

Diversity and Seasonal Incidence of Zooplankton with Physico-Chemical Properties of Thongjaolok Stream of Bishnupur District Manipur, North East India

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ABSTRACT

Biodiversity on the earth consist of innumerable of distinct biological species. The present paper reports on zooplankton diversity from the Thongjaolok stream, a partially subterranean stream located in the Bishnupur District at Manipur, North East India. The stream lies in the intersection of 24° 30"N and 93° 45"E. Due to the prime importance of zooplankton in fish culture, their role in recycling process of natural resources and degrade the waste materials for fish culture has to be investigated. Zooplankton diversity and physico-chemical parameters are important factors to evaluate the quality of a fresh water body. In order to study the status of Thongjaolok Stream, water samples and zooplankton samples were collected from Thongjaolok Stream during 2012-2014 subjected to analysis. A total of 31 species of zooplankton viz., Rotifera, Cladocera and Copepoda were recorded from the investigation. Among zooplankton, Rotifera were the dominant group represented by 22 species belonging to 6 genera and 5 families, cladocera represented by 9 species belonging to 5 genera and 5 families and copepoda of 3 species; 3 genera and 2 families respectively. Physico chemical parameters were also studied in detail and correlated with the zooplankton occurrence and abundance.

Key words: Fish feed, zooplankton, water quality, partially subterranean stream, Thongjaolok, Manipur.

Mathematics Subject Classification: 92B99

Journal of Economic Literature (JEL) Classification: Q22

1. INTRODUCTION

The Thongjaolok stream is located in the Bishnupur District of Manipur, North East India, is a freshwater hill stream originating from the western hill ranges and falling into the Loktak Lake. The river lies in the intersection of 24° 30"N-24° 45'N and 93° 45"E- 93° 47"E. During the rainy season,

the current is torrential. During lean months, the stream exists as an underground current beneath the rocky as well as sandy bed. The stream also serves a very important source of potable water for the local people.

The zooplankton are floating animal communities of aquatic ecosystem. They are natural fish food organisms, considered as one of the most important linkage in aquatic food chain. Based on the importance of zooplankton in fish culture and direct relationship in their survival, growth and productivity, the zooplankton status from the water body is to be highly concerned.

They assist in recycling natural resources, to degrade the waste materials for fish culture, to decompose toxic substances such as nitrate as well as ammonium pesticides and herbicides, to establish biogeochemical cycle, to organize the food chain and food web in aquatic systems (Nasar and Munshi, 1975; Murugan *et al.*, 1998; Dadhick and Sexena, 1999; Sinha and Islam, 2002; Park and Shin, 2007). Zooplanktons represent different form of natural food resources, and established relationship among themselves through food web in an aquatic ecosystem.

These floating planktonic animal communities are generally represented by Rotifera, Cladocera and Copepoda. They are group of primary freshwater invertebrate whereas few groups belonging to minor phylum and micro-crustaceans (Wallace *et al.*, 2006; Michael and Sharma 1988). The species diversity, occurrence, abundance of zooplankton are greatly influenced by various physico chemical parameters of that aquatic ecosystem (Michael and Sharma, 1988). Various researchers worked on the structure on zooplankton community of different water bodies especially in floodplains (Robertson and Hardy, 1984; Bozelli, 1994) and river system (Sendacz, 1997; Lansac-Toha *et al.*, 2004; Bonecker *et al.*, 2005).

Detailed systematic approach on freshwater zooplanktons of India was work out by Tonapi (1980). Review, systematic account as well as distributive ecology of zooplankton in tropical freshwater bodies were studied by Dussart *et al.*, (1984). Study on Seasonal diversity of zooplankton community was carried out by Patil and Auti (2005) in Salim Ali Lake of Aurangabad and observed a characteristic pattern specific to water bodies of urban environment. The diversity of zooplankton of Kashmir and West Bengal were reported by Khan (1987, 2003). Seasonal fluctuation of zooplankton with the prevailing physico-chemical characteristics of river Ramjan in Kishanganj, Bihar were studied in detail by Pandey, *et al.*, 2004. Studies on the diversity of zooplankton in different parts of north east India were carried out by Sharma (2009a, 2009b), Sharma and Sharma (2000, 2008, and 2011). The morphological peculiarities and high richness of zooplankton have been investigated in many freshwater ecosystems Kar and Barbhuiya (2004) and Kar, (2007; 2013 and 2015). Similarly, studies in the zooplankton and their relation to physico-chemical characteristics of the water bodies of Manipur were reported by Bimola *et al.*, (2014a; 2014b and 2014c). In the present investigation, the diversity, occurrence and abundance of fish food organisms particularly zooplankton from Thongjaolok stream in relation with physico chemical parameter of the water were focused.

2. MATERIALS AND METHODS

The Studies were conducted in monthly intervals covering different seasons viz., Summer (March to June), Monsoon (July to October) and Winter (November to February) during September 2012 to August 2014 between 6 am. to 9 am from Thongjaolok stream maril, in Bishnupur district of Manipur. Collection of samples of surface water were done with glass BOD bottle for dissolved oxygen analysis and fixed in the field and surface water samples for analysis of other physico-chemical parameters were collected in 1L polypropylene containers and analysis was done as per (APHA, 2005). Plankton samples were collected using 55 micron mesh size plankton net by filtering 100L of running surface water and preserved in 4% formalin with a little amount of glycerine for further studies. The collection of plankton samples described by Edmondson (1959) and Battish (1992) were followed. Zooplankton were identified following Edmondson (1959), Battish (1992), Nogrady *et al.*, (1993), Segers (2008), Sharma and Sharma (2008).

Preserved samples were observed using Fisher-Scientific Micromaster Stereo zoom microscope for sorting and quantitative analysis of the collected zooplankton sample by Sedgwick Rafter Counting Cell and compound microscope Leica DM 1000 under 10x to 100x magnification for identification of zooplankton upto species level.

3. RESULT

A total of 31 species of zooplankton belonging to three classes viz., Rotifera, Cladocera and Copepoda were collected. Group wise as well as family wise distributions of zooplankton in different seasons are indicated in Table 1. Among zooplankton, rotifera were the dominant group represented by 22 species under 6 genera and 5 families, cladocera represented by 9 species belonging to 5 genera and 5 families and copepoda of 3 species; 3 genera and 2 families respectively. Month wise occurrence of zooplankton is presented in Figure 1. Maximum number of zooplankton occurred in January 2013 in the first year and in the month of April 2014 in the second year. During summer and winter due to hyper tropical condition, generally maximum occurrences of zooplankton were observed (Singh *et al.*, 2002). Among rotifera the family Brachionidae were highly diversified and registered maximum number of species compare to other family followed by Lecanidae, Euchlanidae, Mytilinidae, Epiphanidae and Testudinellidae. *Brachionus calyciflorus*, *B. falcatus*, *B. quadridentatus*, *B. ruben*, *Mytilina mucronata*, *M. ventralis*, *L. curvicornis*, *L. leontina*, *L. papuana*, *Daphnia*, *Bosmina longirostris*, *Neodiaptomus schmackeri* and *Mesocyclops species* were predominant during the study in Thongjaolok stream.

Table 1. List of species and their occurrence in various seasons of Thongjaolok stream

Group	Family	Name of the species	Summer	Monsoon	Winter
Rotifera	Brachionidae	<i>Brachionus angularis</i> Gosse, 1851	+	-	+
		<i>Brachionus bidentatus</i> Anderson, 1889	-	-	+
		<i>Brachionus calyciflorus</i> Pallas, 1766	+	+	+
		<i>Brachionus caudatus</i> (Ahlstrom, 1940)	-	-	+

		<i>Brachionus dimiatus</i> Bryce, 1931	-	-	+
		<i>Brachionus falcatus</i> Zacharias, 1898	+	+	+
		<i>Brachionus plicatilis</i> Muller, 1786	+	-	-
		<i>Brachionus quadridentatus</i> Hermann, 1783	+	+	+
		<i>Brachionus rubens</i> Ehrenberg, 1838	+	+	+
		<i>Brachionus urceolaris</i> Muller, 1773	-	-	+
		<i>Keratella tropica</i> (Apstein, 1907)	+	-	-
	Euchlanidae	<i>Euchlanis dilatata</i> Ehrenberg, 1832	-	-	+
		<i>Euchlanis meneta</i> Myers, 1930	+	-	-
	Mytilinidae	<i>Mytilina ventralis</i> (Ehrenberg, 1830)	+	+	-
		<i>Mytilina mucronata</i> Muller, 1773	-	+	+
	Epiphanidae	<i>Epiphanes brachionus</i> (Ehrenberg, 1837)	+	-	-
	Lecanidae	<i>Lecane curvicornis</i> (Murray, 1913)	-	+	+
		<i>Lecane leontina</i> (Turner, 1892)	+	+	-
		<i>Lecane papuana</i> (Murray, 1913)	+	+	+
		<i>Lecane (M.)bulla</i> (Gosse, 1851)	+	-	+
		<i>Lecane unguolata</i> (Gosse, 1887)	-	-	+
		<i>Lecane (M.)quadridentata</i> (Ehrenberg, 1830)	+	-	+
Cladocera	Daphnidae	<i>Daphnia</i> sp(O.F. Muller, 1785)	+	+	-
	Bosminidae	<i>Bosmina longirostris</i> (O.F. Muller, 1785)	+	+	-
	Moinidae	<i>Moina brachiata</i> (Jurine, 1820)	-	-	+
		<i>Moina macropa</i> (Straus,1820)	-	+	+
	Macrothricidae	<i>Grimaldina brazzai</i> (Richard, 1892)	-	+	-
	Chydoridae	<i>Chydorus sphaericus</i> (O.F.Muller, 1776)	-	+	-
Copepoda	Diaptomidae	<i>Neodiaptomus schmackeri</i> (Poppe& Richard, 1892)	+	+	+
	Cyclopidae	<i>Eucyclops agilis</i> (Koch, 1838)	-	+	-
		<i>Mesocyclops sp.</i> (G. O. Sars, 1914)	+	+	+

Correlation matrix among physico-chemical parameters and occurrence of zooplankton is shown in Table 2. It shows that with temperature, pH shows positive correlation. Dissolved oxygen (DO) ($r=.664$, $p<0.01$), Free carbon dioxide (FCO_2) ($r=-.664$, $p<0.01$), rotifer ($r=-.449$, $p<0.05$), cladocera ($r=-.583$, $p<0.01$) as well as copepoda showed negative correlation with TA. Whereas TA (Total alkalinity) ($r=.622$, $p<0.01$) showed positive correlation with temperature.

Table 2. Correlation matrix of Physico-Chemical parameters with occurrence of Zooplankton of Thongjaolok stream

	Temp	pH	DO	FCO_2	TA	ROT	CLA	COP
Temp	1	.148	-.605**	.605**	.622**	.778**	-.126	.048
pH		1	-.329	-.329	.296	.198	-.127	-.311
DO			1	1.00**	-.664**	.360	.491*	.391
FCO_2				1	-.664**	.360	.491*	.391

TA					1	-.449*	-.538**	-.058
ROT						1	.143	-.051
CLA							1	.094
COP								1
** . Correlation is significant at the 0.01 level (2-tailed). * . Correlation is significant at the 0.05 level (2-tailed).								

DO=Dissolved oxygen, FCO₂= Free Carbon dioxide, TA= Total Alkalinity, ROT= Rotifer, CLA= Cladocera, COP= Copepod

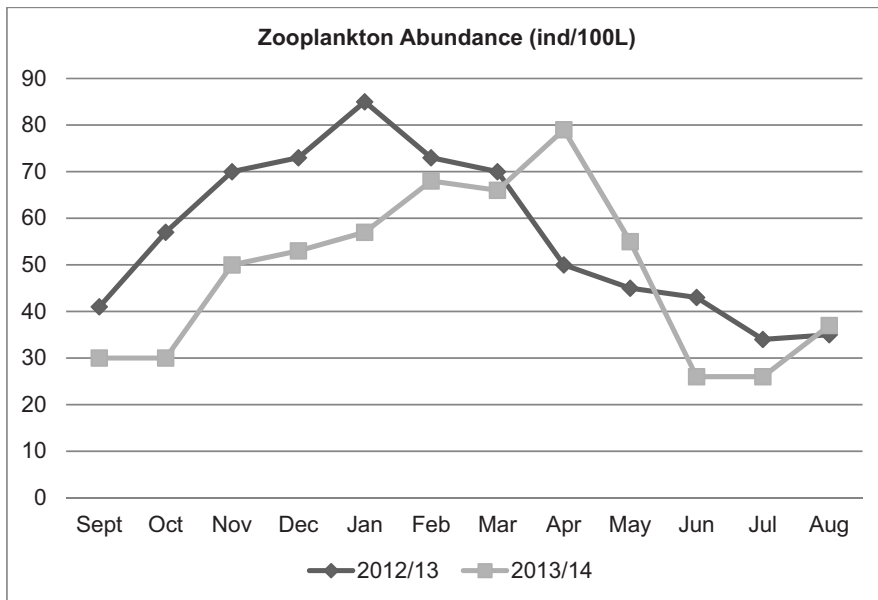


Figure 1. Monthwise occurrence of Zooplankton (individuals/100L) of Thongjaolok stream

Dissolved oxygen (DO), Free carbon dioxide (FCO₂) cladocera and copepoda showed negative correlation with pH whereas TA (Total alkalinity) ($r=.662$, $p<0.01$), rotifer ($r=.778$, $p<0.01$) and copepoda showed positive correlation with temperature. FCO₂ (Free carbon dioxide) ($r=1.00$, $p<0.01$), rotifer, copepoda and cladocera ($r=0.491$, $p<0.05$) showed positive correlation with Dissolved oxygen (DO) and only TA (Total alkalinity) showed negative correlation with dissolved oxygen. Cladocera ($r=.491$, $p<0.05$) showed positive correlation with FCO₂ (Free carbon), rotifer and copepod also showed positive correlation with FCO₂. The correlation matrix also showed that there is a positive correlation between the occurrence of cladocera and copepod. Relative abundance Zooplankton of Thongjaolok stream is shown in Figure 2, where *B. calyciflorus* showing highest relative abundance whereas *Chydorus sphaericus* shows least relative abundance.

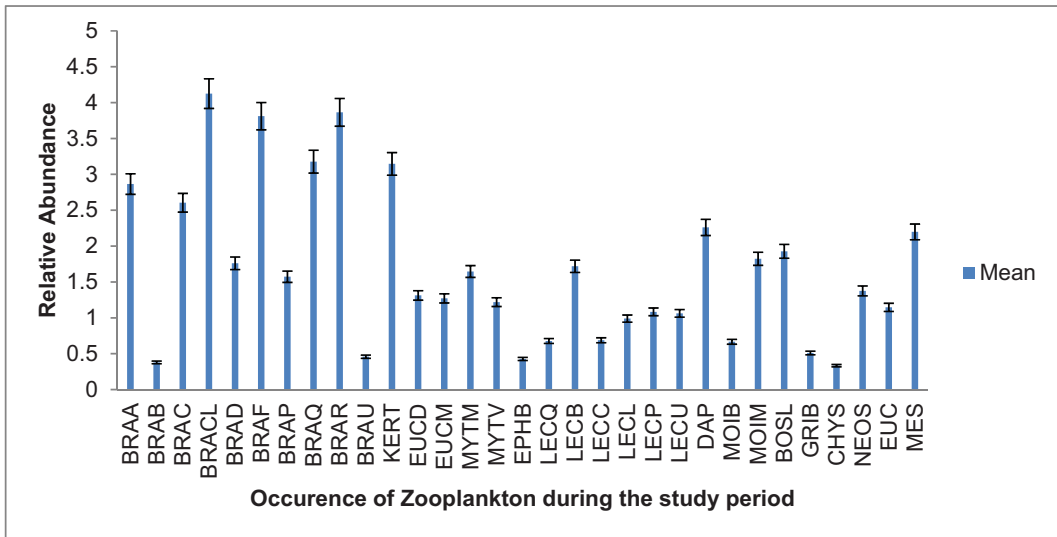


Figure 2. Relative Abundance of Zooplankton of Thongjaolokriver

BRAA= *Brachionus angularis*, BRAB= *B. bidentatus*, BRAC= *B. Caudatus*, BRACL= *B. calyciflorus*, BRAD= *B. dimiatus*, BRAF= *B. falcatus*, BRAP= *B. plicatilis*, BRAQ= *B. quadridentatus*, BRAR= *B. ruben*, BRAU= *B. urceolaris*, KERT= *Keratella tropica*, EUCD= *Euchlanis dilatata*, EUCM= *E. meneta*, MYTM= *Mytilina mucronata*, MYTV= *M. ventralis*, EPHB= *Epiphanes brachionus*, LECQ= *Lecane (M.) quadridentata*, LECB= *L.(M) bulla*, LECC= *L. curvicornis*, LECL= *L. leontina*, LECP= *L. papuana*, LECU= *L. unguata*, DAP= *Daphnia*, MOIB= *Moina brachiata*, MOIM= *M. macropa*, BOSL= *Bosmina longirostris*, GRIB= *Grimaldina brazzai*, CHYS= *Chydorus sphaericus*, NEOS= *Neodiaptomus schmackeri*, EUS= *Eucyclops agilis*, MES= *Mesocyclops sp.*

4. DISCUSSION AND CONCLUSION

The study site is a partially subterranean stream located in the Bishnupur District of Manipur, North East India and finally drains to Loktak lake. In this study site, *Brachionus* is the most abundant and most frequently occurred genera and such observation is generally occurred in the tropical environment (Nogueira, 2001, Mulani *et al.*, 2009). *Brachionus calyciflorus* occurred in all the collection during the study. Generally the maximum species richness of *Brachionus* in the river indicates the status of eutrophication (Sampaio *et al.*, 2002). From the periodical regular monitoring of the Thongjaolok stream, it is inferred that the water is polluted due to the contamination of various influences on the bank of the stream. The provided baseline information from the stream would be source to proceed with ancillary research towards the issue of pollution. Therefore there is a need of approach in terms of conservation strategies for sustainable utilisation of the water and the faunal composition of the stream.

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