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Impact of seasons, host age, size and sex on the prevalence of protozoan parasites in ornamental fish

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Abstract: *Ornamental fish culture is one of the most economically important applied strategies all over the world and considered as one of the most important means of home entertainment, because of its diversity and beauty of picturesque colors. The, ornamental fishes are also used for commercial purposes as a new industry all over the world. World export of ornamental fish was almost US $ 283 million in 2006. The ornamental fish are exposed to various disease problems which causing herm to ornamental fish industry. Present study have been conducted during the period of March 2014--April 2015 to show that the ornamental aquarium fish Gold fish (Carassius auratus* L.*) and ornamental edible fish Tilapia (Oreochromis niloticus) are mainly affected by some external protozoan parasites .i.e Myxozoa and Ciliophora which may cause serious damage to fish industry. The paper deals with the prevalence of protozoan parasites of the ornamental fish. It has been found that the different aspect like seasonal variation, host age, size and sex affects the prevalence of parasitic infestation over the fish species. A definite seasonal effect is observed, the post-monsoon (November-February) found to be season of severe infection of fishes, where the percentage of infection was obviously higher than other seasons. The study revealed that the prevalence of infection was higher in female than male. The large sized adult fishes were more subjected to parasitic infection than small younger ones.*

Key Words: *Ornamental fish, Prevalence, Protozoa, Seasonal variation, Host age, Size, Sex, India.*

I. Introduction

Ornamental business service in India recorded a value of 1.3millions US $ in the export market. West Bengal is also sanctified with a wide range of ornamental fish biological as well as commercial importance. Ornamental fish keeping is a hobby worldwide, mainly in developed countries [1]. Some ornamental fish are edible and it has importance in the diet of different countries especially in the tropics and subtropics.

In recent times, there has been tremendous increase in the development of fish farming and culture attributable to the increased need for affordable animal protein especially in the tropics. Parasitic infection and diseases are some of the factors hindering high productivity in fish farming. In spite of this lucrative businesses, ornamental fishes suffer from loses due to the invasion of different ectoparasites.

In the present study two groups of ornamental fish namely, ornamental aquarium fish Gold fish (*Carassius auratus* L.*)* and ornamental edible fish Tilapia (*Oreochromis niloticus*) was selected for exploration of parasitic survey. The ectoparasitic diseases of fishes play an effective role in the economic losses of fish farms through mortality and decrease growth rate of fish especially in the highly intensified systems. External parasites constitute the largest group of pathogenic organisms in water fish [2] and cause severe mortalities [2, 3]. Ectoparasitic protozoa are cited as the major problem in ornamental fish farms where high temperature and organic content accelerate the life cycles of parasites and promote their spread [4]. In the present study it has been seen that protozoan parasites causes fatal diseases to the fishes [5]. Whitish cyst in the skin and gill were recovered and also loss of mucus, slight hemorrhage at the base of dorsal, pectoral and caudal fin were also observed in case of heavily infected fish. Hatchery diseases of fresh water fish in Sri Lanka are reported heavy mortality in major carp fry and fingerling due to ciliate ectoparasites like *Trichodina sp. , Ichthyophthirius sp., Chilodonella sp.* and fluke like *Dactylogyrus sp.* during nursery operation [6]. In these research works, we have taken Protozoan parasites causing fatal diseases to the fishes directly or indirectly [7]. Amongst the protozoan parasites, Myxozoa and Ciliophora cause serious diseases in fishes [8].Several protozoan parasites which devastatingly affect this fish fall under the Phylum - Ciliophora Doflein, 1901 and Myxozoa Grasse, 1970. Ciliates are the most identified protozoan organisms where they can easily spread among most of fish hosts [2] and trichodinids are common ciliate ectoparasites living on the skin and gills of fish, and have major importance in fish pathology [9, 10].

The paper deals with the prevalence of ectoparasites of ornamental aquarium and edible fish in relation to the Host age, season, size and sex.

II. Material And Methods

2.1 Sampling:

During the period of March 2014--April 2015, around 30 fish farms located at five different districts (Nadia, Hooghly, Howrah ,North 24-pargana and South 24-pargana) of West Bengal have been surveyed. The fish specimens were collected and brought alive to the Parasitology laboratory, Dept. of Zoology, University of Kalyani for examination.

2.2 Parasitological examination:

Total 910 numbers of fishes were observed for detection of ectoparasitic infection. Parasitological examination was carried out for the detection and identification of the external parasites on the skin, gills and the accessory respiratory organs of the samples.

2.3 Isolation of pathogens:

The infected fishes were collected and examined in every season as well as month of the year. Gill, body, and tail fin smear were prepared on grease free clean slides with a drop of 0.5% NaCl solution and air-dried. The Indian ink method of Lom and Vavrá [11] was employed to identify the Myxozoan spore and for permanent preparation, the air-dried smears were stained with Giemsa. The Ciliophorans parasites were subjected to silver impregnation after the method of Klien [12].

The months were divided into three groups namely March- June (Pre-monsoon), July-October (Monsoon) and November-February (Post-monsoon).

Prevalence, mean intensity and abundance concepts as suggested by Margolis *et al*. [13] were used in the present study.

$$\text{Prevalence (\%)} = \frac{\text{No. of Infected fish/(s)} \times 100}{\text{Total number of fish examined}}$$

III. Results

During the study work, a total of 910 specimens of the fish have been collected, out of which 567 fishes were found to be infected with different protozoan parasites. The infected fishes were identified by their irritating and sluggish movement. Heavily infected fishes showed reddish appearance and white spots throughout the whole body including the gills. The survey showed that the fish were mainly affected with Myxozoan as well as Ciliophorans parasites.

3.1 Seasonal variations in prevalence:

The statistical data accurately measured and showed that Myxozoan parasites were most prevalent during monsoon season i.e July to October whereas, the Ciliophorans were affecting the fishes throughout the year but mostly during the post-monsoon season i.e. November to February (Table.1 and Table.2). Considering the average parasitic infection throughout the year it was observed that the maximum parasitic infections occurred during the November to February and the minimum were taken place during the July to October. (Table.2 and Fig.1, Fig.2).

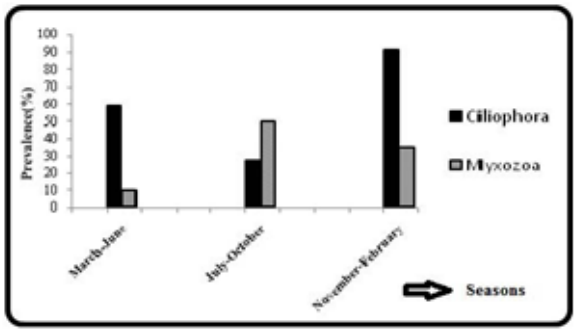

Figure 1: Graphical representation of seasonal prevalence of parasitic protozoa of Gold fish (*Carassius auratus*).

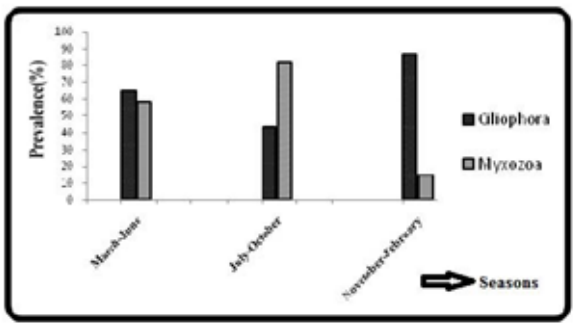

Figure 2: Graphical representation of seasonal prevalence of parasitic protozoa of Tilapia (*Oreochromis niloticus*).

3.2 Age wise variations in prevalence:

In the study it was observed that there is a relationship between the incidence of parasites and age of fish can be established .The occurrence of parasite was less in younger fishes than in adult ones which were above 6 month of age (Table. 3 and Fig.3).

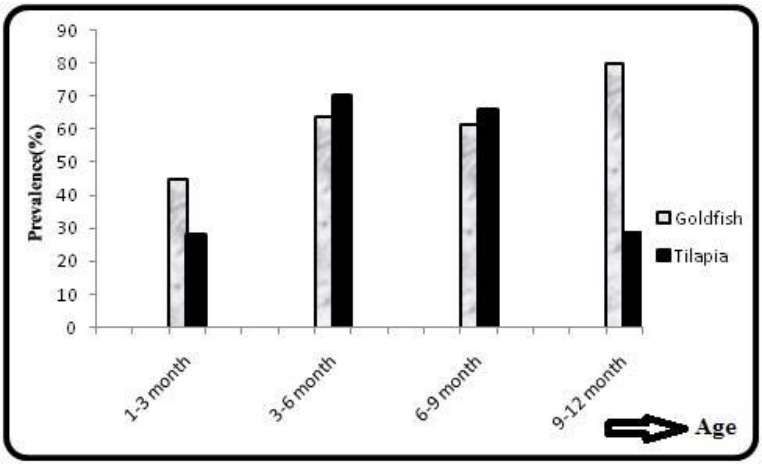

Figure 3: Graphical representation of age wise prevalence of parasitic protozoa in ornamental fish.

3.3 Length wise variations in prevalence:

Present study revealed that the infections are length dependent. It has attempted in this work to find the relationship between length of the fish and the percentage of infected fishes. The fishes belonging to different size were grouped in different length classes (Table.4 and Fig.4) to explore the prevalence of infection of both the fishes in each length group. It is revealed that lengthy fishes are more susceptible to infection in compare to small fish i.e. larger fishes were heavily parasitized than smaller ones. From this study it can be concluded that the smallest fishes were relatively less susceptible to infection than the other length groups and the percentage of infection increases with increasing fish length.

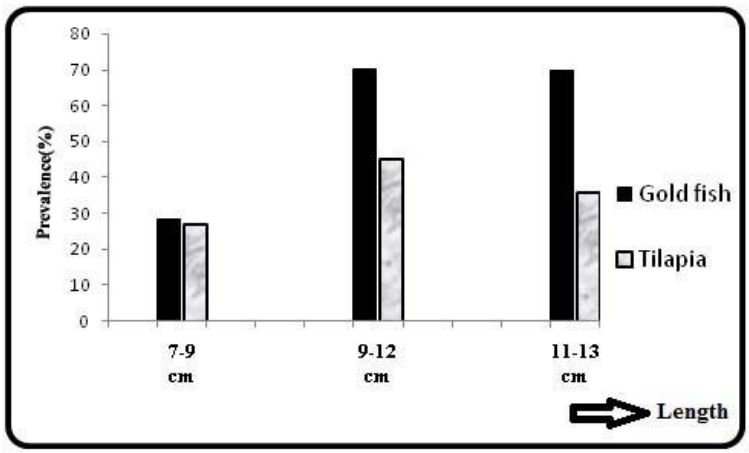

Figure 4: Graphical representation of length wise prevalence of parasitic protozoa in ornamental fish.

3.4 Sex wise variations in prevalence:

Similarly, differences were found in infection rate with regard to the sex of the host both the Tilapia and Goldfish were measured separately and revealed that the female, are more prone to infection as compared to their counter partners (Table 5 and Fig.5).

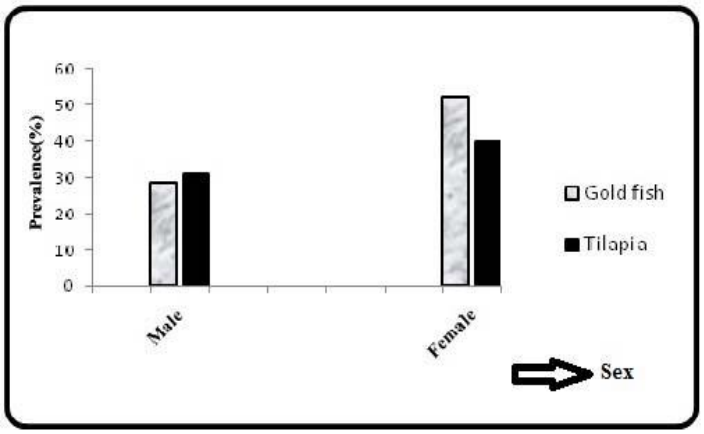

Figure 5: Graphical representation of sex wise prevalence of parasitic protozoa in ornamental fish.

Table. 1 Season wise prevalence of parasitic protozoa in ornamental fish:

Month	Ciliophora							Myxozoa						
	Gold fish (*Carassius auratus*)				Tilapia (*Oreochromis niloticus*)			Gold fish (*Carassius auratus*)				Tilapia (*Oreochromis niloticus*)		
	Parasites	No. of fish examined	No.of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)	Parasites	No. of fish examined	No.of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)
March - June	*Trichodina sp.*	170	85	50.50	60	30	50	*Thelohanellus sp.*	170	17	10	60	21	35
	Trichodinella sp.		69	40.59		12	20							
	Triperticlla sp.		54	31.77		18	30	*Myxobolus sp*		0	0		24	40
	Ichthyophthirtus sp.		14	8.24		9	10							
July - October	Parasites	No. of fish examined	No.of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)	Parasites	No. of fish examined	No. of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)
	Trichodina sp	250	37	14.80	60	12	20	*Thelohanellus sp*	250	49	19.60	60	36	60
	Trichodinella sp.		65	26.00		6	10							
	Triperticlla sp.		47	18.80		6	10	*Myxobolus sp*		76	30.40		33	55
	Ichthyophthirtus sp.		0	0		6	10							
November - February	Parasites	No. of fish examined	No.of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)	Parasites	No. of fish examined	No.of infected fish	Prevalence (%)	No. of fish examined	No.of infected fish	Prevalence (%)
	Trichodina sp	310	271	87.42	60	42	70	*Thelohanellus sp*	310	76	24.52	60	5	8.33
	Trichodinella sp.		212	68.39		30	50							
	Triperticlla sp.		191	61.61		42	70	*Myxobolus sp*		33	10.65		6	10
	Ichthyophthirtus sp.		261	84.19		45	75							

Table. 2 Season wise Prevalence (%) of Parasites in ornamental fish:

Month	Gold fish (*Carrasius auratus)*					Tilapia (*Oreochromis niloticus*)				
	No. fish examined	Ciliophora		Myxozoa		No. fish examined	Ciliophora		Myxozoa	
		No. of infected fish	Prevalence (%)	No. of infected fish	Prevalence (%)		No. of infected fish	Prevalence (%)	No. of infected fish	Prevalence (%)
March - June	170	100	58.82	17	10	60	39	65	35	58.33
July - October	250	68	27.20	125	50	60	26	43.33	49	81.66
November - February	310	282	90.97	109	35.16	60	52	86.66	9	15

Table.3 Age wise prevalence of parasitic protozoa in ornamental fish:

Age (Months)	Gold fish (*Carassius auratus)*			Tilapia (*Oreochromis niloticus*)		
	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)
1 - 3	60	27	45	36	10	27.77
3 - 6	50	32	64	60	42	70
6 - 9	150	92	61.33	108	71	65.74
9 - 12	60	48	80	60	17	28.3

Table.4 Length wise prevalence of parasitic protozoa in ornamental fish:

Length (cm)	Gold fish (*Carassius auratus)*			Tilapia (*Oreochromis niloticus*)		
	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)
7 - 9	14	4	28.57	41	11	26.80
9 - 11	87	61	70.11	71	32	45.07
11 - 13	60	42	70	69	23	35.93

Table.5 Sex wise prevalence of parasitic protozoa in ornamental fish:

Sex	Gold fish (*Carassius auratus)*			Tilapia (*Oreochromis niloticus*)		
	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)	No. Of Fishes Examined	No. Of Fishes Infected	Prevalence (%)
Male	94	27	28.72	120	37	30.83
Female	126	66	52.38	48	19	39.58

IV. Discussion

The protozoan infection in ornamental fishes is very high and several factors have been found to be associated with it. It is the need of the present hour to take more steps to gather more and more information regarding various aspects of prevalence of parasites in this region and it is believed that the present study will provide some sort of help to the future workers who will work on ornamental fish diseases.

During investigation of the parasitic fauna of ornamental fish, it can be stated that prevalence of parasites are more during November to February in comparison to other months of the year. These findings match with findings of Ahmed *et al*. [14]. During the study only two types of parasites like Myxozoans and Ciliophorans have been explored and identified from the ornamental fish. In the present study two type of Myxozoan parasites like *Myxobolus* and *Thelohanellus* have been identified. Among the Myxozoan parasite, *Thelohanellus* infection have been mostly found during July-October months while, the *Myxobolus* infection was detected more in March to June rather than *Thelohanellus* This work corroborated with the findings of Majumder *et al.* [15]. Now, while studying the Ciliophorans parasites, they showed great infestation throughout the year in comparison to other parasites. Chanda *et al*. [16] stated that the prevalence of *Ichthyophthirius* was more prominent than other parasites. The mortality rate of infected fish caused by *Ichthyophthiriasis* reached almost 100% in low temperature. But the number reduced at the time of high temperature. Low temperature is susceptible to high parasitic infestation. This work has similarities with the work of Majumder *et al.* [15]. The prevalence of the protozoan parasites is very much dependent on seasonal changes of temperature Majumdar *et al.* [15] and Hossain *et al*. [17].

Another aspect like age and length of the fish is also an important factor for varying the prevalence of protozoan infection in ornamental fish. In the study, higher prevalence has been recorded in adults and large fishes as compared to the younger and smaller ones which are in agreement with study of Siddiqui [18]. It can be concluded from the given data that the smallest fishes were relatively less infected than the other length groups and the percentage of infection increases with enhancement of fish length. It is also concluded that, larger adult fishes were heavily parasitized than smaller young ones. The invasion index with the increase size (length) and age of the host is attributed to two factors. One is the high metabolic activity in adult large fish due to increased volume of food ingested by large fishes. This work corroborated with the findings of Bashirullah [19] and Dogiel [20]. They also indicated that the degree of parasitism was obviously related to the food habit and age of the fishes.

To evaluate the infection levels the ornamental fishes procured from various fish farm of West Bengal dissected and separated sex wise on the basis of gonads. The incidence of protozoan infection in the two sexes calculated separately. The available data was analyzed and it has explored that the incidence of infection was invariably very high in the female host in compare to male as because of the comparatively strong immunity system carried by the male fish than female. This work has similarities with the work of several authors like Smith [21], Sanwal and Agarwal [22], Sinha [23], Rajaiah [24] that the sex of the host has relevant impact on the regulation and periodicity of the parasites. The differences in infection of protozoan parasites in male and female hosts may be due to biochemical changes in quantity and quality of the steroid hormone presumably of male and female hosts. Therefore, it can be inferred that the impact of seasons, host age, size and sex have important role on the prevalence of protozoan parasites in some ornamental fishes.

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