009

	Male Fish	Female Fish
Size *Vs*	2007-2008	
Infection prevalence (%)	Y=8.712+0.624.X; r=0.998 P<0.001	Y=21.236+0.098.X; r=0.300 P<0.500
Mean Intensity	Y=1.519-0.002 r=0.158 P= <0.500	Y=1.010+0.015.X; r=1.00 P< 0.400
	2008-2009	
Infection prevalence (%)	Y=6.721+0.456.X; r=0.999 P<0.001	Y=14.009+0.049.r=0.413 P<0.500
Mean Intensity	Y=2.476-0.024.X; r=0.896 P<0.100	Y=1.010+0.015.X; r=1.000, P<0.001

DISCUSSION

The findings of interrelationships between body length of *M. armatus vis-à-vis* infection prevalence and mean intensity of *P. yamunica* sp. are given in Table. 1.1. The observed infection prevalence of *P. yamunica* sp. in *M. armatus* was found heavier in larger body size during the investigating year 2007-2009. The intensity was noticed heavier in female than male fish. The significant values of linear regression analysis (r) and Poisson distribution values (P) of infection prevalence and mean intensity on size of fish are given in Tables 1.2.

Surveys of macroparasites (parasitic helminths and arthropods) have shown that, almost without exception, are aggregated across their host populations, with most individuals harbouring low numbers of parasite, but a few individuals enjoying host to many (Shaw and Dobson 1995). Keymer and Anderson (1979) experimentally demonstrated that the extent of spatial aggregation in the infective stage distribution is reflected in the level of parasite aggregation across hosts. Anderson and May (1978) stated the small differences in susceptibility between hosts can rapidly produce non-random, aggregated distributions of

parasites. The parasitic susceptibility to host varied influenced by infection, including age, sex, genetics, physiology, immunology of host and environmental factors (Robert, Thomas, William, Anthony and Cornelia 2008).

The occurrence of heavier incidence of *Proteocephalus ritae* plerocercoids in heavier fish of *Sciaena coitor* in tropical water at Allahabad had been recorded by Chatterjee (1991) similar to identical trends exhibited in study in same habitat. The positive infection prevalence with body size had also been statistically analyzed by many earlier workers (Zar, 1996, Scholz, 1986, Olurin and Somorin, 2006). The physiological and dietary differences between the sexes of the host were argued to be the principle factors that influenced infectivity patterns depicting sexwise differences to show higher infection prevalence in one sex or the other (Chauhan, Malhotra and Capoor, 1981).

Vankara, Mani and Vijayalakshmi (2011) reported that 19 species of metazoans showed positive interrelationship of worm burden to similar host, *M. armatus* in river Godavari, India. The significant linear regression value (r=0.641) between prevalence of Cestode, *Circumonchobothrium shindei* and body size of the host was recorded with the dominance of population among all parasites by the previous author. The present findings of linear regression values between host size and prevalence (r= male 0.998 - 0.999; female 0.300 - 1.00) and mean intensity (r= 0.158 - 0.896; female 1.00 -1.00) showed higher conformity with the previous result and strong confidence of observed results (Table 1.2).

Chatterjee (1991) hypothesized a transmission and receiving host model which performed on the basis of prey and predator system of the same host ***i.e*** cannibalism. Belland and Burt (1991), Guegan and Kennedy (1993) explained that heavier accumulation of heavier infections in larger host would be responsible for the eating of smaller infected host. The present findings of Table 1.1 and 1.2 is closer to the result of Chatterjee (1991) reported that 80% in larger fish (50.0-55.0cm) was stared disappearing in July, thereby resulting into decrease in infection incidence. Bhalya, Seth, Malhotra and Capoor (1983) statistically established that *Wallago attu* fish (>45.1cm) harboured higher incidence with calculated high values of regression coefficient (r=2.1783) than smaller fish (<35.0 cm- r=1.6638; 35.1 cm- r- 2.0806).

The conclusion of Chaurasia (2002) on continuous supply of infective stages of parasites or intermediate hosts (secondary host= Cyclops, arthopods) throughout the life cycle of definite host were in conformity with patterns of larger fish being heavily infected by *Senga rostellata* n.sp., *Polyonchobothrium humidii* sp. and *Gangesia pauciarmatus* sp. in pond fish *Wallago attu* at Ballia (U.P) Furthermore, Wilson, Bjørnstad, Dobson, Merler, Poglayen, Randolph, Read and Skorping (2002) explained that parasite loads tend to increase with age and may plateau in older animals, though if acquired immunity is then they may ultimately decline again, so reducing the degree of parasite aggregation. Genetic differences in susceptibility to infection may also be important in aggression of parasite in larger size of host. Other factors that may contribute to the Mean intensity are the condition of the host, behaviour, parasite's genetics and seasonality. Comparative studies of aggregation suggest that the infection process and the habitat of the host may make significant contributions to the between-species pattern of aggregation (Shaw and Dobson 1995, Shaw, Grenfell and Dobson, 1998). The present findings suggest similar to result of Chaurasia (2002) that *M. armatus* accumulated less infection in smaller class of length (<30.0cm: 2007-2008: male- IP, 18.42%, MI, 1.43; female- IP, 21.30%, MI, 1.23; 2008-2009: male-IP, 13.63, MI, 2.17; female-IP, 14.28, MI, 1.33) due to their less dietary habit in early age of life. Therefore the smaller length class of female fish (14.28-21.30%) harboured more infection than male (13.63-18.42) that might be happened in spite of sex biased-parasitism in spite of immune susceptibility (Hillgarth and Wingfield 1997). The aggression of parasite in larger body size of fish (>30.1cm- 45.0: 2007-2008: male- IP 22.22-32.31%, MI, 1.25- 1.67, female- IP, 21.42-30.56%, MI, 1.55-1.67; 2008-2009: male- IP, 23.53-27.45%, MI, 1.38-1.56; female- IP, 14.81-17.74%, MI, 1.64-2.0; Table 1.1and1.2) occurred due to the ferocious dietary habit of eel (Vankara, Mani and Vijayalakshmi. 2011). But the female showed consistent higher prevalence of infection than male in larger size of eel. Consequently larger fish size (>45cm) found lesser infection than their lower class size (30.1-45.0 cm) this would be resulted due to acquired immunity of the host in spite of enhanced size (age) group (Anderson and May 1985). The more significant Poisson values of prevalence of male ($P<0.001$- 0.001) than female ($P<0.500$ - <0.005) suggest that male was found steady to get the infection in all growing age than female during the investigation period while the significant Poisson values ($P<0.100$-<0.001; 2007-09) of mean intensity of male and female was noted with variance, confine that establishment of parasite did not occurred in regular fashion (Table 1.2).

CONCLUSION

The purview of above discussion that Overall enhanced prevalence (14.81- 32.31%) occurred in enhanced larger body size of fish due to ferocious dietary habit in larger fish and less overall mean intensity (1.23-2.17) in all size explained that the host has acquired immunity against the parasite to carry along its life cycle for nutrition during the investigating period of study. The study becomes important under the circumstances of biohazard, parasitized foodstuff fish and risk assessment of parasite to our health.

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