ISSN: 2347-5129
IJFAS 2015; 2(5): 118-122

www.fisheriesjournal.com
Received: 07-02-2015
Accepted: 25-03-2015

Md. Shirajum Monir
Freshwater Station Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh.

Nazneen Bagum
Freshwater Station Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh.

Shafiqur Rahman
Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute Cox's Bazar, Bangladesh.

Mohammad Ashaf-Ud-Doulah
Head Quarter Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh.

Anuradha Bhadra
Head Quarter Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh.

Shuvho Chakra Borty
Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh- 2202, Bangladesh.

Correspondence
Md. Shirajum Monir
Freshwater Station, Bangladesh Fisheries Research Institute Mymensingh-2201, Bangladesh.

Parasitic diseases and estimation of loss due to infestation of parasites in Indian major carp culture ponds in Bangladesh

Md. Shirajum Monir, Nazneen Bagum, Shafiqur Rahman, Mohammad Ashaf-Ud-Doulah, Anuradha Bhadra, Shuvho Chakra Borty

Abstract
The research work was conducted to determine the parasitic diseases and loss due to infestation of parasites in three Indian major carp (*Labeo rohita, Catla catla* and *Cirrhinus mrigala*) from three districts of Bangladesh namely Mymensingh, Sylhet and Rajshahi during the period from July 2012 to June 2013. A total of nine ectoparasite species and three endoparasite species were identified from the examined carp fish. The highest prevalence of infection (94.54%) was recorded in the host of *L. rohita* in winter and lowest (72.68%) in *C. catla* in summer. The highest abundance and mean density also in *L. rohita* was 14.38 and 12.64, respectively. But the lowest abundance and mean density was 14.38 and 12.64, respectively in *C. catla.* In the present study, the total economic loss was found BDT 35,552.50 ha^{-1} yr^{-1} due to parasitic diseases. However, overall loss due to parasitic diseases was found 11% for mortality, 11% for chemicals cost and 65% for reduction of growth of carps in the study areas.

Keywords: Parasitic diseases, Prevalence, Indian major carp, Economic loss.

1. Introduction
Bangladesh is one of the world's leading fish producing countries and it's total fish production shows a consistently increasing trend from the fiscal year 1983-1984 to 2011-2012 and the production increased more than four times (754,000 MT in 1983-1984 to 3,262,000 MT in 2011-12) [1]. Indian major carps like *Catla catla, Labeo rohita,* and *Cirrhinus mrigala* are considered as the major cultivable fish species in inland aquaculture of Bangladesh and it contributes around 85.29% of total pond fish production of Bangladesh [2, 3]. Along with carps all the freshwater species found more or less to suffer with different types of diseases while 15%-20% are associated with parasite infestation [4]. Indian major carps are highly susceptible to disease in comparison to Chinese and European carps [5]. The intensity of fish parasitic infection is greatly influenced by seasonality, which affects host ecology as well as physiology [6, 7]. Intense parasite infection can cause ulceration and upset the normal course of reproduction [8]. Parasites interfere with host nutrition, metabolism and secretary functions of the alimentary canal and can even damage the host nervous system [9]. All these effects may reduced normal growth of the fish and finally induce the host mortality.
The loss incurred due to parasites diseases is yet to be calculated for Indian major carp culture in Bangladesh. A good number of research works on loss estimates have been reported for *Argulus* infestations in carps fishes in India [10] and sea lice infestations causing heavy damage to salmonid industry in Europe and the Americas [11, 12, 13]. However, keeping in view the importance of parasites diseases, the present study was designed to investigate the prevalence, abundance and mean density of parasites infestation as well as estimate loss due to parasitic diseases in cultured Indian major carp fishes. The present study may be helped fisheries scientists, aquatic animal health specialists and policy makers to approximate the economic costs of infestation to the Indian major carp industry as well as work towards developing long-standing control measures.

2. Materials and methods
2.1 Host fishes selection
Specimens of Indian major carp Catla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*) were collected every month at regular intervals directly from different

carp cultured ponds in Mymensingh, Sylhet and Rajshahi districts, Bangladesh. Approximately 675 carps were examined during the study period from July 2012 to June 2013.

2.2 Survey and collection of specimen
Live host or freshly dead carp fishes were randomly collected and examined immediately after collection. The length and body weight of the fishes and date and site of collection of host specimens were also recorded.

2.3 Collection, fixation and cleaning of parasites
External symptoms and health conditions of each examined specimen were recorded. The scales, gills, fins and operculum were removed and placed on separate petri-dishes containing filtered water and examined by a magnifying glass to find out ectoparasites. The gills were carefully separating to dislodge the live monogeneans and usually placed under a microscope for gross observation [14]. To collect the endoparasites, the fishes were dissected and internal organs were examined. Then the internal organ like stomach, liver, intestine were separated and put into physiological saline solution (0.7% NaCl Solution) in a petri-dish. Each organ was then examined separately, stomach, intestine were split open and were shaken in a tube to dislodge the parasites remaining attached to the epithelial lining. Then the collected parasites were carefully preserved in individual vials in 70% alcohol with a few drops of glycerine for 24 h. Mostly the parasites were fixed in 2 ml of Formalin Acetic Alcohol (FAA) solution and heated on spirit lamp at 70-75 ºC. Parasites were removed from FAA solution and carefully washed with 70% alcohol and temporarily mounted in Canada balsam on slides, and finally examined under a compound microscope (BX51, Olympus, Japan) and identified according to Chandra [15] (2004). The prevalence, abundance and mean density of parasites were estimated according to Margolis [16].

2.4 Estimation of loss due to parasitic diseases in carps cultured ponds
The loss due to parasitic diseases was calculated to consider the fish mortality occurred, expected loss in growth of fish in terms of the total biomass production and expenditure towards drugs/chemicals applied for prevention and control of parasites diseases. The loss was estimated according to the following the formula by Sahoo [10] described below:

Total loss = {(Loss due to reduction in growth + Loss due to mortality) X Rate per kg} + Cost of treatment

where, loss due to reduction in growth (in kg) = average growth/day X number of fish affected X total period of infestation from all the outbreaks in a year (in days) and loss due to mortality (in kg) = average weight of fish X mortality (in number)

Due to parasite diseases, the growth of fishes almost ceases. The average loss due to reduction in growth per day was estimated according to the stocking density and average expected production of the farm per hectare per year. The loss in growth increment per day during the parasite diseases was estimated according to 1, 2 and 3 g loss in growth per day at stocking densities ranging from 12000 and above, 9000-12000 and 9000 and less number per hectare carps cultured ponds respectively. This was based on field survey, discussions with carp fish farmers, according to their own experiences, previous studies conducted as well as specific growth rate relationship there on [17, 18].

3. Results

3.1 Parasites isolated and identified from the investigated carps
During the present study, a total of 675 specimens of Indian major carp (*C. catla, L. rohita* and *C. mrigala*) were examined to investigate the prevalence, abundance and mean density of parasitic infestation. A total of nine ectoparasite species and three endoparasite species were identified from the carps during the study period. The parasites were isolated from different organs like body slime/skin, gill, stomach and intestine of examined carp fishes. The isolated parasites from different organs of investigated fishes were *Apiosoma* sp., *Argulus* sp., *Camallanus* sp., *Chilodonella* sp., *Dactylogyrus* sp., *Eucreadium* sp., *Gyrodactylus* sp, *Ichthyobodo* sp., *Ichthyophthirius* sp., *Larnaea* sp., *Pallisentis* sp. and *Trichodina* sp. (Table 1).

3.2 Parasites infestation in the investigated carps
The overall prevalence, abundance and mean density of the total parasites are shown in Table 1. The prevalence of parasites was ranged from 72.68 to 94.54% during the study period. The highest parasite prevalence (94.54%) was observed in the host *L. rohita* and lowest (72.68%) was found in *C. catla*. The abundance of parasites was also recorded highest (14.38) in *L. rohita* but lowest (5.64) in *C. mrigala*. A second highest abundance was found as 6.85 in the host of *C. catla.* However, the highest (12.64) mean density of parasites was also recorded in *L. rohita* but lowest (3.65) in *C. catla*.

3.3 Comparative prevalence (%), abundance and mean density in different seasons
The overall prevalence (%), abundance and mean density of the total parasites was observed to fluctuate seasonally during the study period. In summer season, the highest (86.67%) prevalence value was observed in *L. rohita* and least prevalence values (72.68%) was in *C. catla*. But in winter season, *L. rohita* showed the highest (94.54%) prevalence value while *C. mrigala* showed lowest prevalence values (85.41%). The highest abundance value was recorded 11.54 in *C. mrigala* and lowest was 8.32 in the host of *C. catla* during the summer. On the other hand, *L. rohita* showed the highest (11.56) abundance value in rainy season where *C. mrigala* showed the lowest value (6.85) in the study area. In winter, the highest abundance value was (14.38) in *L. rohita* where *C. catla* showed second peak value (12.52) and the lowest (5.64) value was observed in *C. mrigala*. The highest mean density (8.63) was recorded in *L. rohita* in summer where *C. mrigala* showed lowest (3.65). In rainy season, the highest (9.74) mean density of parasites was also found in *L. rohita* where as lowest value (4.85) in *C. mrigala*. In winter, *L. rohita* showed the highest mean density (12.64) and lowest value was 4.85 in *C. catla* (Table 2).

3.4 Estimation of losses due to parasitic diseases
During the study period, a total of 120 Indian major carp farms were surveyed, but only available data were from 80 carps farms, which provided actual data to estimate the loss due to parasitic diseases. It was found that some farmers were not applied any chemicals or drugs against parasitic diseases for controlling or treatments in carp farms, but some farmers were found to use huge chemicals or drugs. The range of total loss

among the carps farms was estimated BDT 12,568 - 62,571 ha^{-1} yr^{-1}. Total economic loss was found BDT 35,552.50 (US$ 444) {35,552.50 ± 5,506.46 (mean ± SE)} ha^{-1} yr^{-1} due to parasitic diseases (Table 2). However, overall loss due to parasites diseases were found 11% for carps mortality, 11% for chemicals or drugs cost and 65% for reduction of carps growth in the study areas (Fig 3).

Fig 1: Photograph showing *Ichthyophthirius* sp. on body surface of *C. mrigala*.

Fig 2. Photograph showing *Larnaea* sp. on body surface of *L. rohita.*

Table 1: Prevalence (%), abundance and mean density of parasites in Indian major carps in different seasons of the year.

Season	Fish species	No. of fishes investigated	Recovered Parasites	Site of Infection	Prevalence (%)	Abundance	Mean Density
Summer	*C. catla*	75	*Dactylogyrus* sp.	Gill	72.68	8.32	5.54
			Gyrodactylus sp.	Skin			
			Trichodina sp.	Gill			
	L. rohita	75	*Larnaea* sp.	Gill, Fin	86.67	11.54	8.63
			Ichthyophthirius sp	Skin			
			Ichthyobodo sp.	Skin, Fin			
	C. mrigala	75	*Cammalanus* sp.	Intestine	74.67	8.54	3.65
			Pallisentis sp.	Intestine			
Rainy	*C. catla*	75	*Dactylogyrus* sp.	Gill	85.42	6.85	6.87
			Gyrodactylus sp.	Skin			
			Trichodina sp.	Gill			
	L. rohita	75	*Chilodonella* sp.	Gill, Skin	88.54	11.56	9.74
			Argulus sp.	Skin, Fin			
			Larnaea sp.	Gill, Fin			
	C. mrigala	75	*Ichthyobodo* sp.	Skin, Fin	80.54	7.86	4.85
			Apiosoma sp.	Skin, Fin			
			Cammalanus sp.	Intestine			
Winter	*C. catla*	75	*Dactylogyrus* sp.	Gill	88.68	12.52	9.87
			Gyrodactylus sp.	Skin			
			Trichodina sp.	Gill			
	L. rohita	75	*Argulus* sp.	Skin, Fin	94.54	14.38	12.64
			Larnaea sp.	Gill, Skin			
			Cammalanus sp.	Intestine			
			Ichthyobodo sp.	Skin, Fin			
	C. mrigala	75	*Ichthyophthirius* sp.	Skin	85.41	5.64	6.43
			Trichodina sp.	Gill			
			Eucreadium sp.	Intestine			

Table 2: Economic loss due to parasite diseases in Indian major carps cultured ponds.

Factors considered for estimation of loss due to parasite diseases	Fish weight loss (kg ha^{-1} yr^{-1})	Market price of carp (BDT per kg)	Cost of treatment (BDT ha^{-1} yr^{-1})	Loss in value (BDT)
Mortality of carp fish (average loss in biomass) ha^{-1} yr^{-1}	34.54	110	-	3,799.40
Reduced growth (average loss in biomass) ha^{-1} yr^{-1}	256.41	110	-	28,205.10
Chemicals/drugs applications	-	-	3,548.00	3,548.00
Total average loss due to parasite diseases (BDT ha^{-1} yr^{-1})				35,552.50

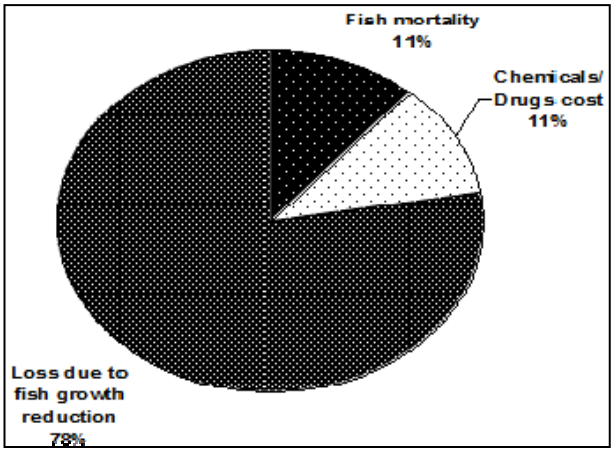

Fig 3: Percentage of economic loss due to parasitic diseases in Indian major carps cultured pond.

4. Discussion

In the present study, the highest prevalence of parasites was observed as compared to the research conducted by Perveen & Ullah [19] and Tasawar [20] in *C. idela* among the all examined fish. The difference in these parasitic infestation might be due to different geo-climatic conditions or these experimental fishes had low resistance against parasites. Akhter [21] examined 5 exotic freshwater carp species, only 793 fish were infected by different ectoparasites and the parasitic prevalence was the highest in *H. molitrix* by *Argulus* sp. (20.1%) and the lowest was seen in *C. carpio.* However, Delwer [3] observed that the highest prevalence of parasites among carp fishes was 87.50% and lowest was 77.04% which is more or less agree with the present study. The highest number of parasites was recorded on the skin and lowest number of parasites was found in the intestine of the examined carp fishes. Delwer [3] also reported that carps fishes are mostly infested by the skin parasites, which indicate the food prevalence and distribution pattern of parasites itself. Moreover, similar observation was found by Sanaullah & Ahmed [22], and Ahmed [22]. The ectoparasite *Ichthyopthirius* sp. was found only in the skin of *L. rohita* and *C. mrigala* whereas endoparasites *Eucreadium* sp. was found only in intestine of *C. mrigala.* Banu [24] and Chowdhury [25] reported these parasites in some exotic fishes. Rahman & Parveen [26] and Rahman [21] observed similar parasitic infestation in different freshwater fish species of Bangladesh.

The highest prevalence of parasites (94.54%) was recorded in the host of *L. rohita* at winter and lowest (72.68%) in *C. catla* during the summer season. On the other hand, the highest abundance and mean density also showed in *L. rohita* at winter season. This might be due to *L. rohita* is more susceptible to parasite diseases than *C. catla* and *C. mrigala*. Khan [27] observed that there existed a direct relation between temperature and parasitic infestation. The results reveal that the parasites infection is more severe during the winter season than other season. Tak [28] and Bhuiyan [29] reported that most of the ectoparasitic infection was occurred during the winter. Mohanta [30] observed that *Puntius* sp. was more infested by parasites in winter than summer season. Many other researchers such as Akhter [31], Banu [24] and Chandra [32] have also found similar observations and heavy infections in the particular season of the year. Furthermore, Hossain [33] has also reported that winter as a period of high susceptibility of fish to pathogens especially ectoparasites. Kabata [34] revealed that the fishes are susceptible to disease in low temperature and low metabolic activity. This finding clearly indicates that the seasonal mode of parasitic infestation among the host fishes. However, winter had already been identified as a period of high susceptibility of fish to parasites [14, 35].

Economic losses for parasite diseases are likely to increase as aquaculture expands and intensifies. Loss due to parasites diseases was found BDT 35,552.50 (US$ 444) ha^{-1} yr^{-1} in the study area. Furthermore, the overall loss due to parasites diseases were found 11% for carps mortality, 11% for chemicals or drugs cost and 78% for reduction of carps growth during the study period. Nazneen [36] reported that the *Argulus* causing a major threat to the fish farmers in their study area as it induces mortality, growth loss and economic loss to the carp farms. Ahmed [37] also reported that the freshwater louse, *Argulus* caused mortality, growth loss and economic loss to the carp farms and hatcheries. Mohan [38] also reported that ectoparasites, protozoan, monogenetic trematodes and fish lice are some of the very important pathogens that have had significant impact on the yield in carp hatcheries and seed production centers in India. Sinnott [39] reported that sea lice infested fishes were 5-15% lesser in weight due to reduced fish growth and suggested that 5% more feed was required to compensate the reduced FCR. Moreover, Sahoo [10] estimated that the loss due to argulosis was estimated to be RS 29,524.40 (US$ 615) ha^{-1} yr^{-1} in a carp culture farm and 82% for reduced growth rate, 8% for carps mortality and 10% for cost of drugs used for controlling of *Argulus* spp. infestations. However, the difference of economic loses between the present and Sahoo [10] findings could be varied for considering a particular parasitic disease (argulosis) and variable fish market in different geo-climatic regions.

5. Conclusion

During the study period, a total of nine ectoparasite species and four endoparasite species were identified from the examined carp fishes. The highest peak of parasite prevalence (%) was recorded in the host of *L. rohita* in winter while the lowest was recorded in *C. catla* in summer. This might be due to stocking density, temperature along with other physico-chemical parameters as well as management practices maintained. However, the total economic loss due to parasite diseases has been estimated BDT 35,552.50 ha^{-1} yr^{-1}. Therefore, management of these parasitic diseases should be given top priority to save the carp industry from this huge economic loss every year at farmer level.

6. Acknowledgements

The authors would like to give thanks the BARC, NATP: Phase-1 (SPGR) for funding this research work under the project entitled 'Investigation in to the fish diseases and economic losses due to fish disease incidence' during 2010-2013. The authors acknowledge the help and support of the upazila level fisheries officers and fish farmers who participated the survey and PRA activities.

7. Reference

1. DoF. National Fish Week 2013 Compendium (In Bengali). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh, 2013, 144.
2. BFRSS. Fisheries Statistical Year Book of Bangladesh. Department of fisheries, Dhaka. Bangladesh, 2005.
3. Delwer MD, Hasan ANGM, Haque ME, Ali MS, Ali MH, Barman AC. Parasitic diseases of Indian major carp in Rajshahi district of Bangladesh. J Agrofor Environ 2010; 3(2):167-170.
4. Chowdhury MBR. Involvement of aeroimonads and

pseudomonads diseases of farmed fish in Bangladesh. Proceedings of the International Symposium on Disease in Marine Aquaculture, Hirosima, 3-6 October 1997. Gyobyo-kenkyu, Fish pathology 1998; 33:247-254.
5. Lilley JH, Philips MJ, Tonguthai K. A review of epizootic ulcerative syndrome (EUS) in asia. Publ. Aquatic Animal research Institute and Network of Aquaculture center in Asia Pacific, Bangkok, Thailand, 1992, 73.
6. Pennycuick L. Differences in the parasite infections in three-spined sticklebacks (*Gasterosteus aculeatus* L.) of different sex, age, and size. Parasitology 1971; 63(3):407-418.
7. Rahman MR, Akter MA, Hossain MD. Parasitic diseases of exotic carp in Bangladesh. J Agric Rural Dev 2007; 5(1-2):127-134.
8. Rahman MR, Jahan MS. Larval trematode parasites of freshwater gastropods. Bangladesh J Zool 2005; 33(1):13-34.
9. Markov GS. Physiology of Fish Parasites. *In*: Dogiel, Petrushevesky VA, Polyansky GK (Eds.), Parasitology of Fishes. Oliver and Boyd, Edinburgh and London, 1961, 117-139.
10. Sahoo PK, Mohanty J, Garnayak JSK, Mohanty BR, Banya Kar, Prasanth H *et al.* Estimation of loss due to argulosis in carp culture ponds in India. Indian J Fish 2013; 60(2):99-102.
11. Mustafa A, Rankaduwa W, Campbell P. Estimating the cost of sea lice to salmon aquaculture in eastern Canada. Can Vet J 2001; 42:54-56.
12. Ra GH. Sea louse control in Scotland, past and present. Pest Manag Sci 2002; 58:515-520.
13. Costello MJ. The global economic cost of sea lice to the salmonid farming industry. J Fish Dis 2009; 32:115-116.
14. Mofasshalin MS, Bashar MA, Alam MM, Alam GM, Moumita D, Mazlan AG *et al.* Parasites of three Indian minor carps of Rajshahi, Bangladesh. Asian J Anim Vet Adv 2012; 7(7):613-620.
15. Chandra KJ. Fish Parasitology. Lima Printing Press, Mymensingh. 2004, 176.
16. Margolis L, Esch GW, Holmes JC, Kuris AM, Schad GA. The use of ecological terms in parasitology (Report of an adhoc committee of the American society of parasitologists). J Parasitol 1982; 68(1):131-133.
17. Jena JK, Ayyappan S, Aravindakshan PK, Dash B, Singh SK, Muduli HK. Evaluation of production performance in carp polyculture with different stocking densities and species combinations. J Appl Icthyol 2002, 18:165-171.
18. Jena JK, Das PC, Kar S, Singh TK. Olive barb, *Puntius sarana* (Hamilton) is a potential candidate species for introduction into the grow-out carp polyculture system. Aquaculture 2008; 280:154-157.
19. Perveen F, Ullah H. Ectoparasites of indigenous and exotic fresh water carp fish (Cypriniformes: Cyprinidae) from Charbanda and Tarbela, Khyber Pakhtunkhwa, Pakistan. American Journal of Research Communication 2013; 1(9):255-269.
20. Tasawar Z, Naz F, Lashari MH, Hayat CS, Ali BSH, Naeem M. *et al.* Incidence of lernaeid parasite in *Catla catla* on a fish farm. Sarhad Journal of Agriculture 2009; 25(2):285-289.
21. Akhter MA, Hossain MD, Rahman MR. Parasitic diseases of exotic carp in Bangladesh. Journal of Agriculture and Rural Development 2007; 5(1-2):127-134.
22. Sanaullah M, Ahmed ATA. Gill myxobulosis of major carps in Bangladesh. J Fish Dis 1980; 3:349-354.
23. Ahmed ATA. Skin myxobulosis of a major carp (*Labeo rohita*) in Bangladesh. Fish Health News, 1982; 2(4):i-ii.
24. Banu ANH, Hossain MA, Khan MH. Investigation into the occurrence of parasites in carps, catfish and tilapia. Prog Agricult 1993; 4:11-16.
25. Chowdhury MBR. Research priorities of microbial fish disease and its control in Bangladesh for fish health. In: Disease prevention and pathology; (ed. Tollervery A) 1993, 8-11.
26. Rahman MR, Parween S. Parasitic infestation in relation to length of *Heteropneustes fossilis*, *Channa punctatus* and *Colisa fasciatus*. Univ J Zool Rajshahi Univ 2001, 20:53-56.
27. Khan NM, Aziz F, Afzal M, Rab A, Sahar L, Ali R, Naqvi SMH. Parasitic infestation in different fresh water fish of mini dams of Potohar Region, Pakistan. Pakistan Journal of Biological Sciences 2003; 6(13):1092-1095.
28. Tak I, Dar SA, Chishti MZ, Kaur H, Dar GH. Parasites of some fishes (*Labeo rohita* and *Schizothorax niger*) of Jammu and Khashmir in India. International Journal of Fisheries and Aquaculture 2014; 6(9):104-107.
29. Bhuiyan AS. Sarmin Akther and Golam Mohammad Musa. Occurrence of parasites in *Labeo rohita* (Hamilton) from Rajshahi, Univ J Zool Rajshahi Univ 2007; 26:31-34.
30. Mohanta SK. Infestation of monogenean gill parasites of certain *Puntius* sp. of Mymensingh. M.S. Thesis, Dept. of Aquaculture, Banglsdesh Agricultural University, Mymensingh 1998, 78.
31. Akter M, Hossain, Arifa, Delwer M, Rahman M, Redwanur. Parasitic Diseases of Exotic Carp in Bangladesh. J Agri & Rural Dev 2007; 5(1-2):127-134.
32. Chandra KJ, Islam KZ, Wootten R. Some aspects of association and development of *Lytocestus indicus moghe* in catfish, *Clarias batrachus*. Bangladesh J. Fish Res 1997; 1:31-38.
33. Hossain MD, Hossain MK, Rahman MH, Akter A. Khanom DA. Prevenlece of Ectoparasites of carp fingerlings at Santaher, Bogra. Univ J Zool Rajsh Univ 2008; 27:17-19.
34. Kabata. Parasites and Diseases of Fish cultured in Tropics. Taylor and Francis Ltd, 1985, 318.
35. Farhaduzzaman AM, Alam MM, Hossain M, Hussain MA, Rahman MH. Prevalence of parasites in the Indian major carp, *Labeo rohita* (Hamilton) in Rajshahi, Bangladesh, Univ J Zool Rajshahi Univ 2010; 28:65-68.
36. Bagum N, Monir MS, Khan MH. Present status of fish diseases and economic losses due to incidence of disease in rural freshwater aquaculture of Bangladesh. J Innov Dev Strategy 2014; 7(3):48-53.
37. Ahmed ATA. Development of environment friendly medicant for the treatment of argulosis in carp brood stock pond. SUFER-DFID Final Report, 2004, 57.
38. Mohan CV. Social and Economic Impacts of aquatic animal health problems in Aquaculture in India. Paper presented at the Aquatic Animal Health Care in Rural Aquaculture, Dhaka, Bangladesh, 1999.
39. Sinnott R. Sea lice –watch out for the hidden costs. Fish Farme 1998; 21(3):45-46.