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Water Quality, Stocking Density and Parasites of Freshwater Fish in Four Selected Areas of Bangladesh

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Abstract: Stocking density, water quality (depth, temperature, dissolved oxygen, pH, total ammonia, hardness as $CaCO_3$ and total alkalinity) and parasites of fishes were investigated in four selected areas (Bogra, Chandpur, Jessore and Mymensingh) for a period of three years. Stocking density varied from $15.74x10^3$ to $34.38x10^3$ ha^{-1}. Water quality parameters (except ammonia) varied significantly from one area to another. Among the parasites, the prevalence of Trichodinids was dominant followed by Monogenians, *Chilodonella* spp. and Myxosporidian. Correlation on physico-chemical parameters and incidence of parasites were studied.

Key words: Water quality, parasites, freshwater fish, Bangladesh

INTRODUCTION

The environmental stress of fish is related to some biological, ecological and management aspects. Stress factors related to pond ecology are dissolved oxygen deficiency, fluctuation of pH, temperature, ammonia toxicity, over fertilization, residual feed, over stocking, adverse effect of drugs and chemicals. The fish growers have the tendency to overstock their ponds. In the crowded fish farm parasites can multiply rapidly, particularly if the fish are stressed. External parasitic infection of the skin and gills is the commonest fish health problem under aquaculture farming conditions. Parasites damage fish skin by attaching to the epidermis and many species of parasites actively feed on the underlying tissues and blood. Heavy infestation can result in skin lesions, reduced growth and even high mortality, especially in younger fish. Indian major carps including exotic carps and catfish nursery operation system contribute significantly to the inland culture fishery of Bangladesh[1]. High stocking density of fish fry and fingerlings during nursery operation accelerate bio-ecological stress[2] and fish become more susceptible to the infectious diseases[3]. Parasites in nursery pond is one of the most important limiting factor for the growth and survival of fry and fingerlings, which in turn regulate the economic success of nursery farming. Therefore, the present study was undertaken to identify the prevalence of external parasites along with aquatic environmental factors in four selected sites of Bangladesh.

MATERIALS AND METHODS

Sampling areas: Sampling sites have been selected on the basis of their significant contribution to the development of freshwater culture fishery. The four major sampling areas were Bogra, Chandpur, Jessore and Mymensingh covering four divisions of the country.

Sampling: Sampling was done once in a month throughout the year from the commercial nursery ponds. Fish fry and fingerlings were collected from five selected ponds of each location. The collected fish fry and fingerlings were subjected to parasitic study *in situ* for each time and each location.

Determination of bio-ecological factors: The bio-ecological parameter viz. stocking density and depth of water of the nursery ponds were recorded during the study period.

Determination of water quality: Water quality parameters viz., temperature, dissolved oxygen, pH, total ammonia, hardness as $CaCO_3$ and total alkalinity were studied using a portable HACH Kit (Model FF-2) at the time of sampling.

Parasite study: Parasites of commercially important freshwater cultured fish, Indian major carps and exotic carps of the nursery operation system were studied once in a month. A total of 1643 fry and fingerlings were examined, comprises of 217 *Labeo rohita* (6.0-11.2 cm), 223 *Catla catla* (5.5-18.5 cm), 215 *Cirrhinus mrigala* (7.0-14.0 cm), 234 *Puntius gonionotus* (4.0-32.0 cm), 197 *Ctenopharyngodon idella* (6.0-11.0 cm), 168 *Hypopthalmicthys molitrix* (7.0-13.2 cm), 189 *Orecochromis niloticus* (8.0-9.0 cm) and 200 *Cyprinus carpio* (1.5-13.0 cm). Parasites from the fish fry and fingerlings were isolated and identified *in situ* following the method of Kabata[4]. The dry smear on glass slide was

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preserved using stain (Neutral red and Giemsa) and mounted with Canada balsam. At the time of sampling, the ecto-parasitic infections and infestations were studied.

RESULTS AND DISCUSSION

Stocking density: The Stocking density of Bogra zone was ranged from 2.49×10^3 to $106.6810^3\times ha^{-1}$ (Table 1). The average was 37.01×10^3 ha^{-1}. In Chandpur it was found to vary form 3.34×10^3 to 33.80×10^3 ha^{-1} (Table 2). The average stocking density was 18.16×10^3 ha^{-1}. In Jessore it was varied from 1.26×10^3 to $97.62x\ 10^3$ ha^{-1} (Table 3). The average was $26.63x10^3$ ha^{-1}. Stocking density of Mymensingh area was found to vary from 2.17×10^3 to 192.45×10^3 ha^{-1} where the average stocking density was 34.28×10^3 ha^{-1} (Table 4).

Water quality parameters: In case of Bogra, the lowest and highest water depths were recorded as 1.58 and 2.18 m, respectively and the average water depth was 1.79 m (Table 1). The lowest water depth recorded in Chandpur which was 1.77 m, where as the highest was 2.44 m (Table 2). The average water depth of Chandpur was 2.14 m. Water depth of Jessore area was varied from 1.38 to 1.99 m having average water depth 1.63 m (Table 3). Water depth of Mymensingh area was 1.26 to 1.71 m (Table 4). The average water depth was 1.49 m. The highest temperature of Bogra was 32.33°C and the lowest was recorded as 19.53°C with an average of 27.27°C. The temperature of Chandpur area ranged from 20.19 to 32.11°C. The average temperature of Chandpur area was 27.80°C. The temperature of Jessore area was ranged from 22.98 to 32.75 having an average of 25.79. Temperature of pond water of Mymensingh area ranged from 23.84 to 33.77 with an average of 29.74°C. The lowest and highest DO of Bogra was 3.63 and 7.29 mg l^{-1}, respectively having an average of 7.33 mg l^{-1}. The DO of Chandpur was recorded as 4.80 to 6.85 mg l^{-1} with an average of 7.51 mg l^{-1}. The DO of Jessore was recorded as 4.8 to 6.85 mg l^{-1}, where the average was 5.38 mg l^{-1}. Dissolved oxygen (DO) of Mymensingh area ranged from 6.64 to 7.03 mg l^{-1}, where average of 7.34 mg l^{-1}. The pH of Bogra varied from 6.75 to 7.90 and the average was 7.33. The pH of Chandpur was ranged from 7.0 to 7.65 with an average of 7.24. The pH of Jessore ranged from 7.20 to 8.20 where the average pH was 7.51. In case of water pH, it has been observed that the lowest pH in Mymensingh area was recorded as 7.03 and the highest was 7.83, where the average was 7.34. The lowest ammonia in Bogra recorded as 0.48 and the highest was 2.07 mg l^{-1} with an average of 1.20 mg l^{-1}. In Chandpur the lowest ammonia content was recorded as 0.83 and the highest was 1.86 mg l^{-1}, where average was 1.21 mg l^{-1}. The lowest and highest ammonia

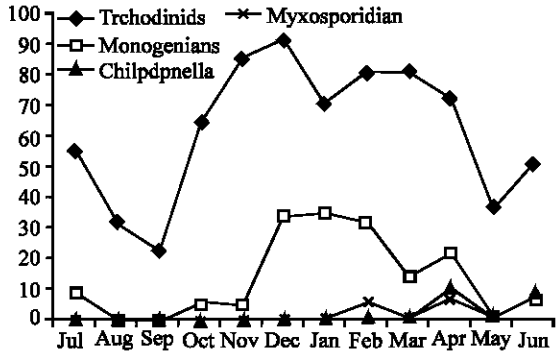

Fig. 1: Prevalence (%) of ectoparasites of fish fry/fingerlings in Bogra zone

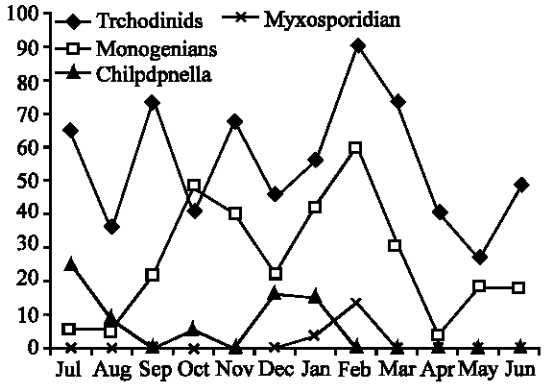

Fig. 2: Prevalence (%) of ectoparasites of fish fry/fingerlings in Chandpur zone

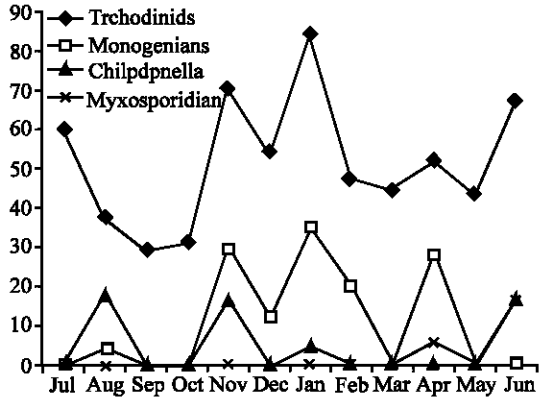

Fig. 3: Prevalence (%) of ectoparasites of fish fry/fingerlings in Jessore zone

in Jessore area varied from 0.47 to 1.89 mg l^{-1}, respectively and the average was recorded as 0.99 mg l^{-1}. The total ammonia content of pond water in Mymensingh area was recorded as 0.75 to 1.96 mg l^{-1} and average by 1.30 mg l^{-1}. The total hardness in Bogra ranged from

Table 1: Monthly mean stocking density and water quality parameters in Bogra zone for a period of three years

Water quality parameters	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Stocking density (thousand h^{-1})	56.06	15.99	2.49	17.73	5.10	3.09	2.72	76.11	95.14	37.17	106.68	25.91
Water depth (ft)	5.27	6.58	5.80	6.63	5.25	5.20	4.58	5.35	6.30	5.71	6.91	7.17
Temperature (°C)	29.84	28.33	31.33	40.61	24.28	22.50	19.53	25.25	26.56	32.33	32.26	30.44
Dissolved oxygen (mg l^{-1})	6.42	6.96	6.49	5.16	3.71	4.70	3.63	3.86	5.15	5.50	7.29	3.77
pH	7.83	7.11	7.16	7.10	7.15	6.75	7.28	7.90	7.16	7.36	7.66	7.50
Total ammonia (mg l^{-1})	0.96	0.76	0.48	0.95	1.12	1.36	1.03	1.48	1.03	2.04	2.07	1.14
Total hardness (mg l^{-1})	79.52	97.00	130.00	113.50	79.70	75.19	111.90	94.83	92.00	96.11	88.02	91.77
Total alkalinity (mg l^{-1})	98.44	119.15	79.75	84.83	98.65	109.50	133.83	117.16	112.50	117.55	125.77	117.44

Table 2: Monthly mean stocking density and water quality parameters in Chandpur zone for a period of three years

Water quality parameters	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Stocking density (thousand h^{-1})	18.70	22.06	12.23	10.17	3.34	17.32	9.66	18.22	26.11	17.33	33.80	29.07
Water depth (ft)	6.82	7.75	7.35	6.61	6.60	5.82	6.53	8.00	7.00	7.04	7.17	7.64
Temperature (°C)	30.57	20.19	29.06	31.19	29.15	25.90	22.28	21.10	30.50	31.69	32.11	29.91
Dissolved oxygen (mg l^{-1})	4.31	5.51	4.48	4.38	4.31	3.45	4.37	4.93	3.21	4.54	4.64	4.01
pH	7.15	7.03	7.15	7.03	7.11	7.00	7.22	7.23	7.41	7.63	7.27	7.65
Total ammonia (mg l^{-1})	1.29	1.12	1.29	1.86	1.24	0.93	1.04	1.13	1.40	1.41	1.01	0.83
Total hardness (mg l^{-1})	116.16	56.66	77.25	81.32	81.00	74.65	82.11	89.33	78.98	127.11	57.44	61.77
Total alkalinity (mg l^{-1})	101.16	70.00	97.63	105.84	95.85	94.20	96.66	107.33	102.50	106.33	68.00	80.66

Table 3: Monthly mean stocking density and water quality parameters in Jessore zone for a period of three years

Water quality parameters	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Stocking density (thousand h^{-1})	28.04	32.85	27.53	14.64	8.41	1.27	1.26	13.36	32.59	22.37	97.62	39.67
Water depth (ft)	4.94	4.75	4.97	4.77	5.96	5.55	4.51	4.86	5.45	6.02	6.05	6.55
Temperature (°C)	30.07	28.86	29.30	29.56	27.25	24.35	22.98	23.56	27.71	31.70	32.75	31.27
Dissolved oxygen (mg l^{-1})	6.13	5.47	6.53	5.69	5.1	4.80	6.85	4.25	4.25	5.01	5.39	5.10
pH	7.62	7.31	7.23	7.46	7.20	7.20	7.71	7.30	8.20	7.78	7.49	7.56
Total ammonia (mg l^{-1})	0.47	1.89	0.73	0.54	1.45	0.75	0.49	0.68	0.97	1.53	1.06	1.37
Total hardness (mg l^{-1})	146.80	74.80	90.33	116.21	207.75	191.25	322.33	160.33	211.83	282.08	194.08	183.88
Total alkalinity (mg l^{-1})	161.06	91.94	113.00	134.83	229.10	217.10	274.33	180.00	226.83	312.30	206.91	204.33

Table 4: Monthly mean stocking density and water quality parameters in Mymensingh zone for a period of three years

Water quality parameters	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Stocking density (thousand h^{-1})	22.59	52.16	46.79	20.69	192.45	5.32	2.17	14.62	8.70	12.34	15.29	18.28
Water depth (ft)	5.36	4.79	4.96	5.62	5.37	4.35	4.63	4.13	4.75	5.44	4.55	4.93
Temperature (°C)	33.77	31.25	31.45	30.72	27.52	24.37	23.84	27.35	28.13	31.60	33.00	33.95
Dissolved oxygen (mg l^{-1})	6.64	5.74	4.81	5.15	5.86	4.33	4.57	6.60	3.78	6.00	5.88	5.71
pH	7.48	7.23	7.15	7.32	7.26	7.31	7.07	7.20	7.03	7.59	7.83	7.61
Total ammonia (mg l^{-1})	1.08	1.96	1.66	1.36	1.31	1.79	1.15	0.86	1.38	0.97	1.36	0.75
Total hardness (mg l^{-1})	68.56	86.09	78.61	64.77	74.50	136.11	80.66	99.55	70.50	90.60	120.77	88.10
Total alkalinity (mg l^{-1})	93.83	84.15	108.87	84.60	90.64	154.66	88.66	106.33	86.16	108.8	147.2	165.00

Data represents mean of three years

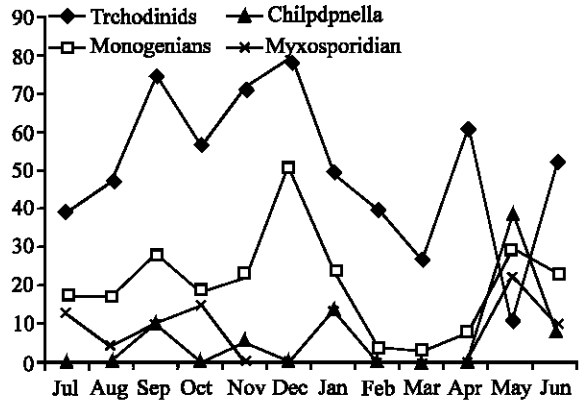

Fig. 4: Prevalence (%) of ectoparasites of fish fry/fingerlings in Mymensingh zone

75.19 to 130.00 mg l^{-1} with an average of 75.79 mg l^{-1}. The total hardness of Chandpur area was ranged from 56.66 to 116.16 mg l^{-1} with an average of 81.98 mg l^{-1}. In Jessore area the total hardness was ranged from 74.80 to 322.33 mg l^{-1}, while the average was recorded as 181.81 mg l^{-1}. Total hardness of pond water of Mymensingh area was ranged from 64.77 to 136.11 mg l^{-1} and an average by 88.24 mg l^{-1}. The total alkalinity of pond water of Bogra area varied from 79.75 to 133.83 mg l^{-1} and the average was determined as 109.55 mg l^{-1}. In case of Chandpur the total alkalinity was ranged from 68.00 to 107.33 mg l^{-1} with an average or 93.85 mg l^{-1}. In Jessore the total alkalinity was ranged from 91.94 to 312.30 mg l^{-1} with an average of 195.98 mg l^{-1}. Total alkalinity of Mymensingh was recorded as 84.15 to 165.00 mg l^{-1} Nd average was 109.91 mg l^{-1}. Water

Table 5: Correlation study of physico-chemical parameters and incidence of parasites in four selected zones of Bangladesh

Location	Parameter	r-value
Bogra	Stocking density x pH	0.611*
	Water depth x Temperature	0.675*
	Water depth x Monogenian	-0.687*
	Temperature x Monogenian	-0.626*
	Dissolved oxygen x Monogenian	0.577*
	Trichodian x Monogenian	0.692*
	Chilodonella x Myxosporidian	0.815**
Chandpur	Water depth x Dissolved oxygen	0.593*
	Total hardness x Total alkalinity	0.738**
	Temperature x Myxosporidian	-0.591*
	Total alkalinity x *Trichodina*	0.612*
	Trichodina x Myxosporidina	0.587*
	Monogenian x Myxosporidian	0.642*
Jessore	Stocking density x Temperature	0.710**
	Total hardness x Total alkalinity	0.963**
	Total ammonia x *Chilodonella*	0.708**
	Total hardness x *Trichodina*	0.719**
	Total hardness x Monogenian	0.692*
	Total alkalinity x *Trichodina*	0.636*
	Total alkalinity x Monogenian	0.670*
	Trichodina x Monogenian	0.607*
	Chilodonella x Myxosporidian	0.607*
Mymensingh	Water depth x Total hardness	-0.665*
	pH x Temperature	0.657*
	Total alkalinity x pH	0.619*
	Total hardness x Total alkalinity	0.747**
	Total hardness x Monogenian	0.591*
	Chilodonella x Myxosporidian	0.749**

Only the significant correlation parameters the shown in Table, * and ** means significant at 5 and 1% level of significant, respectively

quality of Jessore area was found to be better in comparison to other areas.

Prevalence of parasites: The prevalence of parasites of fish fry and fingerlings of Bogra zone have been shown in Fig. 1. It is observed that Trichodinids were the most prevalent parasites throughout the year. The highest prevalence (89.5%) was recorded in December. The highest monogenians (33.4%) was observed also in January. *Chilodonella* spp. and myxosporidian infestation were least dominant. The prevalence of parasites of fish fry and fingerlings of Chandpur zone have been shown in Fig. 2. Trichodinids infestation was recorded as highest (90.2%) in February and the lowest (27.8%) was recorded in May. The highest monogenians was 59.3% in February. The highest *Chilodonella* spp. infestation (24.2%) was recorded in July. Where as myxosporidian was found only during December to March. The prevalence of parasites of fish fry and fingerlings of Jessore zone have been shown in Fig. 3. The highest prevalence of Trichodinids (82.5%) was observed in January. Monogenian infestation was also highest (34.5%) in January. The prevalence of *Chilodonella* spp. and myxosporidian were highest in August by (16.7%) and June by (17.2%), respectively. The prevalence of parasites of fish fry and fingerlings of Mymensingh zone have been shown in Fig. 4. Maximum (78.9%) of Trichodinids were recorded in December. Monogenians were also found highest (50.1%) in December. Highest *Chilodonella* spp. and myxosporidian were recorded by 40.2% and 22.2%, respectively, in May. It was revealed from the study that Trichodinids was the most prevalent parasite throughout the year following monogenians, whereas myxosporidians and *Chilodonella* spp. were found as least dominant parasites. It was observed that there was monthly variation in the rate of infection of parasites in fish. It was also found that the average prevalence of parasites among four selected zones was different from each zone to other. Mohan[5] reported that ecto-parasites, protozoans, monogenetic trematodes, fish lice, anchor worm, endo-parasitic sporazoans are some of the very important pathogens that have had significant impact on the yield in carp hatcheries and seed production centers in India. In the present study, ecto-parasites, *Trichodina* spp. was found to be the most and myxosporidians as the least dominant parasites in all the areas studied. These finding agreed with our previous observation[1,6]. It was also observed that there was monthly variation in the rate of infection and infestation of parasites in fish. This could be due to stocking density, water depth, temperature along with other physico-chemical parameters and management practices maintained. The rate and mode of infection of the parasites investigated was found different in various months. Within the four studied zone, Chandpur was found as most abundant in parasite and Jessore was the least in comparison to other zones. Management practices were found poor in Chandpur followed by Bogra, Mymensingh and Jessore. November-March was more susceptible months of the year when fish parasites were abundant in these months. This could be due to variation in temperature, low metabolic activity and suppression of natural immune system of fish[4].

Correlation study: Correlation study among different physico-chemical parameters of pond water, incidence of different parasites and physico-chemical parameters of pond water with incidence of different parasites considering the four selected zones of Bangladesh were studied and the results were shown in Table 5. Significant correlation has been found among the physico-chemical parameters and on the incidence of parasites in the studied sites of Bangladesh.

From the above study it was revealed that the examined fish were found infected with more than one parasite, i.e. the mode of infection was multiple and there was no host specificity. This could be due to less host preferences and common habitat of the host fish. It was

observed that prevalence of parasites among four selected zones were different. The difference of parasitic infestation in different aqua-ecological zone could be due to differences in soil textures, fertility, water productivity, average rainfall and climatic changes.

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