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TAXOMETRY AND ECOLOGY OF A NEW SPECIES OF *DIPLOZOON* NORDMAN, 1832 FROM THE GILLS OF *SCHIZOTHORAX RICHARDSONI*, INHABITANTS OF POONCH RIVER, JAMMU AND KASHMIR STATE, INDIA

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ABSTRACT
The aim of the study was to conduct parasitological investigations on gills of *Schizothorax richardsoni,* to observe parasitic load with reference to macroenvironmental (season, sex and size) factors. *S. richardsoni* (n = 240) were collected from Poonch river, Jammu and Kashmir, India from November 2009 to October 2011(10 animals per month) to detect infectivity of parasite fauna. More than 20% of *Schizothorax richardsoni* were infected with a new species of monogenean trematode parasite, *Diplozoon poochensis* sp. nov. on their gills characterized by extensively developed vitellaria masking intestine, large band shaped and folded ovary, short uterus, single egg large, elongated, thick shelled having coiled polar filament and opisthaptor bearing four pairs of transversely oval clamps, widest in hind body region. No diporpa larvae were collected. Macroenvironmental studies indicated that the prevalence of the parasite was higher in the first year as compared to the second and in both years, infected females outnumbered the males. The parasite showed no preference for attachment site. Quantitative results indicated that prevalence was high in summer and spring whereas mean intensity was highest during autumn. Fish 20-30 cms in length were most heavily infected (60.6%) having highest Mean Intensity (1.97). Ecological studies indicated that the prevalence of the parasite is affected by its macroenvironment (season, sex and size). This is the first record of *Diplozoon* from *Schizothorax richardsoni* of Poonch river, Jammu province, India.

INTRODUCTION

Monogenea (Platyhelminthes: Trematoda) are mostly ectoparasites having a direct life cycle found on freshwater and marine fishes. Most monogeneans parasitize gills of fish occurring on gill filaments but maybe present on gill rakers or lateral surface of gill arches. *Diplozoon* (Polyopisthocotylea: Diplozoidae) is a unique monogenetic trematode parasite on the gills of freshwater fishes having an expanded geographic range and is known to be completely monogamous. Literally having two bodies, the adult parasites remain permanently united in the form of an 'X'. Heavy infections of *D. nipponicum* seriously hinder the respiratory activity of the fish causing Diplozoonosis. Damage includes hemorrhages and ulceration of host epithelium, development of epithelial outgrowths, and production of excessive amount of mucus, which can disturb the respiratory function of the gills and ionic exchange. *D. barbi* causes small pustules on gills being highly pathogenic and may even cause death of the fish. Keeping in view the pathogenic potential of the parasite and the paucity of information on its taxometry and ecology, the idea behind the work was to isolate and describe an unknown monogenean parasite from the gills of *Schizothorax richardsoni*.

The genus *Diplozoon* was created for a monogenetic trematode collected from the gills of a fresh water fish from Europe and *D. paradoxum* was described as its type species. *D. nipponicum* was discovered from Japan. A number of *Diplozoon* species have since then been described from different countries (Fotedar and Parveen, 1987; Kagel and Taraschewski, 1993; Thapa et al., 2011). In context to Jammu and Kashmir, reports are available on the *Diplozoon* fauna (Ahmed and Chishti, 1999).

Ecological attributes of the host (geographic location, season, temperature and host gender, age and size) constitute the macroenvironment of the parasite, the physical connection between the parasite and host constitutes the microenvironment. The macroenvironment assumes greater importance in case of fish being poikilothermic in nature (Barse, 1998). Although water quality parameters have frequently been investigated (Nirmal Kumar et al., 2008; Lianthuamluaia et al., 2013), as also the effect of pollutants on serum biochemistry of fish (Choudhary and Jha, 2013), however, reports of their impact on parasite incidence are few. The ecology of *Diplozoon* from the gills of *Barbus neumayeri* was investigated by Chapman et al. (2000).

During an exploratory survey of eight species of fin and shellfishes of Jammu, *Diplozoon* was recovered from the gills of *Schizothorax richardsoni* (Gray) collected from river Poonch, a freshwater stream situated at an elevation of 1010m from sea level, of Jammu Province, India. In this study, we documented the prevalence and intensity of a gill monogenean in the common snowtrout from Poonch river of Jammu and Kashmir, India. We also report the seasonal patterns, sex-based differences and size group variations in frequency of infection

MATERIALS AND METHODS

Schizothorax richardsoni (n = 240) from Poonch river were collected monthly (10 specimens per month) and were transported alive to the laboratory in plastic jars containing water. Gills were examined with the aid of dissection microscope. Parasites were gently removed with fine hair brush, brushed gently to remove fish slime and debris and washed in physiological saline (0.8% NaCl). Parasites were covered by glass coverslip, carefully pressed down to avoid damage to the specimen for flattening, fixed in 70% alcohol and processed for whole mount preparations following standard procedure and stained in borax carmine (aqueous). Measurements were taken in micrometer and are expressed in mm. The holotype and paratypes have been deposited in the Department of Zoology, University of Jammu, Jammu.

Size groups

Total length of the hosts was recorded in cms. using a calibrated measuring board and the hosts were divided into 4 groups- A (10-20 cms), B (20-30 cms), C (30-40 cms) and D (40 cms and above) for observing infectivity with respect to host size.

Ecological terms

Prevalence (p), mean intensity (MI) and relative density (RD) (abundance) were calculated as follows:

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

$$\text{Mean intensity} = \frac{\text{Total no. of parasites}}{\text{Total no. of hosts infected}}$$

$$\text{Relative density} = \frac{\text{Total no. of parasites}}{\text{Total no. of hosts infected}}$$

RESULTS AND DISCUSSION

Ecological studies

The physical connection between parasite and host constitutes the micro -environment and the host's environment can be seen as the macro-environment of the parasite. All influences from this macro environment would depend solely on the host, thus including factors such as season, gender, age, length and weight of the host (Barse, 1998). These factors are included in the current investigation on the occurrence of *Diplozoon* on *Schizothorax richardsoni*.

Seasonal variations

The gills of *Schizothorax richardsoni* were infected with *Diplozoon*. The prevalence and intensity of the parasite were maximum during summer for both the years. Although the prevalence of the parasite was higher (22.5%) in the Ist year (Nov.2009-Oct 2010) as compared to the 2nd year (19.16% : Nov. 2010-Oct 2011), but MI and RD were higher during the 2nd year (2.13 and 0.40 respectively) as compared to the first (1.70 and 0.38 respectively). Studies on seasonal occurrence of these parasites for both consecutive periods indicate that prevalence (p) and relative density (RD) are optimum in summers whereas mean intensity (MI) is optimum in autumn and summer months (Table 1).

The parasite's micro-environment can be greatly affected by the temperature of the external environment due to the exothermic nature of the fish. The temperature and cycles of seasons therefore have an obvious influence on the prevalence, mean intensity and abundance of parasites more so for forms which choose to attach themselves to the exterior of the host in this changing macro-environment (Pilcher *et al.*, 1989). The variance observed in monthly, seasonal and annual infections of *Diplozoon* may be due to these factors.

Temperature affects the behavior of all organisms that it interacts with, its competitors, symbionts, parasites and all other species that create or modify the physical environment in which it lives (Begon *et al.*, 1996). Zargar et al. (2012) reported both antagonistic and synergistic response to the combined effect of pollution and eutrophication due to *D. kashmirensis* in *Carassius carassius* and further, the parasite infrapopulations exhibited a marked seasonal regime in infestation pattern (Shah et al., 2013). The response of temperature maybe complex but at its simplest, temperature affects the rate at which life processes (growth, metabolism, reproduction) proceed (Chandra and Gupta, 2007). Therefore, fluctuations in temperature would not only affect the distribution of the host species, but also the parasites and its stages in the life cycle. The present results are in conformity Pilcher *et al*. (1989) who reported a significant decrease in number of *Dicliphora menangi* on *Merlangius merlangus* during winters as compared to summers.

Sex-wise variations

In both years, infected females (37) outnumbered the males (13). Out of the total infection in Ist and 2nd years, 74.07% and 73.91% respectively were females, the remaining being males' thus indicating that infection in females was almost three times higher as compared to males.

Gender-wise prevalence has often been controversial. No significant difference in infestation with respect to host gender has been observed for *Gyrodactylus rarus* on *Gasterosteus asuleatus* (Chappell, 1969), *Diclidophora merlangi* on *Gadus merlangus* (Arme and Halton, 1972) and *Gyrodactylus stephanus* on *Fundulus heteroclitus* (Barse, 1998). Higher infestations with helminth parasites in male perch (Zelmer and Arai, 1998), *Sorabim lima* (Takemoto and Pavanelli, 2000) and *Channa* (Gupta *et al*., 2012) have also been recorded. On the other hand, higher infections in female fish due to *Eustrongylus* (Ibiwoye *et al*., 2004) and *Genarchopsis* (Singhal and Gupta, 2009) have also been recorded and the present findings fall on similar lines. It may be possible that female hosts maybe equipped with a positive stimulus which may preferentially attract parasites and conversely, stronger in-built resistance to the infection in male fish might lead to fewer parasites to establish themselves (Siddiqui and Nizami, 1982).

Size group variations

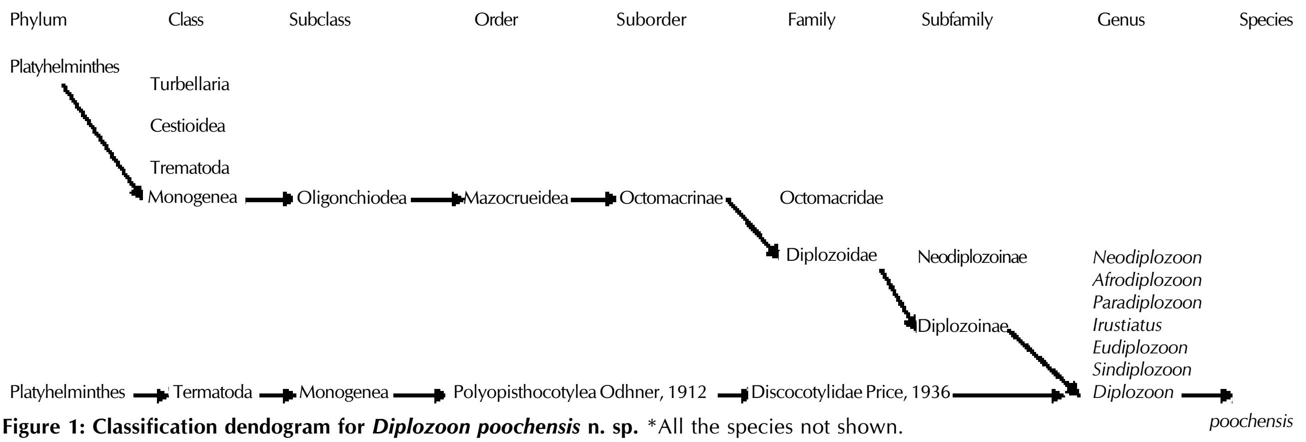

Figure 1: Classification dendogram for *Diplozoon poochensis* n. sp. *All the species not shown.

Table 1: Seasonal occurrence of *Diplozoon* on gills of *Schizothorax richardsoni* from Poonch river

Period	No. of fish hosts examined	No. of fishes infected *M	F	T	Prevalence	No. of parasitesrecovered	M.I.**	R.D.***
November 2009 to October 2010								
Summer	n = 30	5	8	13	43.3	20	1.5	0.6
Autumn	n = 30	0	4	4	13.3	12	3.0	0.4
Winter	n = 30	0	0	0	0	0	0	0
Spring	n = 30	2	8	10	33.3	14	1.4	0.46
Total	120	7	20	27	22.5	46	1.70	0.38
November 2010 to October 2011								
Summer	n = 30	3	7	10	33.3	25	2.5	0.8
Autumn	n = 30	0	5	5	16.6	13	2.6	0.4
Winter	n = 30	0	0	0	0	0	0	0
Spring	n = 30	3	5	8	26.6	11	1.37	0.36
Total	120	6	17	23	19.16	49	2.13	0.40

*M: Male, F: Female; T: Total, **Mean Intensity, ***Relative Density

Table 2: Prevalence and intensity of *Diplozoon* parasite on gills of *Schizothorax richardsoni* of different size groups

Group (size in cms)	No. of hosts examined	No. of hosts found infected	Prevalence	No. of parasites recovered	M.I.*	R.D.*
A (10 - 20)	40	01	2.5	1	1.0	0.02
B (20 - 30)	150	46	60.6	91	1.97	0.60
C (30 - 40)	44	3	6.8	3	1.0	0.06
D (40 and above)	6	Nil	0	0	0	0
Total	240	50	20.83	95	1.90	0.39

*Mean intensity, **Relative density

Incidence and intensity of *Diplozoon* in different size groups is shown in Table 2 for the survey period. Only one host out of 40 was infected in group A, maximum infection being recorded in group B (46 out of 150). Infection was again meager in group C (3 out of 44 hosts) and nil in group D in which all 6 hosts were infection-free. Fish 20-30 cms in length were most heavily infected (60.6%) having highest mean intensity (1.97) and relative density (0.60).

Changes in infection with parasites in different age/size groups may often be due to an increase in surface area (for ectoparasites), the ability of some parasites to accumulate or a change in the behavior of the host (Dogiel, 1964) or increase in age/size, causing increased exposure to parasite infestation (Kagel and Taraschewski, 1993). There are possibilities that larger hosts may offer more space to parasites and may provide greater variety of niches for parasite occupation. On the other hand, with the increase in size/age of the host, the latter may become immune against foreign invaders as the host ages (Schad, 1966) culminating in reduced population density.

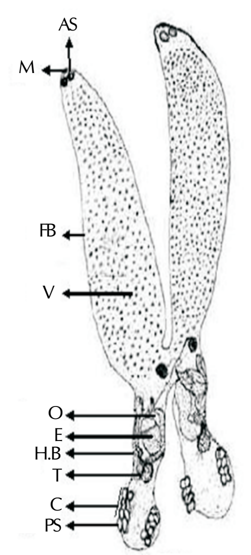

Figure 2: Camera lucida drawings of two individuals of *Diplozoon poochensis* n. sp. showing general organization. AS: anterior sucker; C: clamp; E: egg; FB: forebody; HB: hind body; M: mouth; O: ovary; PS: posterior sucker; T: testis; V: vitelline glands

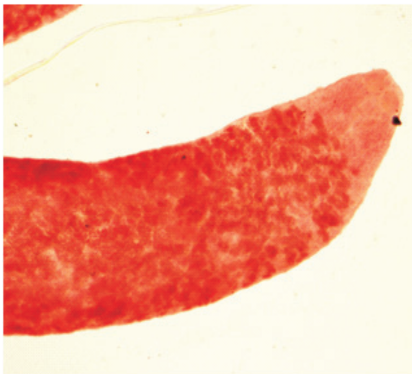

Figure 3: Forebody of *Diplozoon poochensis* n. sp. showing mouth, suckers and vitellaria

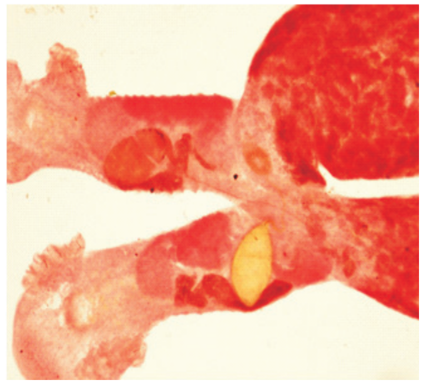

Figure 4: Point of union of two worms of *Diplozoon poochensis* n. sp

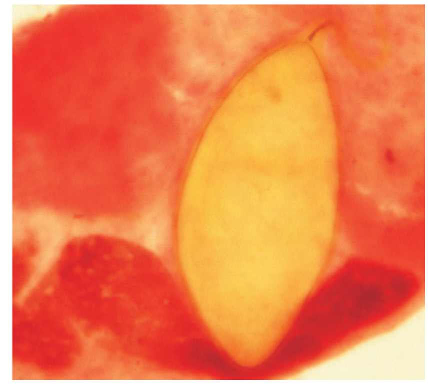

Figure 5: Egg of *Diplozoon poochensis* n. sp with filament

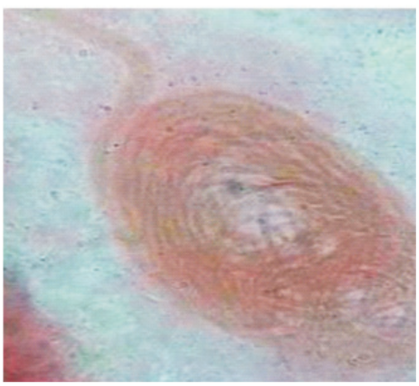

Figure 6: Coiled part of egg filament of *Diplozoon poochensis* n. sp

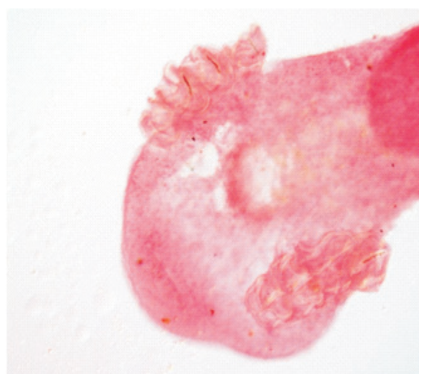

Figure 7: Posterior end of *Diplozoon poochensis* n. sp showing clamps on both sides

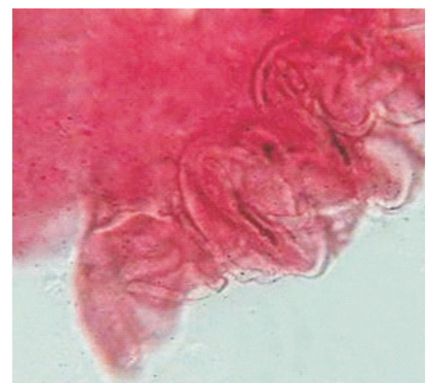

Figure 8: *Diplozoon poochensis* n. sp showing clamp with suckers

During the present investigations, infection was meager in 10-20 cms size fish, but increased rapidly in fish of size 20-30 cms reaching to the maximum prevalence, M.I. and R.D. Then, the fish appeared to acquire resistance showing a decline in infestation whereas the largest fish (>40 cms) were infection-free. These findings are supported by earlier findings where increased infectivity with length groups occurred initially in *Channa* (Singhal and Gupta, 2009) declining subsequently in the largest fishes. It may be possible that with the growth of the host, it becomes immune against the foreign invaders. Host behavior, environmental factors, variation in the biological characteristics of the parasites may contribute for variance in infection (Chubb, 1982).

Taxonomic studies

Systematic position of the genus *Diplozoon*

Monogenea was proposed to be raised to the status of a class, Monogenoidea with two new subclasses, Polyonchoidea and Oligonchoidea and the genus *Diplozoon* was placed in the latter subclass, order Mazocraeidea, family Dacocotylidae Price, 1936 and subfamily Diplozoinae Polombi, 1949. The family Diplozoidae was proposed for *Diplozoon* (Tripathi, 1957), Polyopisthocotylea was retained and *Diplozoon* and *Neodiplozoon* Tripathi, 1957 were placed under the family Diplozoidae, superfamily Diplozooidae in Systema Helminthum (Yamaguti, 1963). Later, the family Diplozoidae was split into two subfamilies, Diplozoinae was proposed for *Diplozoon*, *Inustiatus*, *Sindiplozoon, Eudiplozoon* and *Paradiplozoon* and Neodiplozoinae for *Neodiplozoon* and *Afrodiplozoon* (Khotenovskii, 1985).

A sub-familial split was reported in a compilation of a list of monogenean genus-group names which were not included in Systema Helminthum (Spencer Jones and Gibson, 1990) showing similar genus groupings as those of Khotenovskii (Khotenovskii, 1985), however, the genus *Diplozoon* has not been mentioned. In the present communication, the classification of Khotenovskii (Khotenovskii, 1985) is followed. A simplified dendogram (Fig. 1) depicts Khotenovskii's classification for the newly described species of *Diplozoon*.

The following Key for determining genera of sub-family Diplozoinae based on Khotenovskii (1985) is provided for ease of reference as the original publication of the author is in Russian.

Keys for determining genera of subfamily Diplozooinae (Khotenovskii, 1985)

1. (2) The central region of the posterior part of the body does not show dilation.................... 1. *Paradiplozoon* Achmerov.

2. (1) The central region of the posterior part of the body shows a dilation of varying shapes.

3. (4) In anterior sucker of mouth / buccal cavity there are two

Table 3: Comparative characteristics of Indian *Diplozoon* species (measurement in mm)

Particulars	*D. indicum* Dayal, 1941	*Diplozoon kashmirensis* Kaw, 1950;	Fotedar & Parveen, 1987;	Ahmad & Chishti,1999	*D. soni* Tripathi, 1957	*D. cauveryi* Tripathi, 1957;	Thapa et al., 2012	*Neodiplozoon barbi* Tripathi 1957	*D. aegyptensis* Ahmed & Chishti, 1999	*Diplozoon microclampi* *Kulkarni, 1971*	*Diplozoon thapari* *Gupta& Krishna, 1977*	*D. surankotensis* Sudan, 1979	*Diplozoon nipponicum* Fotedar & Parveen 1987	*Diplozoon dasashwamedhai* Agarwal & Kumar, 1989	*D. guptai* *Ahmed &* Chishti, 1999	Present authors
Host	*Barbus sarana*	*Schizothorax sp.*	*S. niger & S. esocinus*	*S. niger, S. esocinus & Carassius Carassius*	*Oxygaster bacaila*	*Cirrhina cirrhina*	*Labeo pangusia & L.boga*	*Barbus chagunto*	*S. niger*	*Barbus sarana*	*Tor tor*	*Labeo diplostomus*	*Cyprinus carpio specularis*	*Barilius bola*	*S. niger, S. esocinus, Labeo sps. & Carassius carassius.*	*Schizothorax richardsoni*
Locality	Lucknow	Dal Lake, Kashmir	Dal Lake, Kashmir	Dal & Anchar Lakes	River Son, Bihar	River Cauvery Mattur	Dawki, Shella, Muktapur (Meghalaya)	River Son Bihar	Dal Lake	Hyderabad	Nanak Sagar Dam, Nainital	Surankote, Poonch (J&K State)	Japan, China, USSR Kashmir	Varanasi	Dal & Anchar Lakes, Kashmir	River Poonch (J&K) State
Body Length	6.0 - 9.6	2.3 – 4.32	1.75-3.5	2.783 (2.34-3.00)	1.35 – 1.65	4.78 – 5.14	2.82 -5.10	1.76 – 5.14	4.2 (3.95 – 4.25)	-	1.06-1.95	-	3.35-4.50	3.39 x 0.56 x 0.67-0.68	1.873 (1.28-2.55)	2.4 -4.2
Fore body	6.0 – 6.5 X 0.8	1.4 – 2.64 x 0.71 – 1.51	1.0-1.8	1.811x.0.695 (1.48-2.0 x 0.48-0.92)	0.58 – 1.116 X 0.159 – 0.33	3.11 – 3.37 X 1.08 – 1.35	1.79-4.14 x 0.52-1.31	1.16 – 3.27 x 0.391– 1.47	2.82 x 0.88 (2.72-2.92 x 0.84 -0.92)	-	-	2.40 –2.50 x 0.87	2.0-2.53	2.34-2.41	1.66 x 0.604 (0.755 - 0.144 x 0.44 - 0.65)	1.1 - 2.59 x 0.53 -0.68
Hind Body	2 .0– 2.9	0.9 – 1.72 x 0.5 – 0.69	0.65-1.2	0.794-044 (0.64-1.0 x 0.36-0.56)	0.435 – 0.536 x 0.101 – .159	1.5 – 1.76 x 0.58 – 0.68	0.69-1.26 x 0.25-0.66	0.609 – 0.405 x 0.29 – 0.89	1.16 x 0.285 (1.12 – 1.2 x 0.24 – 0.33)	-	-	1.10 –1.15 x 0.33 – 0.35	1.1-1.5	1.02-1.16	0.603 x 0.395 (0.46 -0.76 x 0.289 -0.48)	0.86 -1.51 x 0.44 -1.2
Length Ratio of Fore and Hind Body	01: 0.33	01: 0.646	1:0.58-0.9	1:0.448 (1:0.408-0.510)	01: 0.673	01: 0.505	-	-	-	-	-	-	1: 0.48-0.5	-	01: 0.523	01: 0.33
Clamp Size	0.38 x 0.17 0.37 x 0.16 0.34 x 0.14 0.27 x 0.11	0.15 x 0.75 0.166 x 0.076 0.154 x 0.075 0.140 x 0.074	0.07-0.115 X 0.03-0.046 0.08-0.13 X 0.03-0.05 0.08-0.14 X 0.04-0.07 0.07-0.013 X 0.04-0.06	0.091 x 0.04 0.098 x 0.042 0.091 x 0.039 0.074 x 0.04	0.07 x 0.087 0.076 x 0.076 0.076 x 0.076 0.068 x 0.068	0.106 – 0.133 x 14.19 0.095– 0.144 x 0.13–0.19 0.076–0.11 x 0.13– 0.152 0.068 – 0.098 x 0.125 – 0.152	0.046-0.115 x 0.046-0.115	18 – 28 pairs 0.038 – 0.079 x 0.022 – 0.068	0.114 x 0.045 (0.10 – 0.124 x 0.04 x 0.048)	-	0.05-0.14 X 0.03-0.08 0.06-0.15 X 0.049-0.06 0.05-0.13 X 0.025-0.075 0.05-0.11 X 0.03-0.08	0.06 x0.12 0.05 x .12 0.05 x .12 0.05 x0.10	0.08-0.085 x 0.03-0.035 0.085-0.095 x 0.04-0.045 0.08-0.095 x 0.04 0.075-0.09	0.13-0.16 0.150-0.157 x 0.068-0.082 0.15 x 0.082-0.096 0.12-0.13 x 0.068-0.082	0.102 x 0.045 0.106 x 0.032 0.093 x 0.038 0.081 x0.035	0.06 x 0.05 0.06 x 0.05 0.07 x 0.05 0.06 x 0.05
Testis	-	0.16 x 0.27 – 0.29	0.1-0.15	0.072 x 0.076 (0.056-0.092 x 0.064-0.112)	-	-	0.16-0.29 x 0.09-0.25	-	0.155 x 0.105 (0.14 – 0.17 x 0.10 – 0.11)	-	0.06-0.32 X 0.45-0.51	0.20 x0.24		0.11-0.16 x 0.05-0.05	0.813 x 0.0786 (0.076 – 0.12 x 0.052 – 0.128)	0.34 x .0.171
Egg Size	-	0.27 – 0.29 x 0.07 – 0.09	0.20-0.23 X 0.06-0.07	0.254-0.098 (0.236-0.272 x 0.092-0.104)	0.064 x 0.034	-	0.18-0.25 x 0.092-0.138	0.152 x 0.091	0.52 x 0.082(0.22 – 0.28 x 0.076 - 0.088)	-	0.020-0.025	0.262 -0.80 x 0.08 - 0.07		0.156 x 0.066	0.245 – 0.07 (0.228 – 0.268 x 0.06 – 0.08)	0.24 x 0.172
Anterior Suckers	-	0.063 – 0.074 x 0.045 – .063	0.05- 0.075	0.075 x 0.062 (0.06-0.10 x 0.44-0.092)	-	-		-	0.082 x 0.095 (0.072 – 0.092 x 0.064 – 0.115)	-	0.04-0.10	-		0.051-0.057 x 0.068-0.082	0.056 x 0.05 (0.04 – 0.0 x 0.032 – 0.072)	0.05 x 0.05
Prepharynx	-	0.065		0.04	-	-		-	0.054 (0.041 x 0.068)	-		0.025			0.0356 (0.03 – 0.042)	-
Pharynx	-	0.065 – 0.075	0.04 – 0.055	0.092 x 0.032	-	-		-	0.064 x 0.047 (0.056 – 0.072 x 0.044 – 0.05)	-	0.03-0.065 X 0.025-0.05	0.06 x0.06		0.084 x 0.045	0.057 x 0.025 (0.044 – 0.089 x 0.02 – 0.028)	-

large musculo-glandular organs. Dilation shows large lateral plicae.......... 4. *Eudiplozoon* Khotenovsky.

4. (3) Anterior sucker lacks musculo-glandular organ. Dilation deprived of plicae.

5. (6) Dilation disc-shaped. Intestinal branches form a dense network. External uterine opening lateral in the central region of the anterior part of the body..........2. *Inustiatus* Khotenovsk.

6. (6) Dilation cup-shaped. Intestinal branches do not form a dense network. External opening of uterus on the border between anterior and posterior body parts.

7. (8) Anterior region of posterior body part has plicae......... 5. *Diplozoon* Nordmann.

8. (7) Anterior region of posterior body part does not have plicae. ....3.*Sindiplozoon* Khotenovsky

Based on the above Key, the genus of the specimen was identified as *Diplozoon*.

The following features are proposed to be of significance for differentiating between the different species of *Diplozoon* (i) uniform range of measurements from a large number of specimens, (ii) the shape and size of the clamps on the opisthaptor, (iii) the average size ratio of the fore and hind -body and (iv) the way in which the distal part of the intestinal caecum terminates in the hind body (character 5 above).

Descriptive note

Adults united in pairs in permanent copula, show variation in body size, but in each individual, fore body is longer than hind body, size ratio varies. Anterior body depressed and leaf like; posterior portion of the body behind the cross sub-cylindrical; posterior most end forms a rectangular disc. At its anterior end, each parasite bears two suckers; cup shaped and more or less oval, located ventrally. Mouth is located in middle behind these suckers. Intestine masked by extensively developed vitellaria. Testis single, smooth, compact, oval and post-ovarian, present in hind portion of the body in posterior part of its middle third. Vas deferens arises from anterior end of testis; winding diagonally across region of fusion; its connection with vitelline duct of the other parasite not visible. Well developed ovary; pre-testicular, lies within opistho-haptoral portion of body, nearer to body fusion than to cotylophore. Ovary large band-shaped and folded upon itself. Smaller posterior portion smooth and compact. Vitellaria profusely developed in fore body from pharynx to union of two worms. Uterus short, not clearly demarcated from rest of the organs. Only one egg, clinging by long, coiled polar filament, seen in the uterus at any time. Eggs large, elongated and thick-shelled.

Holdfast region (opisthaptor), bearing four pairs of transversely oval clamps, has maximum width in the hind body region. Size of clamps variable within short limits, last pair usually smaller, second pair larger.

Etymology

The parasite has been classified as the genus *Diplozoon* and as such has been described as a new species belonging to this genus. The species name assigned to this specimen is that of *poochensis* derived from the location of host collection (Poonch river).

DISCUSSION

The present specimen belongs to the genus *Diplozoon* Nordman, 1832 having rectangular opisthohaptor with four pairs of clamps and a pair of inconspicuous posterior anchors. The present species has been compared with all available descriptions of *Diplozoon* from India (Table 3). The genus was first described as *D. indicum* from the gills of *Barbus (Puntius) sarana* from Lucknow U.P (Dayal, 1941). From Kashmir, *D. kashmirensis* was reported from *Schizothorax* sp. Kaw, 1950), *S. niger* and *S. esocinus* (Fotedar and Parveen, 1987), *S. niger, S. esocinus* and *Carassius carassius* (Ahmed and Chishti, 1999). Other species reported from Kashmir are, *D. nipponicum* (Fotedar and Parveen, 1987), *D. aegyptensis* (Ahmed and Chishti, 1999) and *D. guptai* (Ahmed and Chishti, 1999). Species of *Diplozoon* have also been recorded from Bihar {*D. soni* and *Neodiplozoon barbi* (Tripathi, 1957)} Mattur and Meghalaya {*D. cauveryi* (Tripathi, 1957, Thapa et al., 2011)}, Hyderabad {*D. microclampi* (Kulkarni, 1971)}, Nainital {*D. thapari* (Gupta and Krishna, 1977)} and Varanasi {*D. dasashwamedhai* (Agarwal and Kumar, 1989)}. From Poonch river, only one species, *D. surakotensis* (Sudan, 1979) has been reported from Surankote from *Labeo diplostomulus*. However, this is the first record of *Diplozoon* infection in *Schizothorax richardsoni* from Poonch river of Jammu province.

A critical comparison of the present species with the known species of the genus from India including Jammu and Kashmir (Table 3) indicates that although its body length falls within the range of *Neodiplozoon barbi* Tripathi, 1957 (*N. barbi* 1.76-5.14 mm; present species 2.4-4.2 mm) and the fore body and hind body length are comparable but it differs in the egg size and clamp size. Moreover, in *N. barbi*, there are 18-28 pairs of clamps whereas there are only 4 pairs in the present species. Therefore, the latter cannot be identified as *N. barbi* collected from a different host, *Barbus chagunto* from a different site (river Son, Bihar). The present form comes close to *Diplozoon kashmirensis*, Kaw, 1950 in having comparable general appearance, body length, anterior suckers. But it differs in width of fore body and hind body (Table. 3), fore body and hind body length ratio, clamp size, size of testis, size of eggs especially width. The prepharynx is inconspicuous in the present species which is contrarily present in *D. kashmirensis*. Moreover, the site of collection of host of *D. kashmirensis* (Dal Lake) is also different from the present one (river Poonch, J & K state). Subsequent to comparison, it is quite clear that there is no instance where all characteristics would place it within any described species. Therefore, the monogenean parasite discovered from the gills of *Schizothorax richardsoni* is hereby being given a new species status, *Diplozoon poonchensis*, sp. nov. with the specific characters as given in this account. It is first record of the genus from the host *Schizothorax richardsoni* from Jammu province of Jammu and Kashmir State of India.

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