Seasonal distribution of parasites in freshwater exotic carps of West Bengal, India

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ABSTRACT

The study has been carried to find out the distribution of different parasites in exotic carps with respect to different months and seasons. These were isolated and identified from the fishes sampled randomly from five fish markets, which were representing South 24 parganas district, West Bengal. During the study period ten different types of parasites were observed such as *Trichodina sp, Chilodonella sp, Trichinella sp, Acanthocephala sp*, *Nematodes, Epistylis sp, Zoothamnium sp, Vorticella sp, developmental stages of eggs or parasites and some parasites (unidentified) among which most of the parasites were protozoan. Among all the parasites the most dominant were *Trichodina sp, Chilodonella sp* and *Nematodes*. Winter was the most vulnerable period to get parasitic infestation. During this period the water quality get deteriorated and the fishes were in stressed condition which favours the parasites to infest. Some parasites were found more during summer which favours their reproduction due to the availability of their intermediate host. In monsoon the temperature fluctuates which also favours growth of some parasites. During the study period *Trichinella sp* were found solely in *Cyprinus carpio* exclusively in winter. The protozoan parasites were most available during winter and these were the dominant parasites in exotic carps. These parasites were found mostly on gills and skin of the fishes where as nematodes were found in the intestine and body cavity of the fishes.

Key words: Ecto-parasites, Endoparasites, Exotic carps, Seasonal distribution.

INTRODUCTION

The exotic carps, Silver carp (*Hypophthalmichthys molitrix*), Common carp (*Cyprinus carpio*) and Grass carps (*Ctenopharyngodon idella*) are commercially important but they also possess risk of diseases. The increasing intensification of fish production and lack of health management measures have lead to many disease problems of bacterial, viral, fungal and parasitic origin. About 80% of fish diseases are parasitic especially in warm water fish (Eissa, 2002). Ecto-parasites are the most dangerous group that causes severe mortalities. There have been many instances of transfer of disease or parasitic organisms from wild grass carps to other countries and species. Silver carp have also been known to harbor a type of *Salmonella* bacteria which could be devastating to natural fish populations. According to Tatcher (1981) many parasites can live in a host, sometimes causing damage, sometimes not. Parasitic infection and diseases are some of the factors hindering high productivity in fish farming.

MATERIALS AND METHODS

The study on parasites of exotic carps was carried out for a period between July 2010 and June 2011. The samples (20-30 fishes) were collected on monthly basis from five different fish markets namely Garia, Bansgaria, Kalitala, Mukundapur and Jadavpur in the district of South 24 Parganas, West Bengal, India. The vital organs like skin, intestine, kidney and gills were examined for the presence of different parasites. The methods for collection, fixation and preservation of the samples for parasitic examination were followed as described by Soota (1980). Different groups of parasites were identified based on the identifying characters as given by Soulsby (1982). The parasitic frequency index (PFI) was calculated by taking the percentage of the number of hosts infected by an individual parasite species against the total number of hosts examined in a particular area under investigation. The frequency index were further classified into rare (0.1 – 9.9%), occasional (10-29.9%), common (30 – 69.9%) and abundant (70-100%) as per Srivastava (1980). One way ANOVA was done to determine the significance of differences in Parasitic Frequency Index (PFI) of parasites among different seasons as well as different months. Duncan’s Test at 1% and 5% were done to know the significance of differences at microlvel. As the Parasitic Frequency Index

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was recorded in percentage values and these were ranged from 0 to 100, angular transformation was done before analysis.

Formula for angular transformation:

\[ x = \sin^{-1}\sqrt{\text{Percentage}} \]

All statistical calculation was done on a desktop PC using SPSS (Ver. 12.0).

RESULTS AND DISCUSSION

During the study period a total of 253 numbers of Hypothalmichthys molitrix, 255 numbers of Cyprinus carpio and 260 numbers of Ctenopharyngodon idella were examined.

Prevalence of Trichodina sp in Exotic Carps: Trichodina sp. in Hypothalmichthys molitrix were highest during the month of December and January (PFI: 56.00% and 47.83%); while their presence were very low during June (13.33%). In Cyprinus carpio the prevalence of Trichodina sp were highest during December and January (PFI: 68.00% and 59.25%), and lowest during June. In Ctenopharyngodon idella also the same pattern was observed where the prevalence of Trichodina sp was highest during December and January (PFI: 60.00% and 52.38%), and lowest during June (PFI: 16.66%).

Thus in all three species, Trichodina sp was found in the gills and skin of the fishes and infestation was highest in winter and lowest in summer (Table. 1, 2, & 3).

In fish confined to ponds, tanks and aquaria, trichodiniiasis is a frequent problem (Arthur and Lom, 1984). Water temperatures do not seem to be an important parameter, in spite of reports of low temperatures being more optimal for reproduction of some trichodinids (Bauer et al., 1969), which corroborated with the present study. The highest infestation with Trichodina sp. was found in winter, while the lowest infestation rate was in summer reported by Hassan, (1992) which supports the present findings. The results agreed with the findings of McArdle (1984) and El-Khatabi (1989) who reported that, Trichodiniiasis was prevalent all over the year with maximum rate of infestation during spring and winter.

The Trichodina infestation was highest during December-February as reported by Hossain et al., (2008) also supported the present findings.

The probable reason for the higher prevalence of Trichodina sp in fishes in winter may be that they have a direct life cycle, i.e. without involvement of any intermediate hosts. So the temperature may be the main factor of their prevalence. On the other hand in winter the fishes become in stressed condition which may also be the reason for their highest prevalence as it was reported that Trichodins are opportunistic parasites which become pathogenic under stressful condition (Ahmed, 1976 and Eisa et al., 1985). The reason may also be the overcrowding of fish in ponds or deteriorating water quality due to low temperature as suggested by Sarig, (1968a) that the intensification of fish culture creates disease problems that originate from overcrowdings. Dujin, (1973) reported deteriorating water quality such as unsuitable water temperature is a reason for trichodiniiasis. Dogiel (1961a) also reported that trichodiniiasis is caused by Trichodina sp.; the infection being stimulated by the high density of fish in ponds as reported by Hossain et al. (2008) that, during winter when the water quality deteriorates due to decrease of the temperature and dissolved oxygen level the Trichodina sp infestation was more because high stocking density increases the chance of ectoparasitic transmission from fish to fish easily.

Prevalence of Chilodonella sp in Exotic Carps: The PFI of Chilodonella sp. in Hypothalmichthys molitrix were highest during December and January (PFI: 28.00% and 26.08%). The occurrence of these parasites in Cyprinus carpio reached to the peak during December (PFI: 32.00%) and were reached to the lowest in the month of May and June (PFI: 8.69% and 5.00%). In case of Ctenopharyngodon idella also the parasite was found highest in the month of December (PFI: 45%) and lowest in the month of June (PFI: 11.11%). These were mostly found in the skin of the fishes. It was revealed that the prevalence of Chilodonella sp in all the aforesaid fishes were highest in winter and lowest in summer (Table. 1, 2, & 3).

Chilodonellas seem to be of a great ecological adaptability, proliferating both in cold and warm water. Under these conditions which favour their proliferation, Chilodonellas may cover the body surface in a contiguous layer. Shulman (1957) reported that all the members of genus Chilodonella are mostly free living and two serious pathogenic species infecting freshwater fish. According to Paperna et al. (1983) Chilodonella sp., are a frequent occurrence in overwintering stocks of cultured tilapia hybrids in Israel, and O. mossambicus in ponds and dam reservoirs in southern Africa which corroborated with the present findings. Low water temperatures being more optimal for reproduction of Chilodonella piscicola and massive infections with Chilodonella sp occur in low (12–17°C) ambient temperatures in southern Africa and Israel (Bauer et al., 1969) which also supports the present findings. Epidioocites caused by C. hexasticha in Australia occurred during the winter months and the optimum temperature for C. cyprini is 5-10°C (Hoffman et al. 1979) which also corroborated the aforesaid findings.
### TABLE 1: Seasonal abundance of parasites (PFI, %) in silver carp (*H. molitrix*) from July 2010 to June 2011.

<table>
<thead>
<tr>
<th>Period</th>
<th>Total no of fish examined</th>
<th>Trichodina sp No. &amp; PFI (%)</th>
<th>Chilodonella sp No. &amp; PFI (%)</th>
<th>Trichinella sp No. &amp; PFI (%)</th>
<th>Hexanthocaphala sp No. &amp; PFI (%)</th>
<th>Nematode No. &amp; PFI (%)</th>
<th>Epistyli sp No. &amp; PFI (%)</th>
<th>Zootamnnum sp No. &amp; PFI (%)</th>
<th>Vorticella sp No. &amp; PFI (%)</th>
<th>Developmental stages of eggs/parasites</th>
<th>Unidentified parasites PFI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monsoon (Jul-Oct)</td>
<td>89</td>
<td>20</td>
<td>22.47b</td>
<td>12</td>
<td>13.48b</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>33.7a</td>
<td>4</td>
</tr>
<tr>
<td>Winter (Nov-Feb)</td>
<td>92</td>
<td>38</td>
<td>41.3c</td>
<td>22</td>
<td>23.91c</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>19.56b</td>
<td>32</td>
</tr>
<tr>
<td>Summer (Mar-Jun)</td>
<td>72</td>
<td>12</td>
<td>6.66b</td>
<td>8</td>
<td>11.11b</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>15.27b</td>
<td>10</td>
</tr>
</tbody>
</table>

PFI=Parasitic Frequency Index (%). a=rare (0.1 – 9.9%); b=occasional (10 – 29.9%); c = common (30 – 69.9%); d = abundant (70 – 100%)

### TABLE 2: Seasonal abundance of parasites (PFI, %) in common carp (*C. carpio*) from July 2010 to June 2011.

<table>
<thead>
<tr>
<th>Period</th>
<th>Total no of fish examined</th>
<th>Trichodina sp No. &amp; PFI (%)</th>
<th>Chilodonella sp No. &amp; PFI (%)</th>
<th>Trichinella sp No. &amp; PFI (%)</th>
<th>Hexanthocaphala sp No. &amp; PFI (%)</th>
<th>Nematode No. &amp; PFI (%)</th>
<th>Epistyli sp No. &amp; PFI (%)</th>
<th>Zootamnnum sp No. &amp; PFI (%)</th>
<th>Vorticella sp No. &amp; PFI (%)</th>
<th>Developmental stages of eggs/parasites</th>
<th>Unidentified parasites PFI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monsoon (Jul-Oct)</td>
<td>83</td>
<td>25</td>
<td>38.12b</td>
<td>17</td>
<td>21.48b</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>37</td>
<td>44.57b</td>
<td>4</td>
</tr>
<tr>
<td>Winter (Nov-Feb)</td>
<td>91</td>
<td>53</td>
<td>58.24c</td>
<td>26</td>
<td>28.57b</td>
<td>3</td>
<td>3.29a</td>
<td>0</td>
<td>26</td>
<td>28.57b</td>
<td>26</td>
</tr>
<tr>
<td>Summer (Mar-Jun)</td>
<td>81</td>
<td>20</td>
<td>24.69b</td>
<td>10</td>
<td>12.34b</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>23.45b</td>
<td>6</td>
</tr>
</tbody>
</table>

PFI=Parasitic Frequency Index (%). a=rare (0.1 – 9.9%); b=occasional (10 – 29.9%); c = common (30 – 69.9%); d = abundant (70 – 100%)
The probable reason for the highest availability of Childodonella sp in winter may be due to the low temperature which supports their reproduction. Hoffman, (1978) reported that a number of ciliates are facultative parasites, or opportunists which will colonise fish in special circumstances, most often when fish are stressed or traumatised. Epizootics caused by these ciliates are relatively uncommon, unless hosts are stressed by poor conditions or crowding. So we can say that as the fishes were in stressed condition during winter the occurrence of Childodonella sp were more in winter. Overcrowding during winter was also one of the reasons for stress in fishes and lead to higher prevalence of Childodonella sp. During winter the water volume of fish habitat become reduced and the parameters deteriorates leading to suffocation due to lack of O2 in water, which may also be the another reason for highest prevalence of Childodonella sp in winter.

**Prevalence of Trichinella sp in Exotic Carps:** The Trichinella sp were not found in Hypothalmichthys molitrix during the study period. In Cyprinus carpio, Trichinella sp was found exclusively in the month of December and January, but in the rest of the months this species was not found. This was found mostly in the gills and skin of the fishes. In case of Ctenopharyngodon idella also these parasites were absent throughout the study period (Table. 1, 2, &3).

In Sakon Nakhon (place) fish were infected with the infective stage of Trichinella sp. Among these, cyprinid fish were in the majority. The infection rate in these fishes ranged from 10 to 90%, with the highest rate in Pseudorasbora parva with a metacercarial density of 160/fish (Rim, 1997). In 1982-1983, the prevalence were still high, varying from 7- 38%. The reservoir of these parasites includes domestic and wild animals (Min, 1982). The probable reason for the availability of these parasites during winter may be due to the stress of the fishes. In winter the immune activity of the fishes slows down because of low temperature which may be responsible for the occurrence of these parasites. The environmental condition may be conducive for the prevalence of the parasites during winter.

**Prevalence of Acanthocephalan sp in Exotic Carps:** The prevalence of acanthocephalans were more during the summer season (March-April). The PFI of Acanthocephalan sp in Ctenopharyngodon idella was highest during March (22.72%) and April (19.04%). This was found mostly in the gills and skin of the fishes. However, they were not found in Hypothalmichthys molitrix and Cyprinus carpio during the study period (Table. 1, 2, &3).

The results of the present study was in agreement with that of Tweb and Ahmed (1981) who reported that the prevalence of Acanthocephalans was found more in summer. The seasonal fluctuation of Acanthocephalans is mainly influenced by the changes in the feeding habits of the host (Awachie, 1966). Tweb and Ahmed; (1981), also suggested that the prevalence of Acanthocephalans in summer may be due to their breeding season, as gravid female and juveniles were also available in that season. According to George and Nadakal, (1973), first intermediate hosts of piscine Acanthocephalan are amphipods, isopods, copepods or ostracods. So we can say that the higher prevalence of Acanthocephalans during summer may be due to the availability of intermediate hosts.

**Prevalence of Nematodes in Exotic Carps:** Nematodes prevalence were more in intestine and body cavity of the fishes of Cyprinus carpio and Ctenopharyngodon idella compared to Hypothalmichthys molitrix. These were dominant in monsoon season than the winter and summer. In Hypothalmichthys molitrix Nematode infestation was highest in July (PFI: 42.85%) and lowest in April (PFI: 5.55%). In case of Cyprinus carpio highest prevalence was observed in July (PFI: 52.17%) and lowest in April (PFI: 11.11%), while in Ctenopharyngodon idella Nematodes were found highest during July (PFI:44.00%) and lowest during April (PFI:14.28%),(Table. 1, 2, &3).

The results of the present study satisfied all the criteria as reported by Pennyuick (1971). Pennyuick, (1971) and Kim et al., (2001) reported that seasonal distribution of nematodes may be related to the fluctuation in temperature, presence of intermediate hosts and feeding habits of the hosts. Tweb and Ahmed (1981), reported that nematodes were common helminth parasites of freshwater fishes. The results of present study showed that nematode occurrence was more in monsoon than summer and winter. The probable reasons behind this may be due to the environmental condition which was conducive to these parasites, presence of first intermediate hosts (copepod) and host specificity nature of the parasites.

**Prevalence of Epistylis sp in Exotic Carps:** Epistylis sp were found only in Hypothalmichthys molitrix during the months of December (12.00%), January (8.69%) and February (4.76%) on the skin and gills of the fishes, but they were absent in all the other months. So the observation revealed that the occurrences of these parasites was found only in the winter season. Epistyles sp was not found in Cyprinus carpio and Ctenopharyngodon idella during the study period (Table. 1, 2, &3).

In Europe, a few studies have noted the presence of species of Epistylis on warm water fishes (Kahl 1935 and Lom 1966). Rogers (1971), who found these parasites in pond
TABLE 3: Seasonal abundance of parasites (PFI, %) in grass carp (C. idella) from July 2010 to June 2011.

<table>
<thead>
<tr>
<th>Season</th>
<th>Chilodonella sp</th>
<th>Epistylis sp</th>
<th>Stichodactyla sp</th>
<th>Stichodactyla sp a</th>
<th>Nematode</th>
<th>unidentified parasite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fall</td>
<td>20</td>
<td>10</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Summer</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Spring</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Prevalence of Epistylis sp in Exotic Carps:** Epistylis sp were often an ectocommensal in that it simply attaches to the fish and feeds on environmental debris such as bacteria. Poor quality water encourages the growth of Epistylis on fish. The colonies of the Epistylis sp cause lesions (“red sore”) at the attachment site to the fish skin; these inflamed haemorrhagic lesions were also contaminated with the bacterium *Aeromonas hydrophila*.

During winter the water qualities of the pond deteriorates due to lack of oxygen which may be the reason for the occurrence of Epistylis sp in winter. The infestation of these parasites was more during winter season due to the availability of feed which agreed with the works of Durborrow, (2003).

**Prevalence of Zoothamnium sp in Exotic Carps:** Zoothamnium sp were found in *Hypophthalmichthys molitrix* during the months of November (4.34%), December (16.00%) and January (8.69%) though they were absent in the rest of the months. These parasites were not found in *Cyprinus carpio* during the study period. In case of *Ctenopharyngodon idella* these parasites were observed in the months of December (20.00%) January (14.28%) and February (5.00%) while they were absent in rest of the months. They were found in gills and skin of the fishes. The observations revealed that these parasites were found only in the winter and absent in other seasons (Table. 1, 2, & 3).

Mohan (2007) reported that ectoparasitic protozoans such as Zoothamnium sp were often associated with mortalities of younger stages of cultured fish. The situation becomes worst in waters with low oxygen and high organic matter as most of these have simple and direct life cycle enabling them to multiply rapidly in such conditions, which supports the present findings as less oxygen and deteriorated water quality, may be the probable reason for the prevalence of these parasites during winter.

**Prevalence of Vorticella sp in Exotic Carps:** Vorticella sp were absent in *Hypophthalmichthys molitrix* during the entire study period. These parasites were found in *Cyprinus carpio* only in the months of December (8.00%) and January (11.11%) while absent in other months. In *Ctenopharyngodon idella* these parasites were also observed during the months of December (15.00%) and January (9.52%) exclusively though absent in rest of the months. They were found in gills and skin of the fishes. The observation revealed that these parasites were found exclusively in winter but not in the other seasons (Table. 1, 2, & 3).

Scheubel (1973) reported that sessilinite peritrichs (i.e.; *Vorticella*) found in fishes were ectocommensals that use their hosts as a living substrate to settle where they gain access
to a convenient source of food particles - organic debris and water-born bacteria. They are specifically adapted to the life on the surface of certain species of fishes. Migala and Kazubski, (1972), suggested that a great number of Vorticellids teemed on the skin of debilitated, moribund fish which lacking any defence reaction under adverse environmental conditions. These ciliates prey on the body surface of the fishes and feed on the tissues. The probable reason for the occurrence of Vorticella sp during winter in fishes may be due to adverse environmental condition or due to reduce immunity of the fishes as concluded from the aforesaid findings.

Prevalence of developmental stages of eggs/parasites in Exotic Carps: Developmental stages of eggs / parasites were observed in the gills, skin and intestine of the three carps in all the months except May, June, September, October and November. In Hypophthalmichthys molitrix the highest prevalence were found in the month of December (52.00%) and January (47.82%). In case of Cyprinus carpio the highest prevalence were recorded 44.00% in the month of December. In Ctenopharyngodon idella the highest prevalence were 35.00% in the month of December. All these observations revealed that the prevalence of these group of parasites were highest in winter followed by summer and monsoon in all the three exotic carps (Table. 1, 2, &3).

Low temperatures being more confusing for reproduction of Chilodonella piscicola and some trichodinids (Bauer et al., 1969) which supports the present findings. The probable reason for the availability of developmental stages more in winter may be due to the delaying of developmental process at low temperature as suggested by Schaperclaus, 1954, at a temperature of 15–17°C, the process of division of developmental stages of Ichthyothirius sp is lengthened. Davidov, (1978), found that temperatures below 15°C will delay development of Asian tapeworm to 6–8 months which also supports the findings of Schaperclaus, (1954). Hoffman, (1980), reported that low temperatures seem to delay or even interrupt development and consequently completion of the life cycle of tapeworms. At 28–30°C, 77% of the eggs hatched in the first day after release, the remainder during the following five days, where as at 14–15°C, the incubation period extended to 10–28 days and was for all practical purposes interrupted below 12°C which may also be the reason for the availability of developmental stages of eggs more in winter.

Prevalence of parasites (Unidentified) in Exotic Carps: Some parasites were observed (unidentified) in Hypophthalmichthys molitrix in most of the months except September, October, February, April and May. The highest prevalence were found in December (24.00%). In case of Cyprinus carpio the highest prevalence were 24.00% in the month of December and these parasites were absent during the months of September, October, November, March and April. In Ctenopharyngodon idella the highest prevalence were found in the month of December(25.00%) and these parasites were not found in the months of August, September, October, November, March, May and June. The overall observations revealed the prevalence of these in gills, skin as well as intestine of the fishes and the highest occurrence of unidentified parasites were in winter in all the three varieties of fishes(Table. 1, 2, &3).

Ahmed et al. (1991) observed that the prevalence of diseases were more in the winter every year which corroborated the present findings. Dogiel (1961b) suggested 15 factors, which directly influence the parasitic fauna of fish. These factors include age, diet and abundance of fish, independence of the numbers of parasitic fauna within the fish and season etc. Wisheiwski (1958) stated that the character of water body influences and determines the parasitic fauna of its community. The probable reason for the availability of these parasites more in winter may be due to the unfavourable water condition for fishes.

Distribution of parasites in different seasons: In the present study most of the parasites showed a definite seasonal cycle of prevalence. The parasitic infection is greatly influenced by the season, which basically interferes with ecology and physiology of the fish. Several possibilities exist which might account for the seasonal fluctuation in the prevalence of parasitic infection. Seasonality related to hosts feeding habit, immunological alterations, availability of infected intermediate hosts, hormonal changes, and temperature are the most frequent causes suggested for seasonal fluctuation in prevalence and abundance of parasitic infections (Hynes, 1950; Chappell, 1969 and Pennyduck, 1971), (Table. 1, 2, &3).

Seasonal fluctuation in parasites of the present study may be due to the temperature changes, availability of intermediate hosts and host’s feeding habits which corroborated with the above findings.

Statistical analysis for seasonal distribution of parasites: The statistical analysis revealed that the winter was the most favorable season for the occurrence of the parasites. The prevalence of parasites in winter season vary significantly (P<0.01, df=2) with summer and monsoon season but there was no significant differences (P>0.01, df=2) in the prevalence pattern of the parasites during summer and monsoon. (Table. 4)
REFERENCES

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**TABLE 4:** ANOVA for occurrence of parasites in different seasons

<table>
<thead>
<tr>
<th>Host</th>
<th>Source</th>
<th>sum of squares (SS)</th>
<th>Degree of freedom (df)</th>
<th>Mean sum of squares (MS)</th>
<th>F-calculated</th>
<th>P value</th>
</tr>
</thead>
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<td><em>Hypophthalmichthys molitrix</em></td>
<td></td>
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<tr>
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<td>Error</td>
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<tr>
<td><em>Ctenopharyngodon idella</em></td>
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*P<0.05, **P<0.01*


