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A comparative study on the occurrence, density, percentage composition and seasonal variations of cladoceran and copepod fauna in a wetland ecosystem of Tripura, India

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ABSTRACT

The present study makes a comparative record on the density and seasonal abundance of cladoceran and copepod fauna in a wetland ecosystem of Tripura during a period from March 2017 to February 2019. The present observation revealed the presence of 11 species of cladoceran fauna belonging to 7 genera and 5 families. Quantitative analysis during the study period revealed that Daphnidae is the dominant family with 4 species followed by Chydoridae with 3 species, Macrothricidae with 2 species while Moinidae and Sididae have only 1 species each , thus contributing 46%, 29%, 13%, 9% and 3 % respectively to the cladoceran fauna of the studied wetland under observation. The percentage composition of each cladoceran species in the studied wetland was also noted. On the contrary, the present observation also revealed the presence of 5 species of copepoda belonging to 4 genera and 2 families. Quantitative analysis during the study period revealed that Cyclopidae is the dominant family with 4 species followed by Diaptomidae with only 1 species, thus contributing 87%, and 13% respectively to the copepod fauna of the studied wetland under observation. The percentage composition of each copepod species in the studied wetland was also noted. Cladoceran population followed a definite rhythm of seasonal sucession showing maximum density in summer(217ind/L) and minimum in the monsoon(46ind/L).Similar trend of population density was also observed in copepod zooplankton where it exhibited its maximum density(126ind/L) in summer and minimum in monsoon(23 ind/L). Notable physico-chemical parameters of the studied wetland were also observed. The Pearson correlation(r) was made for the statistical interpretation of the physico-chemical parameters of water and crustacean zooplankton density in the studied wetland which presumed that not only a single factor but multiple factors govern over the seasonal abundance of cladoceran and copepod fauna in the studied wetland.

Key words: Cladoceran density, Copepod density, percentage composition, seasonal variations, physico-chemical factors, wetland ecosystem, Tripura.

INTRODUCTION

Zooplankton study is important as it could provide ways to predict the productivity of fresh water aquatic system (Ganesan et al., 2008; Verma et al., 2009). In deciphering trophic status and biomonitoring of aquatic habitats, zooplankters play a vital role (Wang et al., 2007). The qualitative and quantitative abundance of zooplankton in a water body are of great importance for successful aquaculture management, as they vary from one geographical location to another and from one water body to another water body within the same geographical location even within similar ecological conditions (Khan, 2003). Freshwater zooplankton is dominated by Protozoans, Rotifers and three subclass of the Crustacea viz., Cladocerans, Copepods and Ostracods. Rotifers, Copepods and Cladocerans are dominant groups in freshwater habitats than Ostracods. The dominance of zooplankton in shallow water bodies by rotifers, cladocera and copepods varies according to the degree of organic pollution (Bhat et al.2014).

Hence, zooplankton can speak to condition of water body and can be used to assess overall health of the aquatic ecosystem. Cladocerans are an especially important group among zooplankton and in healthy habituate where in external influences of pollution are absent or at least low, members of this group constitute a sizeable population (Muragan et al., 1998). The greater significance of cladocera in the aquatic food chain as they provide diet for zooplanktivorus fish (Venkataraman, 1999). They also control the algal growth by efficient grazing, therefore are considered as potential indicators of water quality (Pinto-Coelho et al., 2005). Copepods playing an important role as prey for many juvenile and adult zooplanktivorus fish (Shah et al., 2013) becoming a key factor in the control of fish stock sizes(Sommer et al., 2002). The occurrence as well as seasonal abundance of crustacean fauna in lentic water habitat may be attributed to varying biological features and species-specific food items (Chakrabarti, 2014; Sharma et al., 2017). Seasonal variation of crustacean assemblages in terms of density and diversity is largely determined by the interactions and the seasonal cycles of physico-chemical factors in the lentic ecosystem (Dejen et al., 2004; Datta, 2011**;** Kar et al., 2018). Temperature has been shown to be critical for the survival, growth and reproduction of cladocerans (Quadri and Yousuf, 1980), yet it is seldom recognised as an important influence on the body size or population dynamics of cladoceran communities (Yousuf and Qadri, 1983.). The physico-chemical parameters of water such as nutrient concentrations or oxygen conditions which often as a consequence of human activity in the catchment area, may often shape the abundance and richness of micro invertebrate communities in the lentic ecosystem(Dobson et al., 2010). Therefore, for understanding the seasonal dynamics of an organism, a population or a community, knowledge of both the organism and its environment is required (Vaidya and Yadav, 2008; Sharma et al, 2017). Wetlands are one of the productive aquatic ecosystem which support aquacultural biota with greater diversity and provide tremendous economic importance to mankind through fisheries potential (Verma et al., 2009). In Tripura, no in-depth studies were made on crustacean assemblages in wetland ecosystem till date. In the present comparative study, an attempt was undertaken to observe the density and seasonal dynamics of freshwater cladoceran and copepod fauna in a wetland ecosystem of Tripura, India.

MATERIALS AND METHODS

The present study was carried out in a freshwater wetland lacated at Melaghar (Latitude23^{0}50′15′′N) and Longitude 91^{0}15′45′′E), Sonamura Sub-Division, Sepahijala District of Tripura during a period of March 2017 to February 2019. The wetland is irregular shaped, the surface area of which is about 3.2 hectare. The mean depth of the wetland varied from 76 cm in winter to 168 cm in the monsoon. The wetland is communicated with one side with Gomoti River. The littoral zone of the wetland harbours some species of macrophytes such as *Eichhornia crassipes*. *Salvinia, Nelumbo, Lemna minor and Utricularia.* The crustacean zooplankton were collected by filtering 100 litre surface water through plankton net(mesh size 55um) and fixed immediately with 4% formalin. The planktonic organisms were analysed quantitatively in the laboratory under the microscope through Sedgwick Rafter plankton counting cell and the results were expressed as individual per litre (ind/L). Crustacean species of the studied wetland were identified following standard works of Pennak(1978), Battish(1992) and Edmondson(1992). To get a clear idea regarding the influence of physico-chemical factors of water on the occurrence as well as abundance of crustacean fauna in the studied wetland,

some physico-chemical factors (such as water temperature, pH and transparency) were determined in situ and the remaining parameters(such as dissolved oxygen, free carbon dioxide, alkalinity, chloride. ammonical nitrogen, nitrate nitrogen and phosphate phosphorus) have been analysed in the laboratory following the standard methods of APHA(2000). The Pearson's correlation coefficient(r) was made for the parametric relationship between the physico-chemical parameters of water and crustacean species density of the studied wetland.

RESULTS

The list of cladoceran species of the studied wetland was presented in Table 1. The list of copepod species of the studied wetland was presented in Table 2.

Table 1. List of cladoceran species in the studied wetland

1. *Ceriodaphnia cornuta*	5. *Alona verrucosa*	9. *Macrothrix goeldi*
2. *Ceriodaphnia reticulata*	6. *Alona rectangula*	10. *Moina micrura*
3. *Daphnia carinata*	7. *Chydorus sphaericus*	11. *Diphanosoma excisum*
4. *Daphnia similis*	8. *Macrothrix spinosa*	

Table 2. List of copepod species in the studied wetland

1. *Mesocyclops hyalinus*	3. *Paracyclops fimbritus*	5. *Heliodiaptomus* sp.
2. *Mesocyclops leuckarti*	4. *Trophocyclops prascinus*	

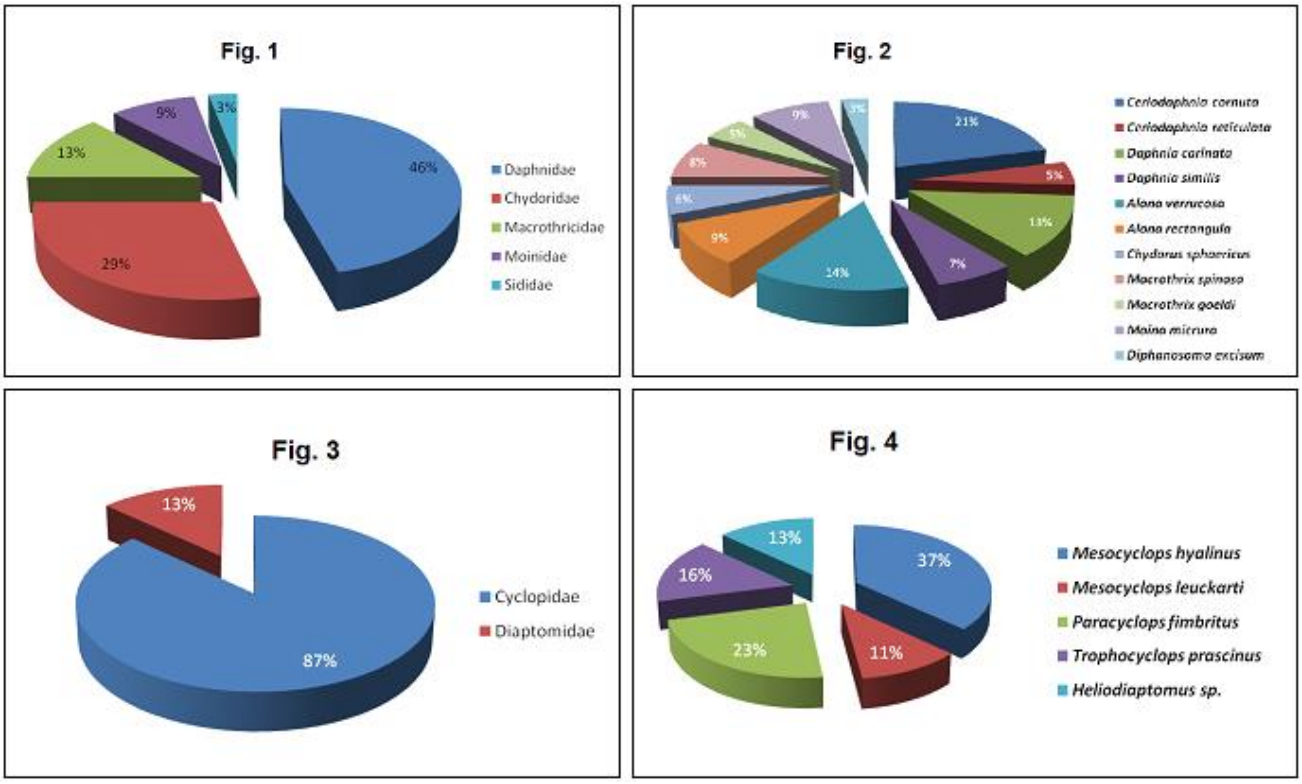

Figure 1: Percentage composition of different families of the cladoceran fauna in the studied wetland
Figure 2: Percentage composition of each species of the total cladocera population in the studied wetland
Figure 3: Percentage composition of different families of the copepod fauna in the studied wetland
Figure 4: Percentage composition of each species of the total copepod population in the studied wetland

The present observation revealed the presence of 11 species of cladocera belonging to 7 genera and 5 families. Quantitative analysis during the study period revealed that Daphnidae is the dominant family with 4 species followed by Chydoridae with 3 species, Macrothricidae with 2 species while Moinidae and

Sididae have only 1 species each , thus contributing 46%, 29%, 13%, 9% and 3% respectively to the cladoceran fauna of the studied wetland under observation (Figure 1).

The percentage composition of each cladoceran species in the studied wetland was also noted. The percentage composition of *Ceriodaphnia cornuta*, *Ceriodaphnia reticulata, Daphnia carinata and Daphnia similis under* the family Daphnidae were 21%, 5%, 13% and 7% respectively. The percentage composition of *Alona verrucosa, Alona rectangula* and *Chydorus sphaericus* under the family Chydoridae were 14%, 9% and 6% respectively. The percentage composition of *Macrothrix spinosa and Macrothrix goeldi* under the family Macrothricidae were 8% and 5% while the percentage composition of *Moina micrura* under the family Moinidae was 9% and the percentage composition of *Diphanosoma excisum* under the family Sididae was 3% (Figure 2).

The present observation revealed the presence of 5 species of copepoda belonging to 4 genera and 2 families. Quantitative analysis during the study period revealed that Cyclopidae is the dominant with 4 species followed by Diaptomidae with only 1 species, thus contributing 87%, and 13% respectively to the copepod fauna of the studied wetland under observation (Figure 3).

The percentage composition of each copepod species in the studied wetland was also noted. The percentage composition *of Mesocyclops hyalinus, Mesocyclops leuckarti, Paracyclops fimbritus* and *Trophocyclops prascinus* under the family Cyclopidae were 37%, 11%, 23% and 16% respectively. The percentage composition of *Heliodiaptomus* sp. under the family Diaptomidae was 13% (Figure 4).

Seasonal variation in the population density (mean density) of cladocerans of the studied wetland revealed that cladocera population depicted its maximum density (217 ind/L) in the summer while minimum density(46 ind/L) recorded in monsoon. Similar trend of population density was also observed in copepod zooplankton where it exhibited its maximum density (126 ind/L) in summer and minimum in monsoon (23 ind/L) (Figure 5).

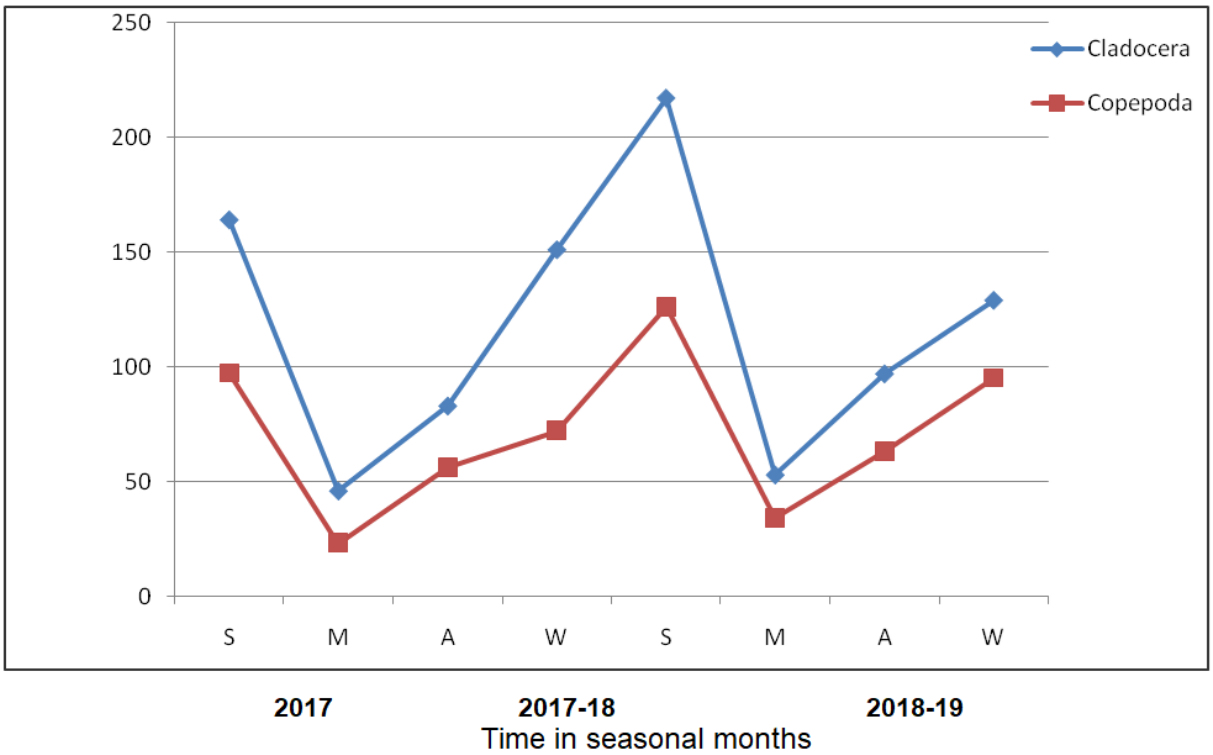

Figure 5. Seasonal variations in the mean density (ind/L) of cladoceran and copepod zooplankton in the studied wetland from March 2017 to February 2019

Table 3: Correlation of crustacean groups (cladocera and copepoda) with physico-chemical parameters of water in the studied wetland

Groups	WT	Transp	pH	DO	TA	CO_2	Cl	NH_4-N	NO_3-N	OP	TP
Cladocera	.769(*)	- .237	.781(**)	- . 223	- . 287	- 453(**)	-.253	-. 373(**)	-.215	-.513	-.259
Copepoda	.641(*)	.613	.663(**)	- . 157	-. 431(**)	. 379(*)	.061	-239	-653(*)	-.471	-.327

*: Correlation at 0.05 (2-tailed) **: Correlation at 0.01(2-tailed) Abbreviation: WT: Water temperature, Transp: Transparency, DO: Dissolved oxygen, TA: Total alkalinity, CO_2: Free carbon dioxide, Cl: Chloride, NH_4-N: Ammonical nitrogen, NO_3-N: Nitrate nitrogen, OP: Orthophosphate phosphorus, TP: Total phosphate phosphorus

The maximum population of Cladocera in summer may be attributed to favourable temperature and availability of food in the form of bacteria, nanoplankton and suspended detritus (Chakravarty, 1990; Neves, et al., 2003; Mohideen et al, 2008; Vaidya and Yadav, 2008; Bhat et al., .2014. Kar et al., 2018). In monsoon, factors like DO, water temperature and turbidity play an important role in controlling the density of Cladocerans **(**Krishnamoorthy et al., 2007; Dutta and Patra, 2013**;** Biswas and Panigrahi, 2015**)**. The present observation shows that cladoceran fauna are comparatively more abundant under the macrophytes than those of the exposed littoral areas in the studied wetland. Several researchers (Bozkurt and Guven, 2009**)** opined that the availability of the cladoceran fauna in higher numerical abundance around the macrophytes than those of the exposed littoral areas indicates that the periphery of macrophytes forms a suitable ecological niche condition for cladoceran population. Dejen et al. (2004) also opined that lower abundance of cladocera in the vegetation free area was due to sunlight factor. Copepod population also showed its maximum density in summer and minimum density in monsoon. Several researchers (Somani and Pejaver, 2004; Tripathi et al., 2006; Shah, et al., 2013) also observed higher numerical abundance of copepod population in summer. The density of crustacean zooplankton (cladocera and copepod) is governed by physico-chemical factors of water (Quadri and Yousuf, 1980; Shinde et al., 2012; Shah and Pandit, 2013, Shah et al.,. 2013; Sharma et al., 2017; Kar et al., 2018). In the present study, cladocera showed significant positive correlation with water temperature($r = 0.769$, $P<0.05$) and P^H ($r = 0.781$, $P<0.01$). However, this group showed negative correlation with the ammonia($r = -0.373$, $P<0.01$) and free carbon dioxide($r = -0.453$, $P<0.01$). On the contrary, copepod fauna showed positive correlation with water temperature($r = 0.641$, $P<0.05$) and P^H($r = 0.663$, $P<0.01$). However, this group exhibited negative correlation with free carbon dioxide($r = -0.379$ $P<0.05$), total alkalinity($r = -0.431$, $P<0.01$) and nitrate nitrogen($r = -0.653$, $P<0.05$) (Table 3).

CONCLUSION

Thus the present observation infers that different crustacean groups (cladocera and copepoda) although have different environmental requirements, many of them co-exist in the same water mass, their abundance may vary with seasons due to the dynamic nature of the aquatic ecosystem and might be also due to optimal condition in the physico-chemical parameters of the lentic ecosystem.

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