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PREVALENCE AND ABUNDANCE OF HELMINTH INFECTIONS IN FISHES OF RIVER GOMATI AT LUCKNOW UTTAR PRADESH, INDIA

[1]Khushi Tiwari, [2]Vivek Kumar Dixit and [3]Shashi Kant Shukla

[1]PG Student of Department of Zoology BSNV PG College, Lucknow U.P. (India)

[2]Department of Zoology BSNV PG College, Lucknow, Uttar Pradesh, India

[3]Department of Zoology BSNV PG College, Lucknow, Uttar Pradesh, India

Abstract

Fish are the most abundant vertebrate species on the planet and are the best source for protein and other protein derivatives along with other amino acids and fatty acids. Fishes also contribute in GDP of our country, can influence our economy directly and indirectly which are frequently found infected with a parasites; Trematoda, Nematoda, Cestoda, and *Acanthocephala*; causing infectious diseases. Among different fish diseases, Gyrodactylussalaris, Ichthyophthirius multifiliis, flukes, are most ubiquitous in fish population that causes huge death. In case of harsh illness by parasites. The major parasitic groups found in freshwater fishes are Monogenia, cestodes, *Acanthocephalans*, protozoans and nematodes. In the present study, the prevalence of helminth parasites has been observed two freshwater fishes *Channa punctatus* and *Wallago attu*. Live fresh specimens of *Channa punctatus* and in *Wallago attu* of all sizes, weight and sex were collected from river gomti, Lucknow. A total of 90 fishes were examined for the presence of helminth parasites in which a total no. of parasites found in *Channa punctatus* was 50 and in *Wallago attu* was 40. In case of *Channa punctatus* (Bloch) 44% of total collected fishes and in *Wallago attu* 37.5% of total collected fishes were found to be infected with helminth parasites.

***Index terms*:** *Channa punctatus*, river Gomti, Freshwater fishes, *Wallago attu*.

Introduction

Fish are the most abundant vertebrate species on the planet. Fishes are the best source for protein and other protein derivatives along with other amino acids and fatty acids. These are significant machinery of ecology, medicinal, dietary and economical point of view. A majority of freshwater fishes bear serious illness of parasites (Trematodes, Nematodes, Cestodes and *Acanthocephalans*) which causes worsening in the food value of fishes and even consequence in their death. Besides these, there are a number of helminth parasites which are transmitted to human beings only through fish (Gupta, 1959). Class Monogenea is a group of parasitic worms commonly found on fishes. These parasites feed on mucus and epithelial cells of the skin and gills and sometimes on the blood also use the fish for their shelter and food, and destruct every organ resulting in pathogenic effects (Dogiel, 1961). Moreover, monogenean infection also lead to indirect damage, making the fishes more susceptible to secondary infections like bacterial, fungal and protozoan. by degrade and break the epithelium and mucous layer Bilame (2012). As far as economic affects of monogenean infestation is concern, it includes decrease or rejection of edible fish products leading to subsequent loss of interest in the aquaculture practice Daw *et al*. (2008). During heavy infections of monogeneans it was found that the fish died which may significant damage and mortality.

Parasites obstruct the nutrition; metabolism and secretary purpose of alimentary canal, damage nervous system (Markov, 1961), and still trouble the regular reproduction of the host (Faust, 1949).

The majority of monogeneans are move about freely on the fish's body surface feeding on mucus and epithelial cells of the skin and gills; however, a few adult monogeneans will stay enduringly attached to a single site on the host. Some monogenean species occupy in the rectal cavity, ureter, body cavity, and still the blood vascular system. They are small hermaphroditic worms so as to parasitize fishes and further aquatic animals. They infect fins, skin and gills of freshwater and marine fishes (Duijn, van C. Jnr. (1973). Their life cycle involves only one host and they mostly spread by means of egg releasing and free-swimming infective larvae. There are three families of Monogenea including Gyrodactylidae, Dactylogyridae and Ancyrocephalidae are the most reported parasites found in cultured and wild fishes, Ozturk (2014) and Paperna (1980). Members of *Gyrodactylus* parasitise the body surface, fins, and gills of its fish hosts, while some species are found on amphibians, tetrapods, and cephalopods (Paetaow *et al*., 2009).

Monogeneans can be divided into two major groups, the monopisthocotyleans, which contain hook-like organs on their haptors to attach to their host, and the polyopisthocotyleans, which use clamp-like structures for attachment. The haptor is usually shaped like a disc. One to three pairs of hook-like structures called anchors or hamuli are usually located in the center of the haptor. In many monogenean species, the anchors are used to attach to the host by penetration of the hosts skin. Very small hooklets called marginal hooks are located near or on the periphery of the haptor and are the primary way of attachment for various monogeneans.

Based on the morphoanatomical observation of opisthaptoral parts of *Gyrodactylus* infecting cyprinid hosts because it has a longer total hamulus length, downward projecting toe, trapezium-shaped ventral bar membrane with slightly striated median portion and small rounded anterolateral processes (Shigoley *et.al*, 2023).

Hooks and other organs of attachment also break the continuity at the site of attachment and result is to localize hemorrhage (Mishra, 2008, 2014b & 2020a). Monogenean infestations responsible for irritation and too much mucus construction form a notch for bacterial attack.

Prevention of monogenean infestations by suitable quarantine have a preference to dealing of the parasites after they have become established in a system (Mishra, 2020b).

Common fishes like *Wallago attu* and *Channa punctatus* equally are common for food and nutrition. The *Channa punctatus* is extremely economical with high nutritional value and market demand because of its relatively low cost and high availability; and *Wallago attu* are the simply available in the fish market. Owing to their feeding pattern, fishes can act as transitional or a ultimate host for numerous helminth parasites. So it is necessary that the fish should be free from all types of infections like viral, bacterial, and parasitic to gain healthy and quality meat fish. The main parasitic groups found in freshwater fishes are monogenean trematodes, cestodes, acanthocephalans and nematodes. Seeing as human prefer white meat resource is utilizing these fishes, so it is significant to study the occurrence of parasites in these fishes. The present study is expected to examine the load and effect of helminth parasites in freshwater fishes *Wallago attu* and *Channa punctatus* (Bloch) obtained from River Gomti in Lucknow, U.P.

Materials and Methods

1) Study area: Gomti River, Lucknow.

2) Study periods: December, 2022 –May, 2023.

3) Study organism: Fresh water fishes (*Channa punctatus* and *Wallago attu*).

4) Collection of host fishes: Live fresh specimens of *Channa punctatus* and *Wallago attu* of all sizes, weight and sex were collected from River Gomti in Lucknow. The specimens were brought in the laboratory alive in a small container with water and maintained in glass aquaria.

5) Methodology:

a) Total and Standard Length and Weight measurement:

The total and standard length of the fish were measured in centimeter (cm) using a measuring board. Fish were weighed to the nearest gram (g) using weighing balance (Paperna, 1996).

b) Examination for Helminth Parasites:

In the laboratory all samples were examined and processed as per standard protocol. External examination of each fish for the helminths ectoparasites was conducted using hand lens. Each gill was examined individually for the presence of parasite. Fishes were opened up dorso-ventrally and all the internal organs were examined separately. The entire digestive system was removed and placed in a petri dish with saline for further examination.

c) Processing of parasites for identification:

The Trematodes were fixed in hot 10% formalin, cestodes and acanthocephala were fixed in AFA solution following staining by borax carmine. After staining, parasites were washed with distilled water, dehydrated in ascending grades of alcohol, cleared in xylene and mounted in D.P.X. Helminth parasites were identified up to class level on the basis of available taxonomical characters as described by Yamaguti, 1958; 1961; 1963.

d) Formula and statistical Analysis

Prevalence, Abundance and Mean density, Index of infection were determined by following the formula proposed by Margolis *et al*. (1982).

$$\textbf{Prevalence} = \frac{\text{Total no. of infected fishes} \times 100}{\text{Total no. of fishes host examined}}$$

$$\textbf{Abundance} = \frac{\text{Total no. of parasites recovered}}{\text{Total no. of fish hosts examined}}$$

$$\textbf{Mean density} = \frac{\text{Total no .of parasites recovered}}{\text{Total no .of infected host examined}}$$

$$\textbf{Index of infection} = \frac{\text{No .of host infected} \times \text{No .of parasites collected}}{\text{Total host examined}}$$

Statistical analysis (Chi-squared test) was done by SPSS 16.0 version software.

Results and Discussion

The results obtained in the present study are depicted in table 1 to 5 and figure 1 to 5. A total no. of 90 specimens of the two species of freshwater fishes *Channa punctatus* and *Wallago attu* were examined, for the presence of helminths parasites. Out of a total of 90 fishes, 22 (44%) *Channa punctatus* and 15 (37.5%) *Wallago attu* were found to be infected with different helminth parasites. (Figure 1)

1: Prevalence of parasites in fishes, *Wallago attu* and *Channa punctatus*

For the study of parasitic infection in two edible fish species we were collected species of edible fishes viz. *Channa punctatus* and *Wallago attu* from River Gomti, Lucknow and examined properly. We were examined and found that out of 50 specimens of C. punctatus, 22 were infected with helminths parasites. Whereas 15 out of 40 specimens of *Wallago attu* were to be infected. The maximum prevalence (44%) showed by *Channa punctatus* while (37.5%) shown by *Wallago attu*.(Table 1, Fig. 1).

Fish species	No. of fish examined	No. of fish infected	No. of parasites	Prevalence
Channa punctatus	**50**	**22**	**31**	**44**
Wallago attu	**40**	**15**	**23**	**37.5**
Total	**90**	**37**	**54**	

Table-1 Species wise prevalence of helminth parasites

There were many environmental factors that is responsible for availability and interaction of parasitic agent with the host like temperature, cold, humidity and dissolved oxygen level in aquatic body. According to Kennedy (1977) and Rohde (1993) the factors responsible for influencing the parasite infection are the temperature, feeding habits of host, availability of infective host and parasite maturation. Such parameters can be easily studied in freshwater fishes.

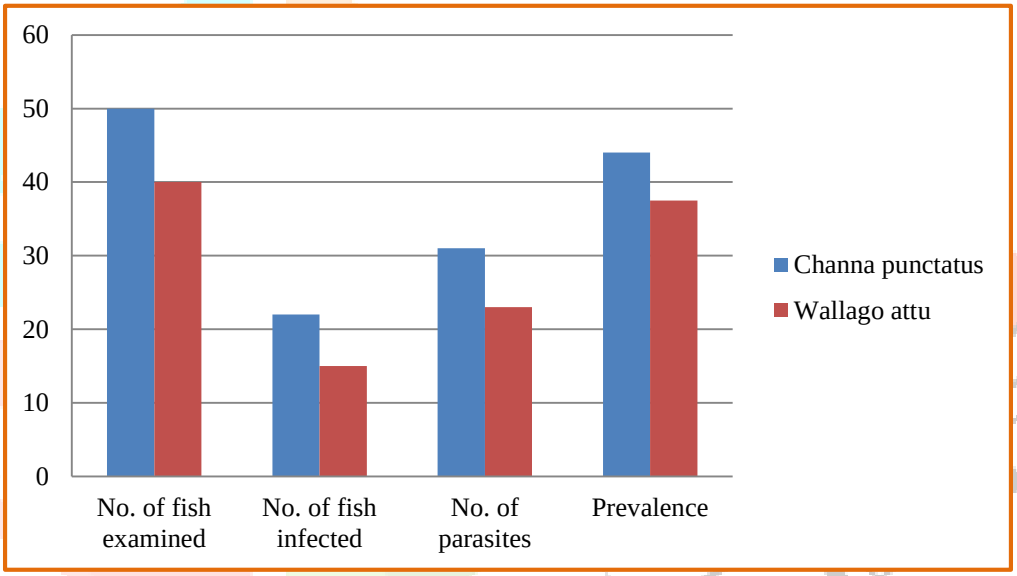

Figure 1: Prevalence of parasite in two fishes, *Wallago attu* and *Channa punctatus*

Wali *et al*., (2016) also reported that fish carrying heavy parasitic burden are extremely lethargic just because of parasites might also alter the physiological as well as reproductive functions of hosts.

Recently, Verma *et al*., 2013, also recorded prevalence of helminth parasites in same fish *C. punctatus* they were found to be infected with three species of helminth parasites, the parasites were associated with gill, stomach and intestine of fishes respectively and Qadri *et al* 2013, also reported prevalence of helminth parasites and compare with the other fish.

Similar findings were reported by (Pawar 2022) and revealed that the Catfish were infected with large number of parasites in winter months, because the environmental conditions are favorable in winter months.

The prevalence and parasitic infestation in freshwater fishes have also been by several researchers (Bhure *et al*., 2016; Bommakanti, 2016; Gupta and Sharma, 2015; Kumari and Perveen, 2017).

Relation between host (Channa punctatus) length and parasitic infection-

In the present study It was observed that an enlarge in the size of fish host was accompanied with an increase in parasitic infection. The larger fishes (12-16.9cm) were more seriously infected than the smaller fishes (7-11.9cm). Table 2 and Figs.2. shows the increase in the Index and mean intensity with the increase in size (length) of the host.

Kaur *et al* (2012), observed that the similarly, the large fishes (10cm). Arme (2002) further explained the reason for gradual increase in intensity of infection with increase in size (length) and according to the author it may be due to the accumulation of plerocercoids in fish as they grow and it is accepted that the plerocercoids may survive in fish for several years.

Length group (cm)	No. of fish examined	No. of fish infected	No. of parasites	Prevalence	Abundance	Mean density	Index of infection
7-11.9	**15**	**8**	**12**	**53.33**	**0.8**	**1.50**	**6.4**
12-16.9	**23**	**18**	**32**	**78.26**	**1.39**	**1.77**	**25.04**
17-21.9	**12**	**9**	**14**	**75.00**	**1.16**	**1.55**	**10.05**
Total	**50**	**35**	**58**	**206.59**	**3.35**	**4.82**	**41.94**

Table 2: Relation between standard length and different indices of parasitic infection in *Channa punctatus*

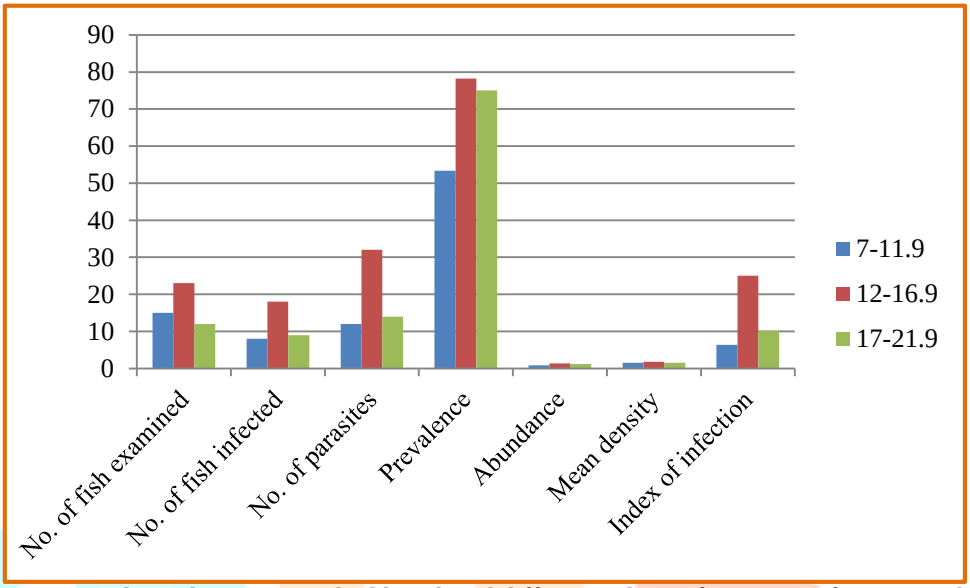

Figure 2: Relation between standard length and different indices of parasitic infection in *Channa punctatus*.

Devi *et al.*, (2015) have studied that many parasite species are host specific to at least some degree and are capable of infecting one or only a limited number of host species.

Chi square test revealed that there was significant difference in prevalence of helminthes parasites among the three length classes of the examined host.

Relation of host Body weight and parasitic infection: -

In the present study in reference of host body weight and parasitic infection, it was observed that the percentage of infection approximately with increasing weight. The bigger fishes (51 to 70 gm) and smaller fishes were more heavily infected than the largest fishes (71 to 90 gm) (Table 3, Figure 3). Parallel observations were stated by Ayanda (2009) and Olurin and Samorin, (2006), According to these workers, the heavier the fish, the greater the vulnerability to parasitic infection. This observation could be recognized to the fact that larger fish provides larger surface area for the infection to multiply in numbers than the smaller ones. Another plausible reason could be that the relation may be the result of changes in diet from phytoplankton and zooplankton to insects, larvae, snails, worms and crustaceans for food as smaller fishes grow into larger ones (Obano *et al.*, 2010b).

Table 3: Relation between body weight and different indices of parasitic infection in *Channa punctatus*

Body weight (gm)	No. of fish examined	No. of fish infected	No. of parasites	Prevalence	Abundance	Mean density	Index of infection
20-50	**21**	**7**	**14**	**33.33**	**0.66**	**2**	**4.66**
51-70	**20**	**9**	**17**	**45.00**	**0.85**	**1.88**	**7.65**
71-90	**9**	**4**	**8**	**44.44**	**0.88**	**2**	**3.55**
Total	**50**	**20**	**39**	**122.77**	**2.39**	**5.88**	**15.86**

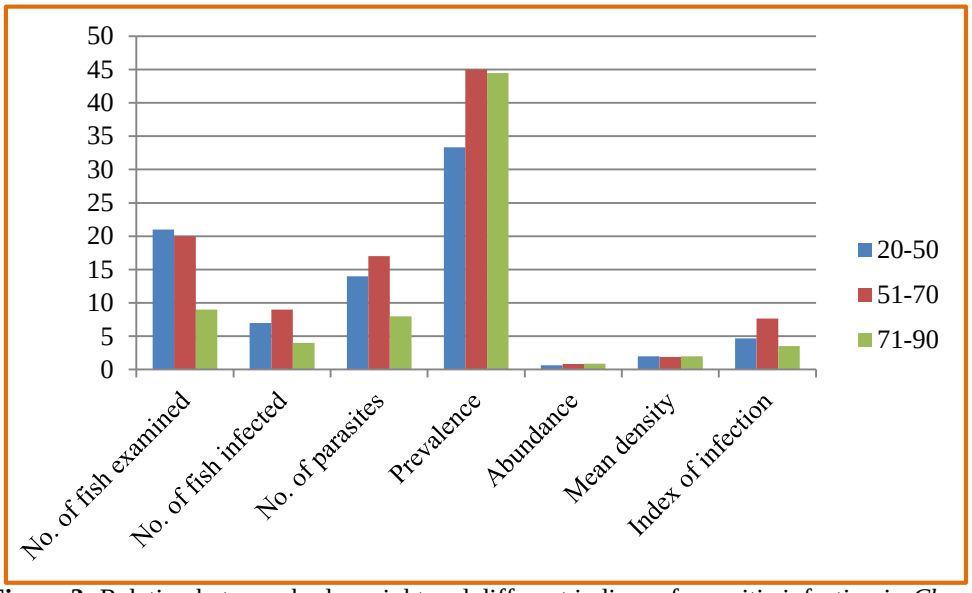

Figure 3: Relation between body weight and different indices of parasitic infection in *Channa punctatus*

Hossain (2015) also observed that parasitic infestation has harmful influence for fish health that affects the normal growth of the fishes and mortalities as effect of the helminth parasites in terms of loss of body weight and mortality was also reported in our study.

Chi square test revealed that there were significant differences in prevalence of helminthes among the three weight classes of the examined host.

Relation between host (*Wallago attu*) size (length) and parasitic infection:

In the present investigation and research work provides useful information on the variety of ectoparasites and observed their relationship between length of the fish and the percentage of infected fishes. It is also investigated which length of *Wallago attu* more infected with parasites than the others. The size of normal and infected fishes was grouped in length classes (15 to 19.9, 20 to 24.9 and 25 to 29.9). (Table 4, Fig. 4) showed that the percentage of infection of both the normal and infected fishes in each length group. It can be concluded from the given data that the smallest fishes in length group from 15 cm to 19.9cm) were comparatively reduced amount of infection than the other length groups and the percentage of infection increases with increasing fish length.

Length group (cm)	No. of fish examined	No. of fish infected	No. of parasites	Prevalence	Abundance	Mean density	Index of infection
15-19.9	**11**	**3**	**5**	**27.27**	**0.45**	**1.66**	**1.36**
20-24.9	**20**	**5**	**7**	**25**	**0.35**	**1.40**	**1.75**
25-29.9	**9**	**2**	**4**	**22.22**	**0.44**	**2**	**0.88**
Total	**40**	**10**	**16**	**74.49**	**1.24**	**5.06**	**3.99**

Table 4: Relation between standard length and different indices of parasitic infection in *Wallago attu*.

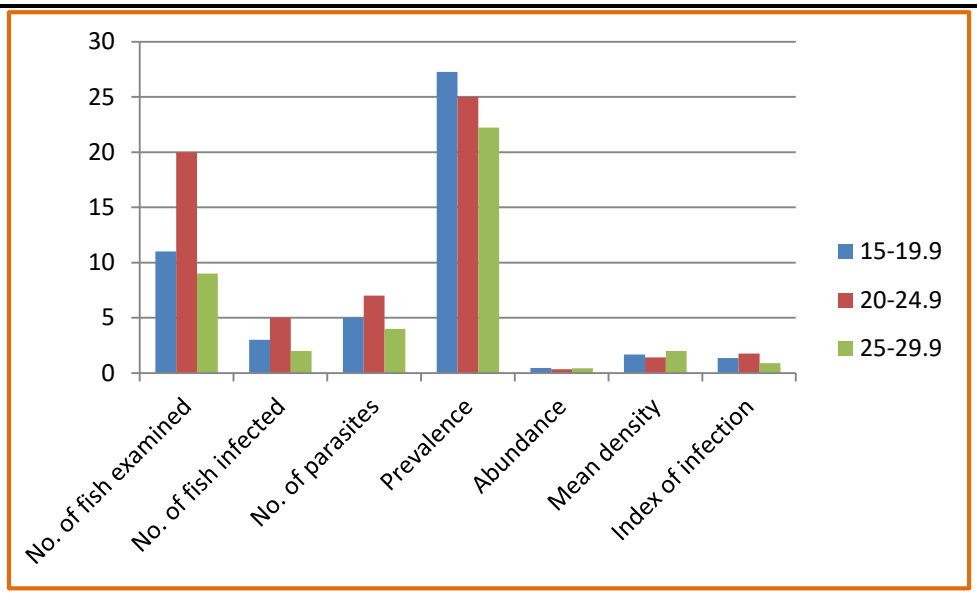

Figure 4: Relation between standard length and different indices of parasitic infection in *Wallago attu*.

It was concluded that, due to their large size of fishes have increased surface area as shelter for the parasites, so larger fishes were heavily parasitized than smaller ones. In these consequences age of fishes may also promote the chances for infection along with the secondary infection also reported by the various researchers.

Khanum *et al.* (1997) reported heavy infestations in the largest size. length groups which is contradictory to the current findings.

Bashirullah (1973) and Dogiel (1961) also reported that the degree of parasitism was obviously related to the food habit and age of the fishes.

Wallago attu infested with ectoparasites demonstrated serious lesions in the gill filaments such as necrosis, hemorrhages, congestion, epithelial and mucus cells proliferation. These alterations may impact the hydromineral balance, gaseous exchange, hormonal production, circulation, nitrogenous waste secretion and making the fish hypoxic or anoxic and finally lead to death and similar pathological results were also observed by Mohammadi *et al*., (2012), The higher intensity, the more serious the gill damage which can decrease the body weight and condition factor, severe changes in osmoregulation or respiratory dysfunction and ultimately lead to death.

Pathological alterations observed by the different workers Fadaei *et al*. (2001), Shamsi *et al*. (2009), Kaur and Shrivastav (2014), Padua *et al*. (2015) and Arya and Singh (2020) who also recorded hyperplasia of the epithelial cells and succeeding lamellar fusion to be the distinctive feature of the parasitic infection.

Chi square test revealed that there was no significant difference in prevalence of helminths among the three length classes of the examined host.

Relation between host (*Wallago attu*) Body weight and parasites–

In the present investigation we conducted the experiment on weight of *Wallago attu* and there infection rate and concluded that the fishes having weight about 81-140 gm. Have increased number of parasites that is 4, than the smaller or low body weight (Table 5 and Figure 5). shows prevalence, abundance, mean density of parasitic infection and index of infection according to body weight of *Wallago attu*. Highest Prevalence (26.66%) was observed in the body weight range of 81 to – 140 gm with Abundance of 0.33, Density of infection of 1.25 and Index of infection of 1.33. There was an experiential result shows increase in Incidence of infection with increase in body weight.

Fishes in length 52-66 cm and 40-62 cm recorded highly correlation to helminths prevalence and medium in the length group 32-69 cm. The weight of the fish samples recovered by nematode ranged from 38 to 1020 g, Cestode from 600 to 2200 gm. while Co-infected ranged from 950 to 1500 gm.

Mahmoud *et al.* (2021) concluded and shows that the prevalence of helminthes with heavy parasitic infection. Furthermore, the results from this study reported here strongly infection Influence the length, weight and condition factor of fishes.

Body Weight (gm.)	No. of fish examined	No. of fish infected	No. of parasites	Prevalence	Abundance	Mean density	Index of infection
20-80	**20**	**3**	**6**	**15**	**0.30**	**2**	**0.9**
81-140	**15**	**4**	**5**	**26.66**	**0.33**	**1.25**	**1.33**
141-200	**5**	**2**	**7**	**40**	**1.4**	**3.50**	**2.8**
Total	**40**	**9**	**18**	**81.66**	**2.03**	**6.75**	**5.03**

Table 5: Relation between body weight and different indices of parasitic infection in *Wallago attu*.

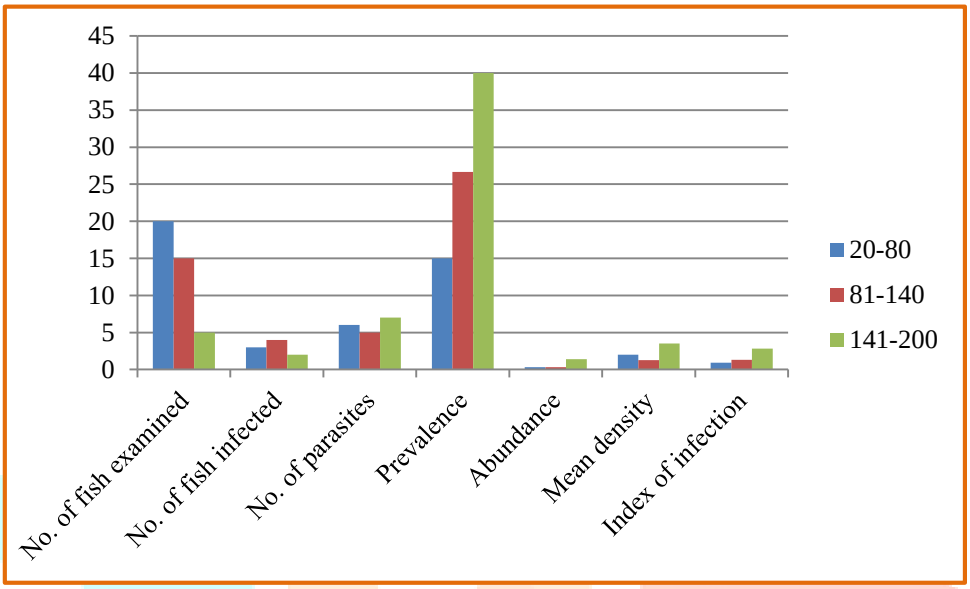

Figure 5: Relation between body weight and different indices of parasitic infection in *Wallago attu*

Chi square test revealed that there were significant ($P<0.05$) differences in prevalence of helminthes among the three weight classes of the examined host.

Conclusion

Fishes (*Channa punctatus* and *Wallago attu*) were infected with large number of parasites in winter months than the other warmer months because the environmental conditions are favorable in winter months as the water warm but not cold. Moderate temperatures of the aquatic body enhance the productivity of various microbes as well as zooplanktons and phytoplanktons compared to high temperature of summer months. This may corresponds to the peak in the feeding activity of the fish together with the richness in the transitional host that is crustaceans, smaller mollusks and fishes leading in high infections.

Thus present study has shown that the *Channa punctatus* fish is one of the most heavily infected fish species as compare to *Wallago attu*. This study thus highlights on the parasitic infection according to the length and weight. We accomplished that the freshwater fishes harbour a wide range of helminth parasites especially trematodes. Out of a total of 90 fish examined 37 were found to be infected with helminth parasites. The overall prevalence of parasites was found to be 81.5. The maximum infection of helminth parasites was found in *Channa punctatus* in comparison *Wallago attu*. The maximum infection of helminth parasites was found in the fishes weighing 51-70 gm and in the fish length ranging from 12-16.9 cm in case of *Channa punctatus*. The maximum infection of helminth parasites was found in the fishes weighing 141-220 gm and in the fish length ranging from 20-24.9 cm in case of *Wallago attu*.

Future Scope

Fishes are the ultimate source of protein that consumed by human being. But bulk of freshwater fishes carry heavy infection of parasites directly and indirectly with lots of secondary infection, which cause decline in the food quality as well as quantity of fishes and still resulting in their mortality. The industry of fish and fisheries also plays an significant task in the Indian economy as it provide employment opportunities. However, due to presence of parasites in aquatic atmosphere, the physiological activities of the infected fishes are delayed their growth and nutritional value. Beside this, there is always chance to transfer to human beings and upper trophic level of food chain by consumption and biomagnifications process of infected fishes. Therefore, it is important to take out the occurrence of helminth parasites in fishes.

References

- Arme C. 2002: Ligula intestinalis, a tapeworm contraceptive. **Biologist**, 49, 265–269.
- Arya, P., & Singh, H. S. 2020. *Wallago attu* (Bl.) and its parasitic monogenea Mizelleus indicus (Jain, 1957), Pandey *et al*., 2003: A model towards histopathological studies for host parasite interaction. **Asian Journal of Biological and Life Sciences**, 9, 25.
- Ayanda,O.I. 2009: Comparative parasitic helminth infection between cultured and wild species of Clariasgariepinusin IIorin, North Central Nigeria. **Scientific Research and Essay**, 4(1): 18-21.Edinburg and London. Pp.117-139.
- Bahirullah, A.K.M. 1973: A brief survey of helminth fauna of certain marine and freshwater fishes of Bangladesh **J. Zool**. 1 (I): 63-81.
- Bhure, D.B., Nanware, S.S., Jadhav, A.N. 2016. Prevalence and diversity of cestode parasites of freshwater fishes of genus Channa scopoli, 1777. **WSN**, 33: 15-26.
- Bilame O. 2012. Contribution of Lake Victoria small-scale fisheries to poverty alleviation: A case study of Tanzania small-scale fisheries. **Journal of Agricultural Science and Technology B**.; 2: 1268.
- Bommakanti, L. 2016. Prevalence of Gyrodactylus sp. in Channa punctatus (Bloch, 1793) monogenean ecto-parasite family: Gyrodactylidae at Lower Manair Dam. **Int. J. Curr. Microbiol.App.Sci.**, 5(9): 496-507.
- Daw T, Neil Adger W, Brown K, Badjeck M. 2008. Climate change and capture fisheries. University of East Anglia, Norwich. **World Fish Center. Penang**.; 136.
- Devi, N.U., Singh, N.R., Kar, D. 2015. Studies on Fish Affected with Epizootic Ulceric Syndrome with Special Emphasis on Parasitic Infestation. A Project Report, Biological Forum, **An International Journal**, 7(1): 155-164.
- Dogiel, V.A. 1961:Ecology of parasites of fresh water fishes, Parasitology of fishes, Transl. by Kabata. Z. 1961 Oliver and Boyd, **Edinburgh**, 1958, pp. 1—47.
- Duijn V., C. Jr., 1973. Diseases of fishes. **Illffe Books Ltd**., London. 372 p.
- Fadaei, F., Mokhayer, B., & Ghorbani, H. 2001. Identification of fishes and their parasites in Choghakhor Lagoon. **Journal of Faculty of Veterinary Medicine**, 56, 109–113.
- Faust, E.C. 1949: Human Helminthology. **Lea and Febriger**, Philadelphia.
- Gupta, A., and Sharma, B. 2015. Parasitic infestation of Diplostomulum cerebralis (Digenean Trematode) in Channa punctatus from Meerut District. **Voyager,** 6: 182-187.
- Gupta, S.P. 1959. Nematode parasites of vertebrates of East Pakistan. III. Camallanidae from Fishes, Amphibia and Reptiles. **Can. J. Zool.**, 87:771-779.
- Hossain d Moazzem Muhammad Manzurul Alam Azizul Islam Angela Hecimovic , 2015,"Dostakeholders or social obligations drive corporate social and environmental responsibility reporting?Managerial views from a developing country", **Qualitative Research in Accounting & Management**,Vol. 12 Iss 3 pp. 287 – 314.
- Kaur, P., & Shrivastav, R. 2014. Histological effect of monogenean parasites on gills of freshwater carps. **European Journal of Biotechnology and Bioscience**, 2(2), 50–53.
- Kaur, Pinky, Shrivastav, Rekha, Qureshi, T.A., Manohar, Susan, Saroch, J.D. and Sharma, Shivani. 2012: Host Parasite Relationship: Sengasp. (Dollfus, 1934) In Association with Naturally Infected Freshwater Host Fish Channa punctatus (Bl.). **J.Chem. Bio. Phy. Sci. Sec.D**, Vol. 2, No. 4, 2175-2181.
- Kennedy CR 1977. The regulation of fish parasite populations. **In regulation of parasite population** (a) 23, 61-109.
- Khanum H, Parveen S 1997 Organal distribution and seasonal prevalence of endoparasites in Macrognathus aculeatus and Mastacembelus armatus, **Bangladesh J Zool** 25(1): 15-21.
- Kumari, A., and Perveen, S. 2017. Comparative study of helminth parasites in freshwater fish, Channa punctatus of Chapra, Bihar. **International Journal of Science and Research,** 6(8):1369.
- Linda J Paetow, David K Cone, Tine Huyse, J. Daniel McLaughlin and David J. Marcogliese 2009. Morphology and molecular taxonomy of *Gyrodactylus jennyaen*. sp. (Monogenea) from tadpoles of captive Rana catesbeiana Shaw (Anura), with a review of the species of *Gyrodactylus* Nordmann, 1832 parasitising amphibians. **Systematic Parasitology** 73(3):219-27
- Mahmoud E.D., Ahmed Egbal O., Rahman A. Abed El. And Abdallah Sana Y. 2021. Incidence of the Helminth Infection in Relation to the Weight and Length of a in Jebel Aulia Dam. **Poult Fish Wildl Sci**. 9:217.
- Margolis, L., Esch, G. W., Holmes, J. C. and Schod, G. A. 1982: The use of ecological terms in parasitology. Report of an ad-hoc Committee of the American Society of Parasitologists. **J. Parasit**. 68, 131-133.
- Markov, G.S. 1961: Physiology of fish parasites. In: parasitology of fishes (V.A. Dogiel, G.K.of Bangladesh. Bangladesh. **J. Zool**. 1973, 1: 63—81.
- Mishra, S. P. and Pande, P. N. 2008: A new monogenean Metahaliotrema Tripathin. sp. from fresh water fish Rita rita (Ham.). **J. PAS Zoological Sciences** Vol. 14: 40-45.
- Mishra, Surya Prakash 2014b: A new monogenean Hamatopeduncularia saketensisn. sp. from fresh water fish Wallago attu. **Int. J. Multidis. Res. Dev**. Vol. 1 (7): 244-246.
- Mishra, Surya Prakash 2020a: Monogenetic Trematode Infestations in Indian major carps of Ayodhya division, Uttar Pradesh, India: **Journal of Emerging Technology and Innovative Research (JETIR)** July 2020 Vol. 7 (issue 7) pp. 1920-1928.
- Mishra, Surya Prakash 2020b: Monogenetic Trematode Infestations in Indian Cat Fishes of River Gomati at District Sultanpur, Uttar Pradesh, India: **International Journal for Modern Trends in Science and Technology** August 2020 Vol. 6 (issue 8) pp. 120-124.
- Mohammadi, F., Mousavi, S. M., & Rezaie, A. 2012. Histopathological study of parasitic infestation of skin and gill on Oscar (Astronotus ocellatus) and discus (Symphysodon discus). **Int. J. Bioflux Soc**, 5(1), 88–93.

- Obano, E.E., Ezeri, G.N.O. and Aniyie, UK. 2010b. Studies on the parasitic infections in fishes in Ovia River atIkoro, Ovia-South West Local Government Area of Edo State, **Nigeria.Bioscience Research Communications**.22(3):137.
- Olurin, K.B. and Samorin, C.A. 2006: Intestinal helminthes of the fishes of Owa stream, South-west Nigeria. Res. **J. Fisheries and Hydrobiology**, 1(1):6-9.
- Ozturk T., ozer A. 2014. Monogenean fish parasites, their host preferences and seasonal distributions in the Lower Kızılırmak Delta (Turkey). **Turk J Fish Aquat Sci.**; 14: pp. 367 78.
- Padua, S. B., Jerônimo, G. T., Menezes-Filho, R. N., Taboga, S. R., Martins, M. L., & Belo, M. A. A. 2015. Pathological assessment of farmed yellowtail tetra Astyanax altiparanae infested by Acusicola sp. (Ergasilidae). **Aquaculture Reports,** 2, 63–66.
- Paperna I. 1980. Parasites, infections and diseases of fish in Africa. Rome: **Food and Agriculture Organization of the United Nations**.
- Paperna I. 1996: Parasites, infections and diseases of fishes in Africa - an update, CIFA Technical Paper No. 31, Rome, FAO, 220p.Petrushevesky & Yu, I. polyansky eds.) **English Translation by Z. Kobata., Oliver and Boyed**.
- Pawar R.T. 2022. Studies on the prevalence and seasonal variation of cestode parasites from freshwater fish, clarias batrachus (linneaus). **International Journal of Zoology and Applied Biosciences**. Volume 7, Issue 3, pp: 8-12, 2022, ISSN: 2455-9571.
- Qadri, M., Johri, S., Shah, B.A. *et al.* 2013. Identification and bioactive potential of endophytic fungi isolated from selected plants of the Western Himalayas. ***SpringerPlus*** **2**, 8. https://doi.org/10.1186/2193-1801-2-8
- Rohde, K. 1993. "Ecology of marine parasites". An introduction to marine Parasitology; Department of Zoology, Univ., of New England, Armidale, NSW 2351, **Australia CAB International**, 0851988458.
- Shamsi, S., Jalali, B., & Aghazady, M. M. 2009. Infection with *Dactylogyrus* spp. among introduced cyprinid fishes and their geographical distribution in Iran. **Iranian Journal of Veterinary Research**, 10(1), 70–74.
- Shigoley M.I., Rahmouni I., Louizi H., Pariselle A. and Vanhove M.P.M. 2023. First Study on *Gyrodactylus* (Monogenea: Gyrodactylidae) in Morocco, with Description of a New Species from Luciobarbus pallaryi and Luciobarbus ksibi (Actinopterygii:Cyprinidae).***Animals*** **2023**, *13*(10),1624; https://doi.org/10.3390/ani13101624.
- Verma, N. and Capoor, A. 2013. Population dynamics of helminth parasites in some edible fishes of river Yamuna, **WJASR**, Volume 3, Issue 2, Pages 54-60, ISSN 22549-4197.
- Wali, A., Balkhi, M.H., Darzi, M.M., Maqbool, R., Shah, F., Bhat, B.A., and Wani, N. 2016. Histopathological alterations and distribution of Adenoscolex oreini in intestines and their seasonal rate of infestation in three freshwater fishes of Kashmir. **Int. J. of Fisheries and Aquatic Studies**, 4(3): 532-537.
- Yamaguti S.1958 Systemahelminthum vol. 1 The digenetic trematodes of vertebrates. **Int. Sci. pub.NewYork** 1575.
- Yamaguti S.1961 Systemahelminthum vol. 2 The Cestode of vertebrates. **Int. Sci. pub. INC, NewYork and London**, 1-860
- Yamaguti S.1961 Systemahelminthum vol. 3part 1st and 2 nd The Nematode of vertebrates. **Int. Sci. pub.INC, NewYork and London**.
- Yamaguti S.1963 Systemahelminthum vol. 5: *Acanthocephala*. **Int. Sci. pub. INC, NewYork and London**, 1-423.