# Ectoparasites of indigenous and exotic fresh water carp fish (Cypriniformes: Cyprinidae) from Charbanda and Tarbela, Khyber Pakhtunkhwa, Pakistan

**Farzana Perveen[*] and Hanif Ullah**

Department of Zoology, Shaheed Benazir Bhutto University (SBBU), Main Campus, Sheringal, Khyber Pakhtunkhwa, Pakistan
***Correspondence should be address to:** Dr Farzana Perveen, Founder Chairperson and Associate Professor, Department of Zoology; Controller Examination, Shaheed Benazir Bhutto University (SBBU), Main Campus, Sheringal, Khyber Pakhtunkhwa, Pakistan; Office Phone: (092)-944-885529; Mobile: (092)-300-2253872; Fax: (092)-944-885805; URL: http://www.sbbu.edu.pk; E.mail: farzana_san@hotmail.com

## Abstract

During the present research, total of 2160 host fresh water carp fish (Cypriniformes: Cyprinidae) of different species were studied for ectoparasitic infestation at Charbanda Carp Fish Hatchery (CCFH), Mardan, and Tarbela Fish Farm (TFF), Tarbela, Khyber Pakhtunkhwa, Pakistan in which 3 were indigenous including the thaila, *Catla catla* Hamilton; moraki, *Cirrhinus mrigala* Hamilton and rohu, *Labeo rohita* Hamilton, however, 3 were exotic including the grass carp, *Ctenopharyngodon idella* Valenciennes; silver carp, *Hypophthalmichthys molitrix* Valenciennes and common carp, *Cyprinus carpio* Linnaeus. The individual ectoparasitic infestation of 3 different species were: the anchor worm, *Lernaea cyprinacea* Linnaeus (Crustacea: Copepoda) (17.2%); carp lice, *Argulus sp* Leach (Crustacea: Maxillopoda) (3.6%) and salmon fluke, *Gyrodactylus sp* Malmberg (Platyhelminthes: Monogenea) (0.3%). The highest overall prevalence and abundance at CCFH, in *C. idella* was 25.4% and 1.3%, respectively and intensity was more in *C. mrigala* 19.5% while at TFF, the highest overall prevalence and abundance in *L. rohita* was 7.9% and 0.2%, respectively and intensity was more in *Ct. idella* 3.7%. The lowest overall prevalence and abundance at CCFH in *Ca. catla* 11% and 0.3%, respectively, and the lowest intensity was seen in *H. molitrix* (6.1%) while at TFF, the lowest overall prevalence and abundance in *C. idella* was 3.3% and 0.1%, respectively, and the lowest intensity was seen in *L. rohita* (3.66%). However, no ectoparasite was recovered from *C. mrigala* and *Cy. carpio* at TFF.

**Key words:** Abundance, intensity, fresh water carps, monthly variation, prevalence

**Running title:** Ectoparasites of indigenous and exotic fresh water carp fish in Pakistan

{**Citation:** Farzana Perveen, Hanif Ullah. 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} www.usa-journals.com, ISSN: 2325-4076.

## Introduction

The aquaculture, in recent decades is considered to be one of the important factors of the world economy. Other than marketing concern, the biggest challenges that face the fish farmers is to control many biotic and abiotic factors, influencing fish rearing and aquaculture operations. The parasites possess a definite position in animal kingdom, due to their adaptation and damaging activities. The normal growth is affected by parasite that lives on the fish if highly infested. Ectoparasites not only harm the fish directly but also render the fish for grown, reduce host population and induce mortalities (Piasecki et al., 2004). In cultured fish population, the parasites may involve in the serious outbreak of disease (Kayis et al., 2009). They have been receiving considerable scientific attention due to serious damage to fishery resources by them (Ravichandram, 2009).

The adult stage of parasite is particularly more dangerous to fish health depending on modes of attachment, the size and weight of host (Jalali and Barzegar, 2006; Tasawar et al., 2007a, 2009). On attachment to gill and skin, the ectoparasites cause localized hyperplasia, disturb osmoregulation and ultimately kill the host (Piasecki et al., 2004; Bednarska et al., 2009) and providing a pathway for the secondary pathogens such as viruses, bacteria and fungi (Tumbol et al., 2001). In the crowded culture conditions, particularly if the fishes are stressed, the parasites multiply rapidly. The temperature and slow water flow rate may also increase the parasitic infestation (Bednarska et al., 2009). The incidence and intensity of parasite also varied with season (Bichi and Bawaki, 2010). Young fishes are more prone to infection than older one (Ozturk, 2005). The stoking density and water quality parameters correlate with the incidence of fish parasites (Bhuiyan et al., 2007). In confined water bodies of Pakistan, the ectoparasites are one of great problem to fresh water carps (Tasawar et al., 2007b).

Most commercial fishes, in Pakistan such as common carp, *Cyprinus carpio* Linnaeus, 1758; grass carp *Ctenopharyngodon idella* (Valenciennes, 1844); silver carp, *Hypophthalmicthys molitrix* (Valenciennes, 1844); mori, *Cirrhinus mrigala* Hamilton, 1822 and Rohu, *Labeo rohita* (Hamilton, 1822) infected by protozoa ectoparasite such as *Chilodonella sp* (Ehrenberg, 1838) and *Trichidina sp* (Ehrenberg, 1831), *Gyrodactylus sp* (von Nordmann, 1831) (monogenetic trematod), *Lernaea cyprinacae*, Linnaeus, 1758; *Ergasilus sp* Nordmann, 1832 and *Argulus sp* Müller, 1785 (Crustaceans) (Khan et al., 2003). Keeping in view the importance of these ectoparasites, the present study was designed to investigate the prevalence, abundance and intensity of ectoparasitic infestation in indigenous and exotic cultured carp fishes.

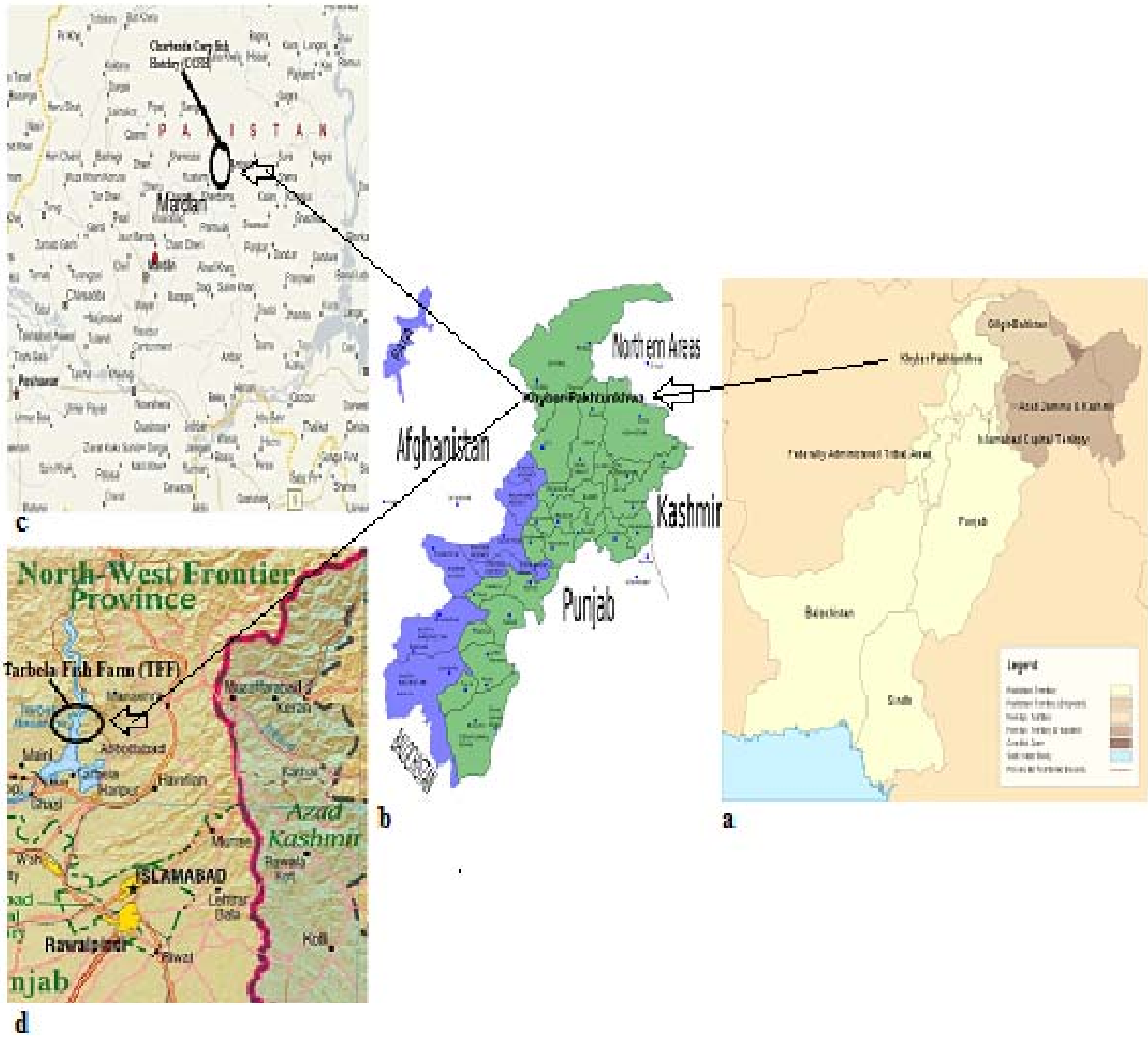


**Figure 1. Map of Charbanda Carp Fish Hatchery (CCFH; c), Mardan and Tarbela Fish Farm (TFF; d), Khyber Pakhtunkhwa (KP; b), Pakistan (a) where the present research was conducted during February-July 2011 (Daoud, 2010).**

## Methods and materials

During the present study a total of 2160 fish were studied to investigate the prevalence, abundance and intensity of ectoparasitic infestation in indigenous and exotic cultured carp fish (Cypriniformes: Cyprinidae) at Charbanda Carp Fish Hatchery (CCFH), Mardan and Tarbela Fish Farm (TFF), Tarbela, Khyber Pakhtunkhwa (KP), Pakistan (Figure 1). Fish were collected randomly 4 times (each week) in a month from February-July 2011 with the help of a seine net of mesh size 1 cm. The infected fish were brought to National Agriculture Research Centre (NARC) Laboratory, Islamabad for further examination and identification has been done according to the key by Mirza and Sandhu (2007). Gills and body surface of fish were thoroughly examined with the help of magnifying glass and ectoparasites were isolated and preserved in 70% ethanol ($C_2H_5OH$). The wet and permanent mounts were prepared to locate ectoparasites. Then both wet and permanent mounts 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, 2010). The statistical analysis was carried out MS Office (Perveen and Hussain, 2012). Prevalence, abundance and mean density were estimated by the formulae proposed by Margolis et al. (1982).

**Results**

During the present research, total of 1800 host fresh water carp fish (Cypriniformes: Cyprinidae) of different species were studied in which 3 were indigenous, including, the thaila, *Catla catla* (Hamilton); moraki, *Ci. mrigala* Hamilton and rohu, *Labeo rohita* Hamilton, however, 3 were exotic including, the grass carp, *Ctenopharyngodon idella* (Valenciennes); silver carp, *Hypophthalmichthys molitrix* (Valenciennes) and common carp, *Cyprinus carpio* Linnaeus. They were examined to investigate the prevalence, abundance and intensity of ectoparasitic infestation. Three different types of parasites namely, the anchor worm, *Lernaea cyprinacea* Linnaeus (Crustacea: Copepoda); carp lice, *Argulus sp* Leach (Crustacea: Maxillopoda) and salmon fluke, *Gyrodactylus sp* Malmberg (Platyhelminthes: Monogenea). In the present research at CCFH, Mardan the overall prevalence of ectoparasites: exotic species 20.5% > indigenous fish 16.2%. The *L. cyprinacea* was the dominant ectoparasites followed by *Argulus sp* and least recovered ectoparasites was *Gyrodactylus sp*. The prevalence of infected indigenous fish species with ectoparasites was:

*Ci. mrigala*: 25.4% > *L. rohita*: 12.3% > *Ca. catla*: 11.0% while the prevalence of infected exotic fish species with ectoparasites: *C. idella*: 28.3 % > *H. molitrix*: 21.0% > *Cy. carpio*: 12% . The abundance of ecto-parasites in indigenous fish species was: *Ci. mrigala*: 1.1% > *L. rohita*: 0.6% > *Ca. catla*: 0.4%. The abundance of ectoparasites in exotic fish species was: *C. idella*: 1.3% > *H. molitrix*: 0.6% > *Cy. carpio*: 0.4%. The Intensity of ecto-parasites in indigenous fish species was: *Ci. mrigala*: 19.6% > *Ca. catla*: 8.4%. > *L. rohita*: 7.6%. The Intensity of infected exotic fish species with ectoparasites was: *C. idella*: 8.0% > *Cy. carpio*: 7.0% > *H. molitrix*: 6.1% (Table 1).

**Table 1 Prevalence, abundance and intensity of ectoparasites in carp fish species at Charbanda Carp Fish Hatchery (CCFH), Mardan, Pakistan***

| SNo | Origin | Fish Name | Ectoparasite | $N^{E*}$ | $N^{I*}$ | $N^{R*}$ | Prevalence (%) | Abundance (%) | Intensity (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Indigenous | *Catla catla* | *Lernaea cyprinacea* | 300 | 32 | 108 | 11 | 0.37 | 8.37 |
| | | | *Argulus sp* | | 1 | 5 | | | |
| 2. | | *Cirrhinus mrigala* | *Lernaea cyprinacea* | 300 | 62 | 229 | 25.35 | 1.1 | 19.56 |
| | | | *Argulus sp* | | 8 | 23 | | | |
| | | | *Gyrodactylus sp* | | 6 | 78 | | | |
| 3. | | *Labeo rohita* | *Lernaea cyprinacea* | 300 | 35 | 162 | 12.34 | 0.56 | 7.62 |
| | | | *Argulus sp* | | 2 | 6 | | | |
| 4. | Exotic | *Ctenopharyngodon idella* | *Lernaea cyprinacea* | 300 | 71 | 361 | 28.34 | 1.34 | 8 |
| | | | *Argulus sp* | | 14 | 41 | | | |
| 5. | | *Cyprinus carpio* | *Lernaea cyprinacea* | 300 | 30 | 114 | 12 | 0.44 | 6.96 |
| | | | *Argulus sp* | | 6 | 19 | | | |
| 6. | | *Hypophthalmichthys molitrix* | *Lernaea cyprinacea* | 300 | 29 | 88 | 21.01 | 0.64 | 6.11 |
| | | | *Argulus sp* | | 34 | 105 | | | |
| | | Total | | 1800 | 330 | 1339 | | | |

*$N^E$: number of fish examined; $N^I$: number of infected fish; $N^R$: number of ectoparasite recovered; *the prevalence, abundance and intensity with the anchor worm, *Lernaea cyprinacea* Linnaeus; carp lice, *Argulus sp* Leach; salmon fluke, *Gyrodactylus sp* Malmberg; present in; 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)

The prevalence of ectoparasites was investigated in indigenous and exotic carp fish TFF in 2 indigenous and exotic fish species each. The prevalence was more in indigenous carp fish as compared to exotic fish. The highest prevalence was seen in *C. idella*: 3.3% > *Cy. carpi*: 0% while in indigenous fish species the prevalence was: *L. rohita*: 7.9% > *Ci. mrigala*: 0%. Only one type of ectoparasite the *Lernaea cyprinacea* was recovered from infected fish. In exotic fish the highest abundance was seen as: *C. idella*: 0.1% > *Cy. carpi*: 0%, while in indigenous fish species: *L. rohita*: 0.2% > *Ci. mrigala*: 0%. The highest abundance was seen in *C. idella*: 3.7% > *Cy. Carpi*: 0%, while in indigenous fish species: *L. rohita*: 3.0% > *Ci. mrigala*: 0% (Table 2).

**Table 2 Prevalence, abundance and intensity of ectoparasites in carp fish species at Tarbela Fish Farm (TFF), Tarbela, Pakistan***

| SNo | | Fish Name | Ectoparasite | $N^{E*}$ | $N^{I*}$ | $N^{R*}$ | Prevalence (%) | Aabundance (%) | Intensity (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | **Indigenous** | *Cirrhinus mrigala* | Nil | 90 | - | - | - | - | - |
| 2. | | *Labeo rohita* | *Lernaea cyprinacea* | 90 | 7 | 21 | 7.78 | 0.24 | 0.3 |
| 3. | **Exotic** | *Ctenopharyngodon idella* | *Lernaea cyprinacea* | 90 | 3 | 11 | 3.34 | 0.13 | 3.66 |
| 4. | | *Cyprinus carpio* | Nil | 90 | - | - | - | - | - |
| | | Total | | 360 | 10 | 32 | | | |

*$N^E$: number of fish examined; $N^I$: number of infected fish; $N^R$: number of ectoparasite recovered; *the prevalence, abundance and intensity with the anchor worm, *Lernaea cyprinacea* Linnaeus; carp lice, *Argulus sp* Leach; the salmon fluke, *Gyrodactylus sp* Malmberg; present in; 1) moraki, *Cirrhinus mrigala* Hamilton; 2) rohu, *Labeo rohita* Hamilton; 3) grass carp, *Ctenopharyngodon idella* (Valenciennes); 4) silver carp, *Hypophthalmichthys molitrix* (Valenciennes)

The individual parasitic infestation at CCFH by *L. cyprinacea*: 14.4% > *Argulus sp*: 3.6% > *Gyrodactylus sp*: 0.3%. At TFF only *L. cyprinacea* was recovered. The infection by *L. cyprinacea* was 2.8% (Table 3).

**Table 3 Individual ectoparasitic infestation in carp fish species at Charbanda Carp Fish Hatchery (CCFH), Mardan and Tarbela Fish Farm (TFF), Tarbela, Khyber Pakhtunkhwa (KP), Pakistan**

| Study site | CCFH, Mardan* | | TFF, Tarbela* | |
|---|---|---|---|---|
| **Ectoparasites** | **$N^{I*}$** | **% infection** | **$N^{I*}$** | **% infection** |
| *Lernaea cyprinacea* | 259 | 14.38 | 10 | 2.77 |
| *Argulus sp* | 65 | 3.61 | 0 | 0 |
| *Gyrodactylus sp* | 6 | 0.34 | 0 | 0 |
| Total | 330 | 18.34% | 10 | 2.77% |

*CCFH, Mardan: Charbanda Carp Fish Hatchery (CCFH), Mardan, Khyber Pakhtunkhwa (KP), Pakistan; TFF, Tarbela: Tarbela Fish Farm (TFF), Tarbela, Khyber Pakhtunkhwa (KP), Pakistan; $N^{I}$: number of infected fish

The more prevalence was seen in April in both study sites which were 29.8% and 7.0%, respectively, followed by the month of May where the prevalence of ectoparasite at CCFH, it was 27.3% and at TFF, it was 4.3%. The least prevalence was seen in February at CCFH (8%). No prevalence of ectoparasite was seen in the same month at TFF (Figure 2).

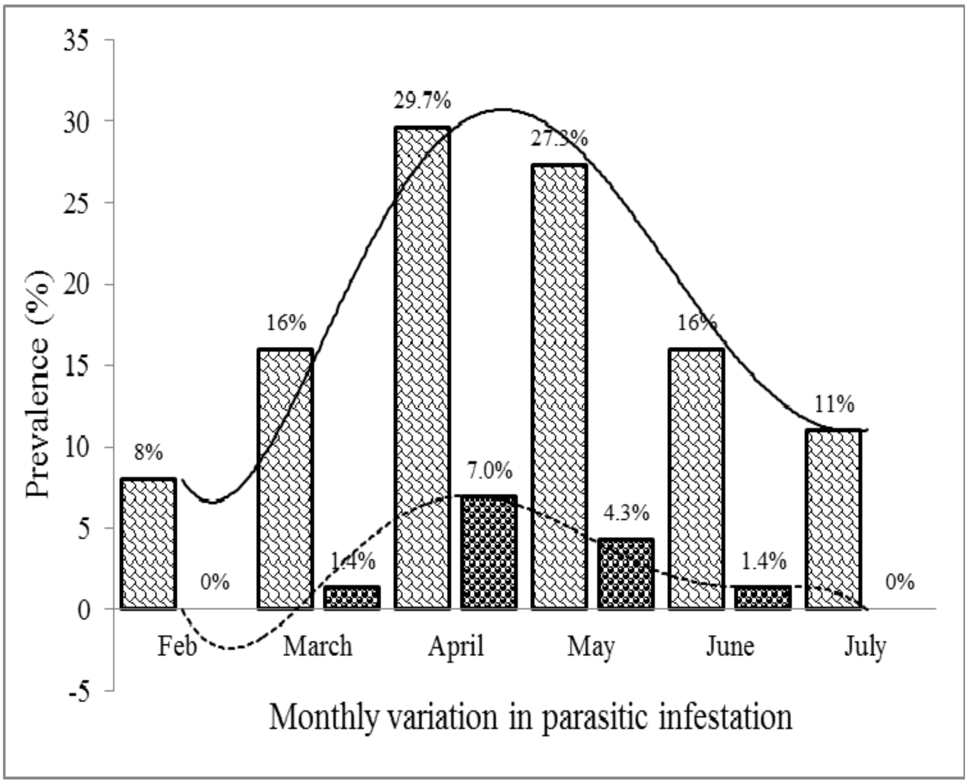


**Figure 2 Monthly variation of prevalence (%) of parasitic infestation in different fresh water carp fish species during February-July 2011; at Charbanda Carp Fish Hatchery (CCFH): and Tarbela Fish Farm (TFF): ; polynomial trend line for CCFH:— ; for TFF:----**

## Discussion

In the present research, the highest prevalence of ectoparasites was seen as compared to the work conducted by Tasawar and Naseem (1999) and Tasawar et al. (1999) in *C. idella* among the all examined fish, indicated that this fish had low resistance against ectoparasites.

Akhter et al. (2007) examined 5 exotic freshwater carp species, only 793 fish were infected by different ectoparasites. The parasitic prevalence was the highest in *H. molitrix* by *Argulus sp* (20.1%) and the lowest was seen in *Cy. carpio.* Parasitic infestation in *C. idella* with *Argulus sp* was 11.5% and with *Gyrodactylus sp* was 5.3% and prevalence in *Cy. carpio* by

*Argulus sp* and *Gyrodactylus sp* was 7.1% and 10.8%, respectively. In the present research, it was found that the exotic fish were generally more infected by ectoparasites than indigenous. This could be due adaptation of indigenous to that environments than the exotic ones. *H. molitrix* was highly infected fish by *Argulus sp*. This showed low resistance of *H. molitrix* against *Argulus sp* and high prevalence of ectoparasites in *C. idella* suggests its low immunity to *L. cyprinacea*.

Infestation in *Ci. mrigala* were previously studied by Tasawar and Khurshid (1999) and Tasawar et al. (2007a). At the present, infestation of *Ci. mrigala* with *Gyrodactylus sp* showed the same results as reported by Khan et al. (2003). This could be due to its nature that this fish is bottom dweller where temperature remains constant as compared to the surface of water.

Jalali and Barzegar (2006) recovered *L. cyprinacea, Argulus sp* and *Gyrodactylus sp* along with other parasites but in the present research, infestation was higher than the results of Jalali and Barzegar (2006). The difference in these ectoparasitic infestation may be due to different geo-climatic conditions.

The higher prevalence of ectoparasites was seen in *Ca. catla* during the present research than the study conducted by Tasawar et al. (2007a) and Tasawar et al. (2009) indicated that *L. cyprinacea* was more adapted to their fish hosts as compared to other *Lernaeid* ectoparasites. The differences may be due to different climatic conditions. The other reason was that the *Ca. catla* was column feeder and more exposed to developmental stages of parasites which were found at or near the bottom.

Tasawar et al. (2001) examined 120 *L. rohita* for copepod parasitic infestation, and found higher infestation by *L. cyprinacea* than the study conducted by Tasawar et al. (2001). The other studies about prevalence of copepod ectoparasites showed that *L. rohita* was more resistant fish against *L. cyprinacea* and other ectoparasites but the higher value at CCFH may be due to mixed fish species, under crowded culture condition, slow water flow rate and water temperature which made good environment for these ectoparasites.

The *Lernaea spp* burden had been studied by Tasawar et al. (1999), Tasawar et al. (2001) and Tasawar and Shahzad (2001). This species was also found in fish studied presently. According to the study made by Tasawar et al. (2007a) *L. cyprinacea* showed the maximum parasite burden (3.61%). According to Bichi and Bawaki (2010) the abundance and intensity of parasite varied with season and habitat.

Shafir and Oldewage (1992) reported that the optimum period for growth of *A. foliaceus* was the summer. This could be explained by temperature requirement of the parasite. The level of infection decreased in other months, i.e., winter. *Gyrodactylus salaris* reproduced throughout the year. However, most of the ectoparasites's reproduction was reduced in the winter due to decreased activity of its fish hosts which decreased its transmission and its availability to other hosts (Cable and Harris, 2002). Khan et al. (2003) concluded from their study that there existed a direct relation between temperature and parasitic infestation. Temperature was one of the most important factors determining the existing of *Argulids* parasites (Harison et al., 2006). The suitable temperature for development of life cycle and reproduction of ectoparasites is called optimum temperature (Bednarska et al., 2009) which was agreement with the present findings. In the present research, the ectoparasitic infestation was relatively higher in the months of April and May. This showed that the temperature play important role in infestation and create a suitable environment for ectoparasitic reproduction.

**Conclusion**

*Lernaea cyprinacea* was the dominant ectoparasite followed by *Argulus sp* and least recovered ectoparasite was *Gyrodactylus sp*. The highest prevalence was seen in *Ct. idella* followed by *Ci. mrigala* while the lowest prevalence was seen in *Ca. catla*. Only *Ci. mrigala* was infected with ectoparasite, *Gyrodactylus sp*. It was found that infection increased with increased in temperature. Indigenous fish were less infected than the exotic fish. This study contributed to the existing stage of knowledge about the extremely important ectoparasites i.e., *L. cyprinacea*, *Argulus sp* and *Gyrodactylus sp* on the fish population specifically in fresh water carp fish hatcheries in Pakistan.

## Recommendation

It is recommended to study the variation in intensity of infection of ectoparasites in fish with sex, with pollution state of the habitat and with the habitat type. It is also recommended that the health status of imported fish should be checked. To overcome the infestation, it is recommended to use different effective chemicals against ectoparasites.

## Notes

The present research was conducted in Department of Zoology, Hazara University, Garden Campus, Mansehra, Pakistan.

## References

Akhter, M. A., Hossain, M. D. and Rahman, M. R. (2007) Parasitic diseases of exotic carp in Bangladesh. Journal of Agriculture and Rural Development 5 (1 and 2): 127-134.

Bednarska, M., Bednarski, M., Soltysiak, Z. and Polechonski, R. (2009) Invasion of *Lernaea cyprinacea* in Rainbow Trout (*Oncorynchus mykiss*). ACTA Scientiarum Polonorum Medicina Veterinaria 8 (4): 27-32.

Bhuiyan, A. S. and Musa, A. S. M. (2008) Seasonal prevalence and intensity of infestation by the ectoparasites in carps relating to physico-chemical parameters in some ponds of Mymensingh and Bogra districts of Bangladesh. Bangladesh Journal of Scientific and Industrialresearch 43 (3): 411-418.

Bichi, A. H. and Bawaki, S. S. (2010) A survey of ectoparasites on the gill, skin, and fins of *Oreochromis niloticus* at Bagauda Fish Farm, Kano, Nigeria. Bayero Journal of Pure and Applied Science 3 (1): 83-86.

Cable, J. and Harris, P. (2002) Gyrodactylid developmental biology: historical review, current status and future trends. International Journal for Parasitology 32: 255-280.

Daoud, K. and Javed, K. (2010) FATA: general education. Online: hpp//www.fata.edu.pk (Assessed: 4/5/2011)

Harison, A. J., Gault, N. F. S. and Dick, J. T. A. (2006) Seasonal and vertical patterns of egg-laying by the freshwater fish louse *Argulus foliaceus* (Crustacean: Branchiura). Aquatic Organism 68: 167-173.

Jalali, B. and Barzegar, M. (2006) Fish parasites in Zarivar Lake. Journal of Agricultural Science Technology 8: 47-58.

Kayis, S. Ozceplep, T., Capkin, E. and Altinok, I. (2009) Protozoan and metazoan parasites of cultured fish in Turkey and their applied treatments. The Israel Journal of Aquaculture–Bamidgeh 61: 93-102.

Khan, N. M., Aziz, F., Afzal, M., Rab, A., Sahar, L., Ali, R. and Naqvi, S. M. H. (2003) Parasitic infestation in different fresh water fish of mini dams of Potohar Region, Pakistan. Pakistan Journal of Biological Sciences 6 (13): 1092-1095.

Margolis, L., Esch, G. W., Holmes, J. C. and Schod, G. A. (1982) The use of ecological terms in parasitology. Report of an adhoc Committee of the American Society of Parasitologists. Journal of Parasitology 68: 131-133.

Mirza, M. R. and Sandhu, A. A. (2007) Fish of the Punjab, Pakistan. Polymer Publication, Rahat Market, Urdu Bazar, Lahore, Pakistan 1-69.

Ozturk, M. O. (2005) An investigation on metazoan parasites of common carp (*Cyprinus carpio*) in Lake Eber. Turkiye Parazitol Derg 29 (3): 204-210.

Perveen, F. (2010) Effects of sublethal doses of chlorfluazuron on embryogenesis in *Spodoptera litura*. Journal of Agricultural Science and Technology USA 5(2:33): 127-138; Online: http://www.ourglocal.com/journal/?issn=19391250.

Perveen, F. and Hussain, Z. (2012) Use of statistical techniques in analysis of biological data. Basic Research Journal of Agricultural Science and Review 1(1): 01-10; Online: http://basicresearchjournals.org/agric/pdf/Perveen%20&%20Hussain.pdf

Piasecki, W., Andrew, E. G. Jorge, C. E and Barbara, F. N. (2004) Importance of copepoda in fresh water aquaculture. Zoological Studies 43 (2): 193-205.

Ravichandram, S., Rameshkumar, G. and Kumaravel, K. (2009) Variation in the morphological feature of isopod fish parasites. World Journal of fish and Marine Sciences 1 (2): 137-140.

Shafir, A. and Oldewage, H. (1992) Dynamics of a fish ectoparasite population: Opportunistic parasitism in *A. japonicus*. Crustaceans 62 (1): 50-64.

Tasawar, Z. and Khurshid, S. (1999) Seasonal variation in the Lernaeid parasites of *Cirrhinus mrigala*, Acta Science 9: 19-24.

Tasawar, Z. and Naseem, R. (1999) Observation on lernaeid parasites of *Ctenopharyngodon idella.* Acta Science 9: 33-38.

Tasawar, Z. and Shahzad, M. F. (2001) Seasonal prevalence of copepod ectoparasites of silver carp (*Hypophthalmichthys molitrix*). Punjab University Journal of Zoology 16: 49-54.

Tasawar, Z., Arshad, M. and Hayat, C. S. (2001) Copepod Ectoparasites of *Labeo rohita*. Pakistan Journal of Biological Sciences 1: 676-677.

Tasawar, Z., Hanif, M., Lashari, M. H. and Hayat, C. S. (2007a) The prevalence of Lernaeid ectoparasites of mori fish *Cirrhinus mrigala* fish. Pakistan Veterinary Journal 27(4): 176-178.

Tasawar, Z., Naseem, R. and Akhtar, M. (1999) Prevalence of copepod ectoparasites of grass carp *Ctenopharyngodon idella*. Pakistan Journal of Biological Science 2: 1053-1054.

Tasawar, Z., Naz, F., Lashari, M. H., Hayat, C. S., Ali, B. S. H. Naeem, M. and Shaheen, R. (2009) Incidence of lernaeid parasite in *Catla catla* on a fish farm. Sarhad Journal of Agriculture 25 (2): 285-289.

Tasawar, Z., Umer, K. and Hayat, C. S. (2007b) Observations on Lernaeid parasites of *Catla catla* from a fish hatchery, Muzaffargarh, Pakistan. Pakistan Veterinary Journal 27: 17-19.

Tumbol, R. A., Powell M. D. and Nowak, B. F. (2001) Ionic effect of infection of *Ichthyophthirius multifiliis* in goldfish. Journal of Aquaculture and Animal Health 13: 20-26.