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Original Article

Intraspecific Relationship between Freshwater Carp Fish (Cypriniformes: Cyprinidae) Length-Weight and Prevalence of Ectoparasites

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ABSTRACT

During the present study, a total of 1800 fish of 6 species including indigenous and exotic fresh water carp (Cypriniformes: Cyprinidae) were examined for determining intraspecific-relationship between their length-weight and prevalence of ectoparasites at Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa, Pakistan. The prevalence of 3 ectoparasites were recovered *viz.*: the anchor worm, *Lernaea cyprinacea* Linnaeus (Crustacea: Copepoda) (14.4%); carp lice, *Argulus foliaceus* Linnaeus (Crustacea: Maxillopoda) (3.6%) and salmon fluke, *Gyrodactylus sp.* Malmberg (Platyhelminthes: Monogenea) (2%). The relationship between body-length and ectoparasites revealed maximum infestation was 18.3% on both sides by *L. cyprinacea* in length group of 12-30 cm and it was minimum 8.1% in 69<cm group. While maximum prevalence was 15.5% by *A. foliaceus* in 69<cm and minimum 0.6% was in 12-30 cm groups. The prevalence by *Gyrodactylus sp.* was maximum 0.7% in 50-68 cm group. The relationship between body-weight and ectoparasites showed that *L. cyprinacea* was the highest 21% in 15-500 g and the lowest 8.2% in 987<g groups, while for *A. foliaceus* maximum prevalence 7.2% was observed in 987<g and the prevalence by *Gyrodactylus sp.* was maximum 0.5% in 501-986 g group. The prevalence of *L. cyprinacea* was 50.2% in indigenous and 49.9% exotic carp, however, the prevalence of *A. foliaceus* was 54% in exotic compared with indigenous (11%), moreover, *Gyrodactylus sp.* was only found in indigenous carp, i.e., *C. mrigala* (6%). Ectoparasites, *L. cyprinacea, A. foliaceus* and *Gyrodactylus sp.* are existing in Pakistan. This paper helps in keeping the health status of carp fish with respect to observe ectoparasites.

Keyword: *Argulus foliaceus*, body length-weight, exotic/indigenous freshwater carp, *Gyrodactylus* sp, *Lernaea cyprinacea*, prevalence.

INTRODUCTION

Food production (FP) is an essential process for energy transformation. Accordingly, the aquaculture is one of the important methods for food production. Due to increase in human

population, there is an increase in global interest for development of aquaculture towards larger economic benefits (Chua, 1986). It is being practiced throughout the world in different environments using different fish species ranging from mono- to poly-culture systems (Nash, 1995). As a result of over exploitation of natural environment by pollution and chemicals for agricultural purposes, our precious food resources are declining, for example aquaculture and fisheries (Mishra, 2010).

Pakistan is rich in marine and freshwater resources, which hold a tremendous potential for development of aquaculture and fisheries, offering great opportunities for their advancement. Now a day, they are developing as cottage industries by skillful-poor people and larger industries by industrialists, educational and research institutions in Pakistan. The government of Pakistan has introduced some exotic fish species specially the carps. Recently, successfully reared exotic carp fish species were released into freshwater bodies of Pakistan for enhancement of their yield. Beside it, Pakistan has vast resources of marine and brackish waters, however, carp farming in freshwater is the major productive aquaculture activity in Punjab, Sindh and Khyber Pakhtunkhwa (KP) (Akhtar, 2001).

The challenges that face the fish-farmers are to overcome many biotic and abiotic factors, which influence fish rearing and aquaculture operations. The parasites possess a distinct position in animal kingdom, due to their adaptative and damaging activities of the hosts. The normal growth of fish hosts is affected by parasites live on and in them, if they are highly infested. The ectoparasites are not only harming the fish directly but also effect the fish-growth as they reduce their population by inducing mortality (Piasecki *et al.*, 2004). To gain high marketable fish values, they must be grown in suitable environment where they do not only survive, but also do grow healthy. Infestation with various parasites and pathogens slow down the fish metabolic rates, injure the skin, decrease quality of meat and produce diseases. Normally, few diseases at low level of infestation do not cause problems for aqua-culturists. However, when fish were stressed under crowded culture system, their natural defense systems against diseases may be reduced which causes larger economic lost and difficulties for aqua-culturists (Munteanu, and Bogatu, 2003).

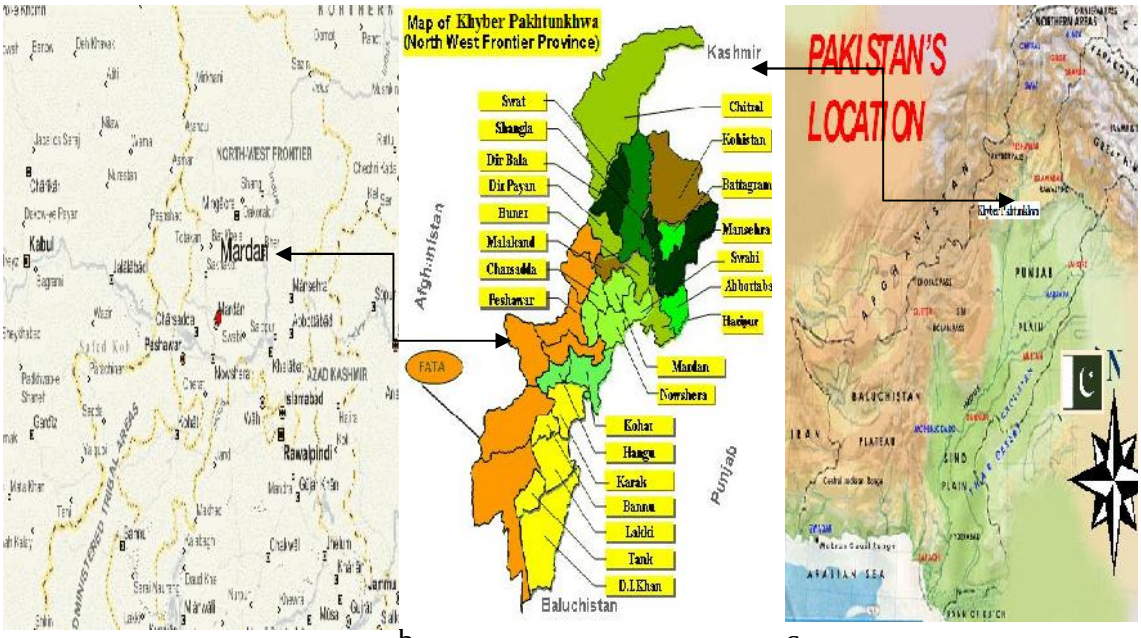
To obtain healthy fish stocks, chiefly depend on control of health problems of fish population by reducing living creatures, i.e., parasites and maintaining their environment (Snieszko, 1983). The ectoparasites of fish constitute important economic problems in pond culture system (Tasawar *et al.*, 2007a; Tasawar *et al.*, 2007b), therefore, it requires proper attention to be given by the aqua-culturists/ scientists for their healthy production. There is considerable work has been done on various aspects of ectoparasites by Bjorn *et al.*, 2006; Boxaspen, 2006; Jones *et al.*, 2006; Kir, 2007; Koyun *et al.*, 2007; Oktener *et al.*, 2007; Revie *et al.*, 2007; Tassawar and Hussain, 1999a; Tasawar and Khurshid, 1999b; Tasawar *et al.*, 2000 in various parts of world including Pakistan.

The Charbanda Carp Fish Hatchery (CCFH), Mardan, KP, Pakistan (Figure 1) is located at 34° 15' 51" north latitudes, 72° 4' 33" east longitudes and an altitude of 283 m (928 ft). It is bounded by Swabi on the north, Buner on the east, Nowshera on the south and Charsada districts and Malakand protected area on the west (Akhtar, 2001). The objective of the present research is to determine intraspecific-relationship of fish length-weight and prevalence of ectoparasites among 6 fresh water carp species.

METHODS AND MATERIALS

In the present research, 1800 fish were collected from Charbanda Carp Fish Hatchery (CCFH), Mardan, KP, Pakistan (Figure 1) and examined to investigate the intraspecific-relationship between fish length-weight and prevalence of ectoparasites. Fish were reared in the single pond with different age classes given dry artificial (50-60% protein) diet® under 25±1 °C, 50-60% RH and local photoperiod 12:12 (L:D) h. Fish were collected randomly in each week (4 times) in a month from February-July with the help of seine-net of mesh size 1

cm. The fish were weighed using a Chyo Electric Balance (Chyo Balance Corp., Tokyo, Japan) in gm (Perveen, 2000) and measured for length in cm using a fixed-calibrated ocular-meter (Olympus, Tokyo, Japan) (Merera *et al.*, 2014; Weldemariam, 2015).



a b c

Figure 1: Map of the study area, Charbanda Carp Fish Hatchery (CCFH) is located in Mardan (a) which is in Khyber Pakhtunkhwa (b) one of the province of Pakistan (c) where the present research was conducted (Akhtar, 2001).

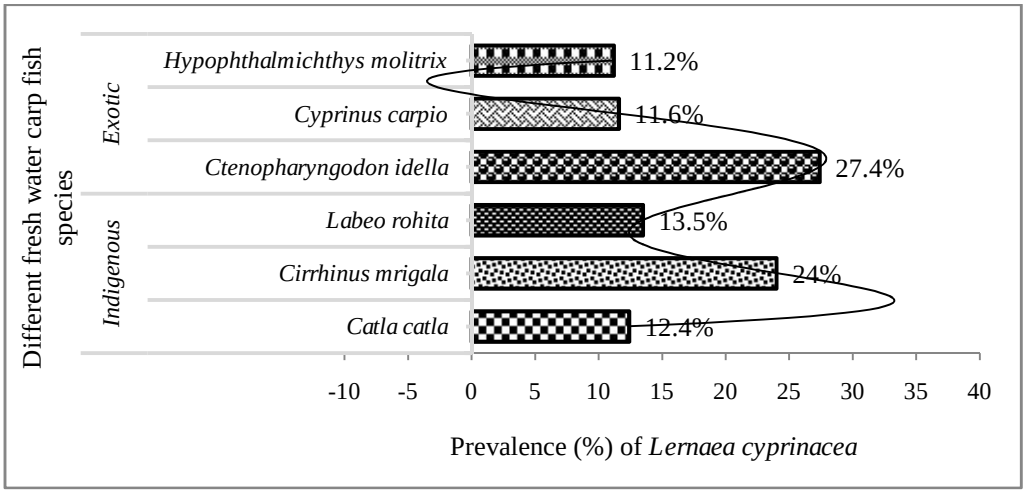
The infected fish were brought to National Agricultural Research Center (NARC) Laboratory, Islamabad, Pakistan for further examination. Gills and body surface of fish were thoroughly examined with the help of magnifying-glass for presence of ectoparasites. As parasitic crustaceans such as the anchor worm, *Lernaea cyprinacea* Linnaeus 1758 (Crustacea: Copepoda) and carp lice, *Argulus foliaceus* (Linnaeus) 1758 (Crustacea: Maxillopoda) were clearly visible by naked eye, therefore, they were isolated with the help of forceps and preserved in 70% ethanol (C_2H_5OH). For platyhelminth such as salmon fluke, *Gyrodactylus sp.* Malmberg 1957 (Platyhelminthes: Monogenea), the mounting procedure has been included a simple ammonium picrate-glycerine (APG) mounting (also called Malmberg's fixative). Then they were examined under microscope (BH_2; Olympus Co. Ltd., Tokyo, Japan) at × 400 magnification and photographs were taken (camera used: Nikon, Tokyo, Japan; Figure 2) (Perveen *et al.*, 2010). Identification of ectoparasites has been conducted according to the key by Mirza and Sandhu (2007). The statistical analysis was carried out by MS Office (Perveen, and Hussain, 2012) and prevalence was estimated according to Margolis *et al*. (1982) as: Prevalence (%) = Numbers of host infected × 100 / Numbers of host examined.

RESULTS

During the present research, total of 1800 host freshwater carp fish (Cypriniformes: Cyprinidae) of different species were studied in which 3 were indigenous, including, the thaila, *Catla catla* (Hamilton, 1822); moraki, *Cirrhinus mrigala* Hamilton, 1822 and rohu, *Labeo rohita* (Hamilton, 1822), however, 3 were exotic including, the grass carp, *Ctenopharyngodon idella* (Valenciennes, 1844); silver carp, *Hypophthalmichthys molitrix* (Valenciennes, 1844); common carp, *Cyprinus carpio* Linnaeus, 1758. They were examined to determine intraspecific-relationship between fish length-weight and prevalence of ectoparasites at Charbanda Carp Fish Hatchery (CCFH), Mardan, KP, Pakistan.

There 3 ectoparasites were recognized, *viz.*: the anchor worm, *Lernaea cyprinacea* Linnaeus, 1758 (Crustacea: Copepoda); carp lice, *Argulus foliaceus* (Linnaeus, 1758) (Crustacea: Maxillopoda) and salmon fluke, *Gyrodactylus sp.* Malmberg, 1957 (Platyhelminthes: Monogenea). Their prevalence (%) was: *L. cyprinacea*: 14.4% > *A. foliaceus*: 3.6% > *G. salaries*: 2.0%. The prevalence of infected endogenous fish species with *L. cyprinacea* was: *Ci. mrigala*: 24.0% > *L. rohita*: 13.5% > *Ca. catla*: 12.4%. The prevalence of infected exotic fish species with *Lernaea cyprinacea*: *C. idella*: 27.4% > *Cy. carpio*: 11.6% > *H. molitrix*: 11.2%. The prevalence of infected indigenous fish species with *A. foliaceus* was: *Ci. mrigala*: 12.3% > *L. rohita*: 3.1% > *Ca. catla*: 1.5%. The prevalence of infected exotic fish species with *A. foliaceus*: *H. molitrix*: 52.3% > *C. idella*: 21.5% > *Cy. carpio*: 9.2%. *Gyrodactylus sp.* was not found accept on *Ci. Mrigala* is an indigenous fish (Figure 2).

The present research showed the *L. cyprinacea* prevalence was the highest (18.3%) in fish body length ranges from 12-30 cm. A decrease (16.6%) in prevalence was recorded in fish having 31-49 cm, by further decrease (8.8%) and (8.1%) in larger fish 50-68 cm and 69 < cm, respectively. The prevalence of *L. cyprinacea* was shown negatively correlated with host length. The highest (33.3%) prevalence was found in exogenous fish, *Ct. idella* in 12-30 cm group (Table 1).



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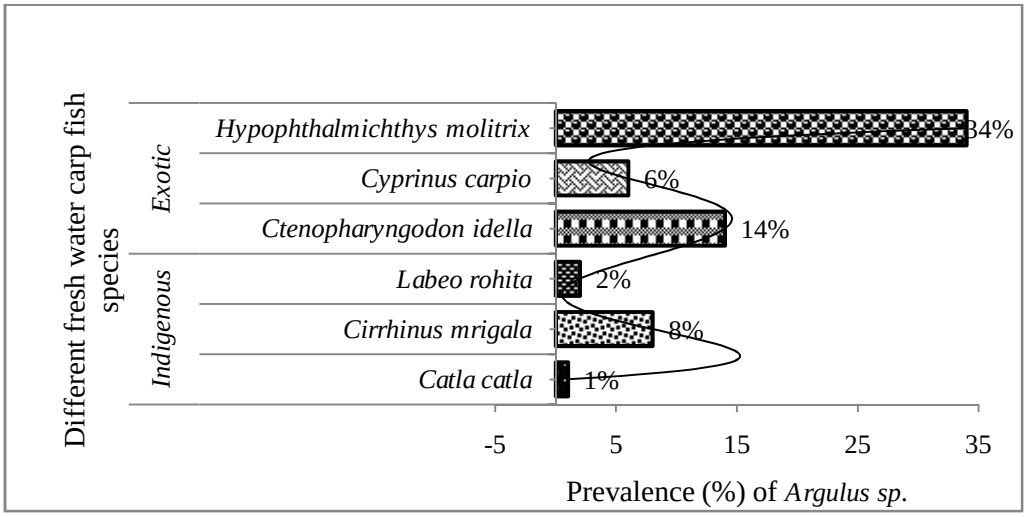

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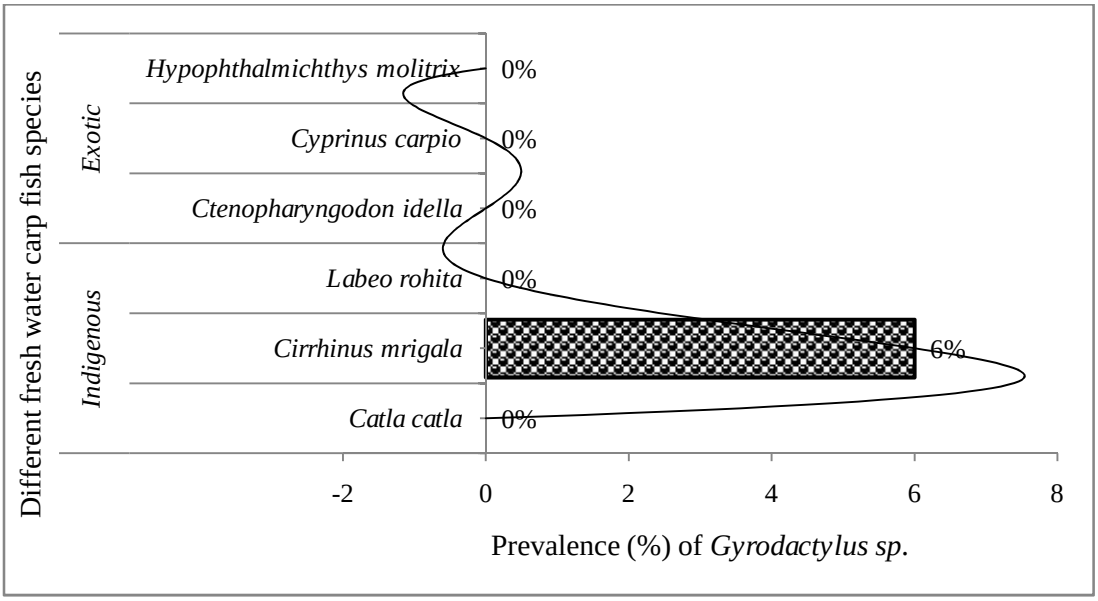

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Figure 2: Prevalence of the ectoparasites on different fresh water carps fish species at Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa, Pakistan; indigenous fish: thaila, *Catla catla* (Hamilton); moraki, *Cirrhinus mrigala* Hamilton; Rohu, *Labeo rohita* Hamilton; exotic fish: grass carp, *Ctenopharyngodon idella* (Valenciennes); common carp, *Cyprinus carpio* Linnaeus; silver carp, *Hypophthalmichthys molitrix* (Valenciennes); n=1800 (300 for each species); trend line: polynomial; prevalence of anchor worm, *Lernaea cyprinacea* Linnaeus: a; prevalence of carp lice, *Argulus foliaceus* (Linnaeus): b; prevalence of salmon fluke, *Gyrodactylus sp.* Malmberg: c.

In the present research, *A. foliaceus* prevalence was lower in smaller host fish whose body length between 12-30 cm (0.6%) and increase in infestation occurred as the fish size increase and the highest prevalence (15.5%) was seen in body length greater than 69 cm. The prevalence of *A. foliaceus* was shown the positively correlated with host length. The highest prevalence was found in exotic fish, *H. molitrix* (75.0%) in 12-30 cm group (Table 1).

The present study showed that *Gyrodactylus sp.* prevalence was the highest (0.7%) in fish body length ranges from 50-68 and 69< cm and no prevalence was seen in fish length 12-3 cm. In this study, the prevalence of *Gyrodactylus sp.* was shown negatively correlated with host length and the highest prevalence (100%) was found in indigenous fish, *Ci. mrigala* in 31-49, 50-68 and 69< cm length groups (Table 1).

In the present research, *L. cyprinacea* was the highest prevalent (21.0%) in the body weight group of 15-500 g followed by weight group of 501-986 g (11.6%) and the lowest (8.2%) in 987 < g (Table 2). The prevalence of *L. cyprinacea* was shown positively correlated with host length. The highest prevalence (28.8%) was found in exotic fish, *Ct. idella* and the lowest prevalence (2.9%) was also found in indigenous fish, *C. catla* (Table 2).

Argulus foliaceus infestation also increased along the side of the body of fish. It has the highest prevalent (7.2%) in the body weight group of 987< g followed by weight group of 501-986 g (3.6%) and the lowest (1.2%) in 15-500 g. The prevalence of *L. cyprinacea* was shown positively correlated with host length and the highest prevalence (54.3%) was found in exotic fish, *H. molitrix* in 987< g group and the lowest prevalence (2.9%) was found in indigenous fish *Ca. catla* and *L. rohita* (Table 2).

Gyrodactylus sp. was the most prevalent (0.5%) in the body weight group of 501-986 g followed by weight group of 15-500 g (0.3%) and the lowest (0.2%) in 987< g. This parasite was not found in any other fish except *C. mrigala* with the highest prevalence (100%) in each weight groups of the same species (Table 2).

Table 1: Intraspecific-relationship between body-length of host fresh water carp fish species and ectoparasites at Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa, Pakistan

SNo	Indigenous/ Exotic	Carp fish species Collected from CCFH*	N^{E*}	Prevalence (%) of parasites*											
				12-30 cm (n=705)			31-49 cm (n=513)			50-68 cm (n=434)			69< cm (n=148)		
				P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
1.	Indigenous	*Catla catla*	300	13.2	0.0	0.0	10.0	0.0	0.0	11.1	0.0	0.0	21.4	4.8	0.0
2.		*Cirrhinus mrigala*	300	22.5	0.0	0.0	26.3	17.4	100.0	27.8	5.9	100.0	14.3	14.3	100.0
3.		*Labeo rohita*	300	12.4	0.0	0.0	15.0	4.4	0.0	13.9	0.0	0.0	14.3	4.8	0.0
4.	Exotic	*Ctenopharyngodon idella*	300	33.3	25.0	0.0	22.5	17.4	0.0	19.4	35.3	0.0	21.4	14.3	0.0
5.		*Cyprinus carpio*	300	11.6	0.0	0.0	13.7	8.6	0.0	8.4	11.8	0.0	7.2	9.5	0.0
6.		*Hypophthalmichthys molitrix*	300	7.0	75.0	0.0	12.5	52.2	0.0	19.4	47.1	0.0	21.4	52.3	0.0
		Number	1800	129	4	0.0	80	23	0	36	17	3	14	21	1
		%	100	18.3	0.6	0.0	16	4.5	0	8.3	3.9	0.7	9.5	14.2	0.7

*N^E: number of fish examined; n: number of fish observed in selected range of body length; P_1: % of fish with the anchor worm, *Lernaea cyprinacea* Linnaeus; P_2: % of fish with the carp lice, *Argulus foliaceus* (Linnaeus); P_3: % of fish with the salmon fluke, *Gyrodactylus sp.* Malmberg present; 1) thaila, *Catla catla* (Hamilton); 2) moraki, *Cirrhinus mrigala* Hamilton; 3) rohu, *Labeo rohita* Hamilton; 4) grass carp, *Ctenopharyngodon idella* (Valenciennes); 5) common carp, *Cyprinus carpio* Linnaeus; 6) silver carp, *Hypophthalmichthys molitrix* (Valenciennes)

Table 2: Intraspecific-relationship between body-weight of host fresh water carp fish species and ectoparasites at Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa, Pakistan

S. No	Indigenous/ Exotic	Carp fish species Collected from CCFH*	N^{E*}	Prevalence (%) of parasites*								
				15-500 g (n=705)			501-986 g (n=605)			987< g (n=484)		
				P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
1.	Indigenous	*Catla catla*	300	14.1	0.0	0.0	2.9	0.0	0.0	11.2	2.9	0.0
2.		*Cirrhinus mrigala*	300	22.2	25.0	100	27.1	13.6	100	27.8	8.6	100
3.		*Labeo rohita*	300	14.1	12.5	0.0	14.3	0	0.0	13.9	2.9	0.0
4.	Exotic	*Ctenopharyngodon idella*	300	28.8	12.5	0.0	31.4	27.3	0.0	19.4	20.0	0.0
5.		*Cyprinus carpio*	300	11.4	0.0	0.0	10	9.1	0.0	8.3	11.4	0.0
6.		*Hypophthalmichthys molitrix*	300	9.4	50.0	0.0	14.3	50	0.0	19.4	54.3	0.0
		Number	1800	149	8	2	70	22	3	36	35	1
		%	100	21.1	1.1	0.3	11.6	3.6	0.5	7.4	7.2	0.2

*N^E: number of fish examined; n: number of fish observed in selected range of body length; P_1: % of fish with the anchor worm, *Lernaea cyprinacea* Linnaeus; P_2: % of fish with the carp lice, *Argulus foliaceus* (Linnaeus); P_3: % of fish with the salmon fluke, *Gyrodactylus sp.* Malmberg present; 1) thaila, *Catla catla* (Hamilton); 2) moraki, *Cirrhinus mrigala* Hamilton; 3) rohu, *Labeo rohita* Hamilton; 4) grass carp, *Ctenopharyngodon idella* (Valenciennes); 5) common carp, *Cyprinus carpio* Linnaeus; 6) silver carp, *Hypophthalmichthys molitrix* (Valenciennes)

DISCUSSION

During the present research, 3 species of ectoparasites were detected on 6 species, including 3 indigenous and 3 exotic fresh water carp fish at Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa, Pakistan. A total of 1800 fish were examined to determine intraspecific-relationship between fish 2 parameters length-weight and prevalence of ectoparasites. The same parameters were also used by Tassawar and Hussain (1999a) and Tasawar, and Khurshid (1999b), Tasawar *et al.* (2000; 2001a) in *L. rohita*; Tasawar *et al.* (2009b), in *Ci. mrigala* and Tasawar *et al.* (1999 c and d) in *Ct. idella.* Tasawar *et al.* (2009c) in *Ca. catla*; Tasawar and Shahzad (2001) in *H. molitrix*; Noga (1986), Dorovskikh (1993), Hayward *et al.* (1998) and Fernandes *et al.* (2006) in different other fish species. The present study showed similar results as investigated by them.

Different researchers have worked on fresh water carp from various parts of the world (Tasawar *et al.,* 2007a; Tassawar and Hussain, 1999a; Tasawar and Khurshid, 1999b; Tasawar *et al.,* 2009c; Walker *et al.,* 2007; Harris, 2004) for ectoparasites burden on them. Berry *et al.* (1991) reported *L. cyprinacea* on rainbow trout, *Onchorynchus mykiss* (Walbaum, 1792). Rohde *et al.* (1995) studied *Lernaea sp.* in marine fishes in New Zealand. Ho and Kim (1997) reported 10 species of Lernaeid copepods from Thailand. The present research was comparable with the study conducted by above ichthyologists. However, the difference in number of ectoparasites species might be due to the geo-climatic conditions of different countries. The higher number of infested species by ectoparasites at CCFH, Mardan might be due to fish species mixed and crowded culture conditions, slow water flow rate and water temperature fluctuation, which might be provided good environment for flourishing of the ectoparasites.

According to the present research, either minimum number or no *L. cyprinacea* was found on the smallest sized fish. The absence of parasites on very small size fish below 12 cm might be due to the small size of scales, where parasites cannot uphold proper cling to the fish body. The less prevalence of *L. cyprinacea* on the smallest sized fish could be due to scale structure of these fishes. It might be correlated to the smallest surface area provided by the confined hosts. Moreover, a decrease in the ectoparasites count in the larger fish (greater than 69 cm) might be due to the development of acquired immunity against ectoparasites.

In the present research, the maximum prevalent of *L. cyprinacea* was found in the body weight group of 15-500 g but decreased by weight group of 501-986 g and the lowest in 987 < g (Table 2). Tasawar *et al.* (2009c) found the relationship between *L. cyprinacea* and body weight in *Ct. idella* indicated that parasitic burden decreased as weight of fish increased. Results of the Tasawar *et al.* (2007b) revealed an increase in fish burden from 160-553 gm body weight. The parameter, i.e., weight was also studied by other worker in different hosts (Kir, 2007; Tasawar and Khurshid, 1999b; Tasawar and Naeem, 1999c; Tasawar *et al.,* 2001a; Tasawar and Naeem, 1999c). Their results were correlated with the present research. In addition to that it was also observed as the body weight of the fish increased, *L. cyprinacea* numbers were decreased.

In the present research *A. foliaceus* prevalence was lower in smaller host fish whose body length between 12-30 cm and an increase in infestation found as the fish size increase and the highest prevalence was seen in body length greater than 69 cm (Table 1). Several researchers were studied with reference to the relationship between *A. foliaceus* infestation and the size of host fish. However, Pojmanska and Chabros (1993) found *Argulus foliaceus* infestation in *Cy. carpio* aged 0-2 year. Walker *et al.* (2007) and Pojmanska and Chabros (1993) also reported relationship of infestation of *Argulus foliaceus* and size of stickleback, *Gasterosteus aculeatus* Linnaeus. In the present study, the age of fish was not studied, moreover, species of *Argulus* were also not identified, however, results were comparable.

Poulin *et al*. (1991) describe this relationship *A. foliaceus* with weight of brook trout, *Salvelinus fontinalis* (Mitchill). The general trend was that larger fish with higher weight would harbor higher number of *A. foliaceus* (Tucker *et al.,* 2000) and weight mostly correlated in majority cases (O'Shea *et al.,* 2006). The present findings were in agreement as body weight of fish increase *A. foliaceus* infestation. It may be due to the fact that larger fish were easier to find and attach for *A. foliaceus* due to larger surface area.

The present results were parallel to finding on earlier work by Ozturk (2005) and also supported the conclusion of Ozturk and Bulut (2006). The increase in infestation may be due to larger gill surface area and no permanent immunity against mentioned parasites. Therefore, the present study showed *Gyrodactylus sp.* prevalence was the highest in fish body length ranges from 50-68 cm followed by 31-49 cm and it was not seen in fish length 12-3-cm (Table 1).

Prevalence of *L. cyprinacea* was increased with increase of body length as well as body weight, however, body length of fish 69<cm was not followed this pattern. Moreover, prevalence of *A. foliaceus* has no specific pattern related to body length and weight. Further, % prevalance of *Gyrodactylus sp.* was very low in different carp species and has no specific relation with body length and weight. However, during the present research, fish were kept in the single pond with different age classes under the temperature 25±1 °C, 50-60% RH and local photoperiod, i.e., 12:12 (L:D) h and provided dry artificial (50-60% protein) diet®. If the fish were not in the same pond, there were certainly great pond effects in the occurrence and prevalence of infection of different parasitic species. Accordingly, the feeding, water temperature and other water quality factors were responsible for different fertilization or feeding practices in the different ponds. They have an influence on the parasitic prevalence. The same applies to the gender and degree of sexual maturation. The number of individuals of different body length groups were associated with different body weight groups in different fish species, therefore, increase in their body length simultaneously increase in their body weight. It was not just the prevalence of the parasite infections.

Harris *et al.* (2004) mentioned that *Gyrodactylus sp.* was recorded from single hosts. In addition, it can also survive for short periods in the absence of the host (Kearn, 2004). This trend was previously observed in the case of other monogeneans trematodes parasites (Grutter *et al.,* 2002; Mattiucci *et al.,* 2005; Perveen and Ullah, 2013). In this study, the prevalence of *Gyrodactylus sp.* was shown negatively correlated with host length and the highest prevalence in *Ci. mrigala* could be due to its nature that this fish is bottom dweller where temperature remains constant as compared to surface of water. In the present research, *Gyrodactylus sp.* was significantly more prevalent in the body weight group of 501-986 g, followed by weight group of 15-500 g and lowest in 987< g (Table 2). The low infestation in the larger weight group in *C. mrigala* could be due to resistance against this ectoparasite.

The prevalence of *L. cyprinacea* was the same in indigenous and exotic carp fish species, however, the prevalence of *A. foliaceus* was more in exotic carps as compared with indigenous; moreover, *Gyrodactylus sp.* was only found in indigenous carp, *C. mrigala.* Therefore, ectoparasites burden should be decreased by using different methods for increasing production of fish to overcome their need.

CONCLUSION

The prevalence of ectoparasites on at CCFH, Mardan, KP, Pakistan has shown that *L. cyprinacea* was the dominant followed by *A. foliaceus* and least recovered was *Gyrodactylus sp.* The highest prevalence of *L. cyprinacea* and *A. foliaceus* were seen in *Ct. idella* and *H. molitrix,* respectively. Only *Cirrhinus mrigala* was infected with *Gyrodactylus sp.* However, it may be not depended on body length and weight of different carp fish species.

RECOMMENDATION

The physico-chemical parameters should be monitor regularly to prevent the abundance of ectoparasitic infestation. A detail study should be needed on seasonal variation in prevalence of gender of ectoparasitic infestation with pollution state of habitat type. To prevent ectoparasites infestation, effective control measures, e.g., chemicals should be used.

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