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Genarchopsis dasus and *Camallanus anabantis* parasites of *Channa punctatus* from Dinajpur Region of Bangladesh

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ABSTRACT

This study was conducted to identify seasonal infestations of parasites in *Channa punctatus* of Dinajpur, Bangladesh. Sampling was carried out frequently over a year in selected cultural and natural sources. A total of 120 fish were examined among them 32 fishes were infested and collected parasites were 72. Two parasites were recorded, *Genarchopsis dasus* and *Camallanus anabantis.* The prevalence was found 26.67% and the mean intensity was 2.41. The maximum prevalence was found in August (50%) and the lowest in December, January, and February (10%). The maximum mean intensity was in January (8) and the lowest was in December and June (1). The highest prevalence (40%) was observed in winter and the lowest (10%) was in the rainy season. The maximum prevalence (50%) was recorded in male fish in summer and autumn. However, the mean intensity (6.5), index of infection (3.71), and abundance (1.85) were highest in female fishes. The prevalence (30.23%), abundance (0.74), and index of infection (0.68) were observed maximum in the smaller size group and the lowest in the large size group (24.44%, 0.38%, and 4.16 respectively). There was a variation of infestation of fish according to length, sex, season, and sources.

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INTRODUCTION

Bangladesh is a land of rivers which is located in the Asia-Pacific region of the world. It holds the third position in aquatic biodiversity in Asia and the richest freshwater resources. In 2017-18, this sector contributed 3.57% to the national GDP and more than one-fourth (25.30%) to the agricultural GDP. More than 11% of the total population of Bangladesh is engaged in this sector on a full-time and part-time basis for their livelihoods. This sector also has high potential for the perspective for the economic development of the country (DoF, 2018). Fish provides essential nourishment, especially quality proteins and fats, vitamins, and minerals for humans. An increasing number of people are involved now in fisheries and aquaculture, fish-related trade. In accordance with the Food and Agriculture Organization of the United Nations, nowadays, aquaculture makes a major contribution to human nutrition (Chakraborty *et al.,* 2013). *Channa punctatus* is a carnivorous fish; and mainly fed on different aquatic organisms and is abundantly found all over Bangladesh including ditches, beels, and swamps (Chandra and Haq, 1986). Due to its feeding habit, this fish can act as an intermediate or a final host for many helminth parasites. Infections are harmful to fish health, growth, and fishery industry caused by various pathogens among fishes in the natural and man-made culture system. The parasitic infections are sometimes very fatal and cause high mortalities when their life cycles are well supported by intermediate hosts. The helminth parasites mainly found in freshwater fishes are trematodes, cestodes, acanthocephalans, and nematodes which complete their life cycles through intermediate hosts like snails and piscivorous birds. Thus, it needs to assess the parasitic infection that arises because the fish suffering from parasitic infection and/or disease result in severe damage to the fishery industry. For successful prevention and elimination of such parasitic infections, it is extremely important to achieve early and correct data about the prevalence and intensity of a particular parasitic infection in a specific group of fish with well-established modes of infection including the larval stages of the parasite.

There was some research has been conducted on digenetic trematode in many countries. For example, the ecology of *Clinostomum complanatum* infecting fish was reported from the floodplain of the high Paraná River, Brazil (Dias *et al.,* 2006). The authors described that the season, habitat, and sex were not related to its prevalence. The relationship between species richness and the abundance of larval trematodes and local benthos and fishes was recorded by Hechinger et al. (2007). However, there is little work has been done on digenetic trematodes in Bangladesh such as the prevalence of the parasite *Genarchopsis dasus* in the fish *Channa punctatus* of Mymensingh, Bangladesh to determine the infestation and seasonal variation (Chandra *et al.,* 2011). The parasites of *Channa punctatus* from the freshwater Ichamoti river and a polluted sewerage treatment lagoon near Dhaka city were reported and found that trematode was the most prevalent group (Ghani *et al.,* 2011). The clinico-anatomical studies on *Clinostomum sp*. from *Heteropneustes fossilis* in Mymensingh, Bangladesh reported by Chandra et al. (1998). Seven species of parasites were identified from *Channa punctatus* including *Genarchopsis banglensis* and the prevalence and the intensity of endoparasites was higher in fishes (Alam *et al.,* 2010). Though some works have been conducted on the type, location, prevalence mean intensity of parasites in many countries, however, there is no research on the parasitic infestation of *Channa punctatus* reported yet from Dinajpur region of Bangladesh. The distribution of parasites in different parts of the body and different seasons is not also known in this region. The present study was aimed to explore the most available fish parasite species in *Channa punctatus* in Dinajpur region with the following objectives:

- To identify the seasonal parasitic infestation of *Channa punctatus,*
- To study their prevalence, mean intensity, abundance, and index of infestation,
- To study the infestation in relation to season, sex, and size of the host.

MATERIALS AND METHODS

The experimental fish were collected from Caritas fish hatchery and Tangon river in the northern part of Bangladesh from September 2018 to August 2019. The entire study period was divided into four seasons including Autumn (September-November), winter (December-February), summer (March-May), and rainy season (June-August).

Sampling technique

A total of 120 fish were examined. Fishes were collected from culture and natural sources and brought in polythene bags with water in live condition for investigation to the laboratory of the Department of Aquaculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. Then the length and weight were measured and sex was identified. The length of fish was divided into 3 groups to depict a clear picture of the relationship between the length to the fish and parasite infestation. The length groups were small (< 13 cm), medium (13-15 cm) and large (15 < cm).

Collection of parasites

All the organs of fish were examined for the collection of endoparasites. The surface of the visceral organs, mesenteries, and body cavity were examined carefully by using a hand lens. Each organ of viscera including stomach, intestine, and liver were separated and kept in different petridishes containing water. The stomach, intestine, and liver were opened by an incision. To dislodge the parasite, the organs were scrapped by a scalpel because the parasite might have attached to the lining of the epithelium. Livers and kidneys were shredded with forceps to isolate the parasite.

Preparation of parasites for microscopic studies

The parasites were kept in normal saline for relaxation, flattened, and fixed in FAA (Formalin, Acetic acid, and Alcohol). Some of the fixed specimens were prepared in glycerin jelly for clearing. Some others were made permanent slides staining in Borax carmine, dehydrated in alcohol grades, clearing in lactophenol, and mounted in Canada balsam. After collection, the parasites were kept in normal saline for relaxation, flattened, and fixed in FAA. Some of the parasites were prepared for permanent slides. The schematic diagram of slide preparation for parasite identification is presented in Figure 1.

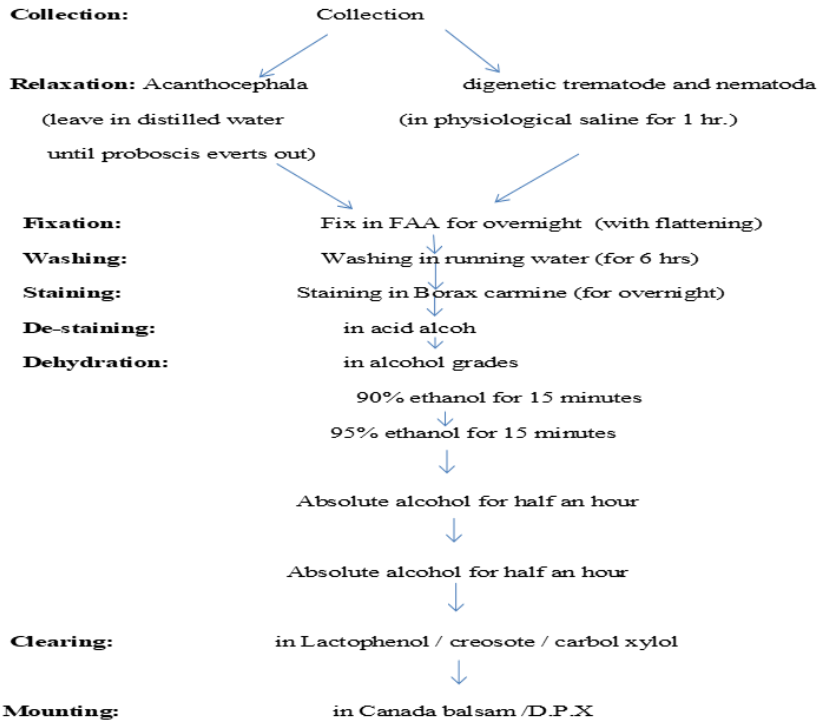

Figure 1. Schematic diagram of whole mount preparation

Identification and classification of parasite

Parasites were identified and classified according to Yamaguti (1958, 1959, 1961, and 1963). The following ecological term was used to analyze the results (Margolis *et al.,* 1982).

$$\text{Prevalence} = \frac{\text{No. of host infested}}{\text{No. of host examined}} \times 100$$

$$\text{Mean intensity} = \frac{\text{Total no. of parasite}}{\text{No. of infested host}}$$

$$\text{Abundance} = \frac{\text{Total no. of parasite in host species}}{\text{Total no. of host species examined}}$$

$$\text{Index of infection} = \frac{\text{No. of the parasites collected x No. of the infested hosts}}{\text{No. of the hosts examined}}$$

RESULTS AND DISCUSSION

The research was conducted to identify the parasitic infestation of *Channa punctatus.* Data were recorded based on the length, sex, season, culture, and capture. This study has been methodically completed to fulfill the objectives. During the period of investigation, 120 *Channa punctatus* were examined. Among them, 32 fish were infested with 72 parasites of a digenea and nematode, and only two different species of parasites, *Genarchopsis dasus* and *Camallanus anabantis* were recorded (Table 1). Similarly, some authors observed different groups of parasites including digenea, nematode, acanthocephala, crustacea, and cestode. Seven different species of parasites were identified from the studied hosts *i)Allocreadium handiai, ii) Argulus bengalensis, iii) Camallanus anabantis, iv) Euclinostomum multicaecum, v) Procamallanus mystic, vi) Pallisentis ophiocephali* and *vii) Sangaophio cephalina* of which six were endoparasites and one was ectoparasite (Das *et al.,* 2018). All of the parasites were found to be infested in the stomach, intestine, and body cavity of the host fish. However, *Genarchopsis dasus* was collected from the posterior part of the stomach. Similarly, the prevalence and intensity of helminths were recorded in the snake-headed fish, *Channa punctatus*. They found Majority of the parasites were found in the intestine (Sultana and Salam, 2015).

Table 1. Identified parasites and their site of infection

Sl. No.	Species	Site of infection
1	*Genarchopsis dasus*	Stomach, Intestine
2	*Camallanus anabantis*	Stomach, Body cavity

Description of identified Parasites

The identified parasites are briefly described below with their morphological characters.

Genarchopsis dasus (Gupta 1951) (Figure 2). Body muscular, cylindrical with rounded ends, 2.54-3.78 x 0.93-1.05 mm. Oral sucker subterminal, prepharynx absent. Oesophagus absent, intestinal caeca broad and wavy with several marked constrictions, extending beyond the vitellaria where they united. Acetabulum is larger than oral sucker situated at the middle and measures 0.71-0.87 x 0.71-0.87 mm. Testes lie behind acetabulum. The left testis lies at a distance of 1.72-1.77 mm from anterior end. Right testis extra caecal. Vesicula seminalis was curved and intercaecal. Ovary post-testicular, close to right testis, 0.19-0.25 x 0.25-0.34 mm. uterine coils extended from ovary to genital opening. Eggs large, numerous with filament, 0.04-0.05 x 0.02 mm. Vitellaria consist.

Camallanus anabantis (Pearse, 1933) (Figure 3). Male body 2.9-16.77 mm long, 0.10-0.45 mm wide; buccal capsule of two valves, each with nine longitudinal rows of teeth; tridents 0.023-0.010 mm long; cephalic papillae present; oesophagus divided into two parts, anterior muscular 0.25-0.634 mm long, posterior glandular 0.38-1.068; nerve ring 0.14-0.30 from anterior end; tail 0.09-0.099 long, with two spines and a short precaudalala; spicules two, unequal, smaller 0.07-0.32 long, larger 0.35-0.65 mm; caudal papillae 10-13 pairs, 4-7 preanal, 5-6 postanal; a pair of phasmids. Female body 7.2-20.0 mm long, 0.15-0.55 wide; tridents 0.022 long; cephalic papillae present; a pair of cervical papillae also sometimes observable, 0.22 mm from the anterior end; oesophagus, anterior muscular 0.36-0.651 mm long, posterior glandular 0.52-1.00; tail 0.1-0.24 mm long, bifid; vulva pre-equatorial.

Fig. 2

Fig. 3

Figure 2. *Genarchopsis dasus* **Figure 3.** *Camallanus anabantis*

Table 2. Infestations of parasites in *Channa punctatus* in different months during the period from September 2018 to August 2019

Months/Year	No. of hosts examined	No. of hosts infested	No. of parasites collected	Prevalence (%)	Mean intensity
Sept/18	10	4	18	40	4.50
Oct/18	10	4	5	40	1.25
Nov/18	10	2	7	20	3.50
Dec/18	10	1	1	10	1.00
Jan/19	10	1	8	10	8.00
Feb/19	10	1		10	1.00
Mar/19	10	3	7	30	2.33
Apr/19	10	2	2	20	1.00
May/19	10	2	3	20	1.50
Jun/19	10	3	3	30	1.00
July/19	10	4	8	40	2.00
Aug/19	10	5	9	50	1.80
Total	120	32	72	26.67	2.41

Monthly infestations

During the period of investigation, 120 *Channa punctatus* were examined. Among them, 32 fish were infested with 72 parasites of different digenetic trematode and nematode species. The nature of infestations due to infection of digenea and nematode parasites onto the host was presented in Table 2. The maximum number of parasites collected from the host in September and the minimum in December and February. The maximum number of parasites of an infected fish was 5 in August, and February, and the lowest number (1) in December, January, and February. The maximum prevalence (50%) was in the month of August. Though the minimum prevalence was in December, January, and February (10%), appeared different from the rest month of the year. On the other hand, the highest mean intensity was recorded in January (8). Similar findings were noticed by Khalil et al. (2014) who observed maximum infestation in January and lowest in February whereas nematodes occurred throughout the year in different intensities in *Heteropneustes fossilis* and prevalence was highest in November (96.86%) and lowest in February (67.86%) (Chandra, 1994).

Seasonal infestations

Equal numbers (30) of fish were examined in all the seasons, where 120 hosts were examined. The number of parasites collected was higher in the rainy season. The overall infestations were lower in winter. Prevalence was recorded at 40% and mean intensity at 3.33. Similarly, the index of infestation and abundance were higher in autumn (10 and 1, respectively). Though infestations were recorded throughout the year comparatively lower in winter. Therefore, prevalence, index of infection, and abundance were lower in winter but the mean intensity was lower in autumn. However, the prevalence was highest in the summer season followed by winter, and lowest in monsoon reported by Sharma (2016). Detailed seasonal patterns of infestation are shown in Table 3.

Table 3. Infestation of parasites in *Channa punctatus* in different seasons

Season	No. hosts examined	No. of hosts infested	Prevalence (%)	Mean intensity	Index of infection	Abundance
Autumn	30	10	33.33	0.33	10	1
Winter	30	3	10.00	3.33	1	0.33
Summer	30	7	23.33	1.71	2.8	0.40
Rainy season	30	12	40.00	1.67	8	0.67

Infestation in different sex of host

Infestation due to parasites in male and female hosts showed some variations (Table 4). The highest prevalence was recorded 66.67% in both males in September and females during April. The highest index of infection and abundance (3.71 and 1.85 respectively) were recorded in female fishes during the month of September. On the other hand, a high rate of mean intensity (8) was found in male fishes of *C. punctatus* in January. Higher infestations in female fish were reported by several authors (Verma *et al.,* 2018; Khalil *et al.,* 2014), however, some authors reported no conspicuous variation in infection in different sex (Ahmed *et al.,* 2007). The prevalence of endoparasites in the host fish *Channa punctatus* was 91.30% in female and 88.88% in male fishes, among them in sewage water fishes the prevalence was 85.71% in female and 86.66% in male and in fishes collected from a hatchery the prevalence was 100% in both the male and female fishes (Alam *et al.,* 2010; Rakibuzzaman *et al.,* 2011).

Table 4. Infestation of parasites in male and female *Channa punctatus* in different month during September 2018 to August 2019

Months	No. of fish examined		No. of fish infested		Prevalence (%)		Mean intensity		Index of infection		Abundance	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Sept/18	3	7	2	2	66.67	28.57	2.5	6.5	3.33	3.71	1.67	1.85
Oct/18	4	6	2	2	50.0	33.33	1.0	1.5	1.0	1.0	0.5	0.5
Nov/18	1	9	0	2	0	22.22	0	3.5	0	1.56	0	.78
Dec/18	4	6	1	0	25.0	0	1.0	0	0.25	0	0.25	0
Jan/19	5	5	1	0	20.0	0	8.0	0	1.6	0	1.6	0
Feb/19	3	7	0	1	0	14.29	0	1.0	0	0.14	0	0.14
Mar/19	4	6	1	2	25.0	33.33	5.0	1.0	1.25	0.67	1.25	0.33
Apr/19	7	3	0	2	0	66.67	0	1.0	0	1.33	0	0.67
May/19	1	9	0	2	0	22.22	0	1.5	0	0.67	0	0.33
Jun/19	5	5	2	1	40.0	20.0	1.0	1.0	0.8	0.2	0.4	1.2
July/19	6	4	2	2	33.33	50.0	2.0	2.0	1.33	2.0	0.67	1.0
Aug/19	5	5	2	3	40.0	60.0	1.5	2.0	1.2	3.6	0.6	1.2

Seasonal infestation in different length groups of hosts

The fishes were infested with parasites in all length groups. Parasites were also different levels of capacity of infestation in different age or length groups of fishes. The variation of infestation in different size groups was presented in Table 5. Differences of infestations among different length groups of hosts were found. A higher rate of prevalence (30.23%) was recorded in smaller size fishes and lower (24.44%) in large groups of fishes. Meanwhile, abundance (0.74**)** and index of infection (9.68) was also higher in smaller size fishes. Mean intensity was higher (2.88) in medium size group and lower (1.54) in higher size group of fishes. Lower index of infection (4.16) was in higher size fishes. Just opposite results were noted by Rahman et al. (2017) and Parbin and Mech (2019) and the prevalence and intensity of infestations increased with the age of fish hosts. While, some authors reported the prevalence and intensity of infection generally increased with host size up to a point and then declined (Stromberg and Crites, 1975).

Table 5. Infestation of parasites in different length groups of *Channa punctatus* during September 2018 to August 2019

Size group	Prevalence (%)	Mean intensity	Abundance	Index of infection
13>	30.23%	2.46	0.74	9.68
13-15	25%	2.88	0.72	5.75
15<	24.44%	1.54	0.38	4.16

Infestation on capture and culture *C. punctatus*

There was also found difference in infestation (Table 6) between culture and capture *C. punctatus*. The equal number of examined host (60) but higher infestation was in capture host (19) and lower in culture (13). Higher infestation of culture *C. punctatus* in July and lower in November, December and January. Meanwhile in case of capture *C. punctatus* higher infestation in September and August, lower in February.

Table 6. Monthly infestation of parasites in capture and culture *Channa punctatus* in different season

Month	Capture		Capture	
	No of Examined Host Fish	Infested Fish	No of Examined Host Fish	Infested Fish
Sept/18	5	1	5	3
Oct/18	5	2	5	2
Nov/18	5	0	5	2
Dec/18	5	0	5	1
Jan/19	5	0	5	1
Feb/19	5	1	5	0
Mar/19	5	1	5	2
Apr/19	5	1	5	1
May/19	5	1	5	1
Jun/19	5	1	5	2
July/19	5	3	5	1
Aug/19	5	2	5	3
Total	60	13	60	19

CONCLUSION

Parasites are common in freshwater fishes because all are inhabited in polluted environment at high stocking density. The parasites are group of digenetic trematodes and nematode. *Channa punctatus* were mostly infected by endoparasites. Two species of parasites were found both were endoparasites. The maximum number of parasites collected in rainy season and lower in winter. Female fishes were more infested than males. Maximum prevalence was recorded in smaller size fishes and lower in higher size fishes. The abundance and index of infection were also higher in smaller size fishes. The higher infestation was found in capture fish and lower in culture. However, research on their biology, host-parasite relationship, the effect of parasitism on hosts, and their control measures require to get more detailed knowledge about these parasites.

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CONFLICT OF INTEREST

The authors did not have any conflict of interest with respect to research conduct, authorship or publication of this study.

REFERENCES

1. Ahmed MS, Iqbal T, Mahmood A, Gulzarin M and Abid M, 2007. Helminth parasites of some freshwater fishes. Punjab University Journal of Zoology, 22(1-2): 1-6.
2. Alam MJ, Rakibuzzaman M and Hasan MM, 2010. Comparative study of endo-parasitic infestation in *Channa punctatus* (Bloch, 1793) collected from hatchery and sewage lagoon. Nature and Science, 8(5): 152-156.
3. Chakraborty K, Vijayan KK, Vijayagopal P and Mohanty BP, 2013. Marine Fishes in India: Their Importance in Health & Nutrition, Issue 110 of Central Marine Fisheries Research Institute (CMFRI) Special Publication, Kochi, India.
4. Chandra KJ, Hasan M and Basak SS, 2011. Prevalence of *Genarchopsis dasus* (Digenea: Hemiuridae) in *Channa punctatus* of Mymensingh. The Bangladesh Veterinarian, 28(1): 47-54.
5. Chandra KJ, 2008. A practical text Book of fish parasitology and health management. The University Grants commission of Bangladesh. 213pp.
6. Chandra KJ, 1994. Infections, concurrent infections and fecundity of *Procamallanus heteropneustus* Ali, parasite to the fish *Heteropneustus fossilis*. Environmental Ecology, 12: 679-684.
7. Chandra KJ, 1998. The anatomy and histology of the alimentary tract of perch *Perca fluviatilis* (L.) Progressive Agriculture, 9(1-2): 157-162.
8. Chandra KJ and Haq MS, 1986. Food and feeding habits of freshwater fish of Bangladesh: A review. Bangladesh Journal of Agricultural science, 13(2): 63-78.
9. Das H, Alam MM, Bari SM, Al-Mamun MA, Das M, Chowdhury NK and Islam MS, 2018. Parasitic infestation in *Channa punctatus* at Sylhet in Bangladesh. Journal of Fisheries and Life Sciences, 3(2): 1-8.
10. Dias MLG, Minte-Vera CV, Eiras JC, Machado MH, Souza GTT and Pavnelli GC, 2006. Ecology of *Clinostomum complanatum* Rudolphi, 1814 (Trematoda: Clinostomidae) infecting fish from the floodplain of the high parna river, Brazil. Parasitological Research, 99(6): 675-681.
11. DoF, 2018. Yearbook of Fisheries Statistics of Bangladesh. Department of Fisheries, Ministry of Fisheries and Livestock. Government of the people's republic of Bangladesh, Ramna, Dhaka.
12. Ghani MO and Bhuiyan AI, 2011. Community structures of endoparasitic helminths of *Channa punctatus* from a freshwater river and a polluted lagoon of Bangladesh. Bangladesh Journal of Zoology, 39(2): 173-185.
13. Gupta SP, 1951. On a new trematode, *Phyllodistomum singhiai* new species of the family Gorgoderidae Looss, 1899, from the intestine of a freshwater fish *Mastacembelus armatus* (Lacep.). Indian Journal of Helminthology, 3: 21-28.
14. Heinchiger RP, Laffarty KD, Huspeni TC, Brookes AJ and Kuris AM, 2007. Relationship between species richness and abundance of larval trematodes and of local benthos and fishes. Ecologia, Heildelburg, Germany, 151(1): 82-92.
15. Khalil SMI, Mamun MAA and Haque MN, 2014. Endoparasitic infestation in *Channa punctatus* collected from different water bodies in Sylhet. Journal of Sylhet Agricultural University, 1(1): 59-64.
16. Margulis L, Esch GW, Holmes JC, Kuris AM and Schad GA, 1982. The use of ecological terms in parasitology (Report on AN AD Hoc.) committee of the American society of parasitologists. Journal of Parasitology, 68(1): 131-133.
17. Parbin H and Mech B, 2019. Histopathological study of parasite infested *Channa punctatus*. International Journal of Life Sciences Research, 7: 44-52.
18. Pearse AS, 1933. Parasites of Siamese fishes and crustaceans. Journal of the Siam Society (Natural History Supplement), 9: 179–191.
19. Rahman MR, Shaha DC, Majumder BC, Akter T and Khatun HA, 2017. Intensity of parasitic infestation in freshwater snakehead (*Channa punctatus*) of Belai Beel, Gazipur, Bangladesh in Winter Season. IJSRSET, 3: 493-499.
20. Rakibuzzaman M, Raknuzzaman M, Bhuiyan AI and Hasan MM, 2011. Comparative study of endoparasitic infestation in *Channa punctatus* collected from hatchery and sewage lagoon. Daffodil International University Journal of Science and Technology, 6: 7-10.

21. Stromberg PC and Crites JL, 1975. Population biology of *Camallanus oxicephalus* Ward and Magath, 1916 (Nematoda: Camallanidae) in white bass in western Lake Erie. Journal of Parasitology, 61: 123-132.
22. Sharma B, 2016. Studies on prevalence of cestode parasites in freshwater fish, *Channa punctatus* from Meerut (Uttarpradesh) India. Journal of Applied and Natural Science, 8(1): 485 – 488.
23. Sultana S and Salam A, 2015. Prevalence and intensity of helminth parasites in the snakehead fish, *Channa punctatus* of Savar, Dhaka. Jahangirnagar University Journal of Biological Science, 4(1): 1-7.
24. Verma SK, Yadav S and Saxena AM, 2018. An ecological analysis of acanthocephalan parasites of *Channa punctatus* of river Gomti, Lucknow, Uttar Pradesh, India. International Journal of Zoology Studies, 3: 1-4.
25. Yamaguti S, 1958. *Systema Helminthum.* Interscience publishers, London.Vol. I. The Digenetic Trematodes of Vertebrates. Part I and II, 979 and 1575pp.
26. Yamaguti S, 1959. *Systema Helminthum.* Interscience publishers, London. Vol. II. The Cestodes of Vertebrates. 860pp.
27. Yamaguti S, 1961. *Systema Helminthum*. Interscience publishers, London. Vol. III. The Nematodes of Vertebrates. Part I and II 679 and 1261pp.
28. Yamaguti S, 1963. *Systema Helminthum*. Interscience publishers, London. Vol. V. Acanthocephala. 423pp.