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Diversity and density of cladoceran population in different types of water bodies of Ludhiana, Punjab (India)

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Abstract

The present study was conducted to record the diversity and density of cladoceran population during the year 2015. Water samples were collected from different types of water bodies viz; village ponds, fish ponds and paddy fields of Ludhiana, Punjab (India). Identification of cladocerans was done on the basis of morphological features and their enumeration with the help of Sedgewick-Rafter counting chamber (S-R cell). Out of the recorded nine species of cladocerans, six were found to belong to family Daphnidae, two to family Moinidae and only one to family Chydoridae. Average percent composition of cladocerans in village ponds showed the distribution pattern with predominance of Daphnidae (51.01%) > Moinidae (48.27%) > Chydoridae (0.68%). In fish ponds Moinidae family was found to be predominant (62.95%) > Daphnidae (34.61%) > chydoridae (1.29%). Paddy fields were represented by Moinidae family only.

Keywords: Cladocerans, density, diversity, water bodies

1. Introduction

Among aquatic biota, freshwater zooplankton community comprises of protozoans, rotifers, cladocerans, copepods and ostracods. Out of these, cladocera is an ancient group of palaeozoic origin [6] and found in almost all kind of aquatic habitats. Cladocerans are tiny aquatic crustaceans and popularly known as "water fleas." They vary in size from 0.2 to 6 mm. About 600 species of fresh water cladocerans have been reported to occur throughout the world [9] and in India 110 species have been recorded so far [14]. Besides acting as major source of natural food for fish and shellfish, they also play an important role in recycling nutrients as well as cycling energy within their respective environments. They are highly responsive against pollutants and can even react to very low concentration of contaminants [5]. Thus, the abundance of zooplankton in a water body is regarded as an indicator of productivity. Both the qualitative and quantitative abundance of zooplankton in a fish pond are of great importance in managing the successful aquaculture operations, as they vary from location to location and pond to pond within the same location and even within similar ecological conditions [2]. These water fleas are important components of the fauna of fresh waters and are particularly significant in the food web of stagnant waters thus, play a critical role in the aquatic biotope [6]. Cladocerans are also found to be promising candidates as for mosquito control, as they reduce the size of larval mosquito population through suppressing both mosquito oviposition and larval development [4] [11]. In view of the fact that no published report on cladoceran community in different types of water bodies of Ludhiana (Punjab) is available. The present study was therefore, aimed to ascertain cladoceran diversity and its abundance in different types of local water bodies.

2. Materials and Methods

Monitoring of water bodies was carried out at monthly intervals from January to December during the year 2015. Three different types of water bodies i.e. fish ponds at Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Atta village ponds located at 35 kms away from Ludhiana city and paddy fields of Punjab Agricultural University and adjoining Ludhiana city of Punjab (India) were selected to record the diversity and population abundance of cladocerans. Water samples were collected during morning hours between 8 to 10 a.m. by using zooplankton net having mesh size 60 µm. Water was sieved from 3 sites/location (approx. 10L/site) through zooplankton net. Filtered zooplankton were fixed and preserved in

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5ml of 5% formalin. For counting cladoceran population, sample was concentrated upto 30 ml by keeping it overnight. Their number was counted manually with Sedgewick Rafter Counting cell under binocular light microscope by taking 1 ml of concentrated sample in three replicates ^[19]. Cladocerans were identified on the basis of morphological features following the identification keys given by Battish, Karen and Michael ^[1, 8, 12]. Cladocerans density was calculated by using the formula:

$$\text{Number of cladocerans /ml} = \frac{C \times 1000}{A \times D \times F}$$

Where, C= Number of cladocerans counted

A= Area of field (1.369mm²)

D = Depth (1mm), F = Number of fields observed

$$\text{Number of cladocerans/L} = \frac{M \times v}{V}$$

Where, M = Number of cladocerans/ml,

v = Volume of concentrated sample

V= Volume of filtered water

Collected data was analysed using average and percentage of overall population density recorded from three different types of water bodies of Ludhiana district.

3. Results and Discussion

3.1 Diversity of cladocerans

The population of cladocerans collected from the water samples of selected water bodies like village ponds, fish ponds and paddy fields indicated the presence of nine species belonging to three families i.e. Daphnidae, Moinidae and Chydoridae, which were identified on the basis of their morphological features (Tables 1, 2 and Fig 1, a-i). Out of these three types of water bodies, maximum diversity of cladocerans was observed at village ponds where all the nine species of cladocerans were present. In village ponds, Daphnidae family was having six species namely *Daphnia magna*, *Ceriodaphnia cornuta*, *Ceriodaphnia reticulata*, *Semiocephalus expinosus*, *Semiocephalus vetulooides*, *Scapholeberis kingi* and in Moinidae family two species viz. *Moina micrura* and *Moina macrocopa* were observed, while family chydoridae was represented by only one species i.e. *Chydorus sphaericus*. Similar study was conducted by researchers in Guntur pond (Tamilnadu), showed the predominance of Daphnidae family than Moinidae, Macrothricidae and Chydoridae family ^[11]. It was also reported that village pond was dominated by cladoceran species due to the presence of nutrient rich organic matter and favourable environmental conditions than fish pond ^[13]. Availability and quality of food resources in the aquatic ecosystem directly affects the phytoplankton abundance, induce distribution pattern of diverse zooplankton species ^[3]. In fish ponds a total of eight cladoceran species were found, here *D. magna* was not observed throughout the study period which might be due to predation by fish or variations in environmental conditions. Zooplankton communities are subjected to wide variations in environmental conditions in addition to fish predation ^[15], while in paddy fields only Moinidae family having *M. micrura* and *M. macrocopa* were observed (Table 1). Researchers have also studied that the dominant genus of cladocera was Moina and the population

density was found highest during mid-season which might be due to application of herbicides in paddy fields ^[20].

3.2 Density of cladocerans

Collection of water samples at monthly intervals from various standing water bodies was analysed for the determination of family and species composition of cladocerans and has been described location wise as:

a) Village ponds: In village ponds the predominant family of cladocerans was Daphnidae with an average annual composition of 51.1% followed by Moinidae 48.27% and Chydoridae with least composition i.e. only 0.68%. Species level composition of Daphnidae family was calculated out to be *S. kingi* (13.22%) > *S. vetulooides* (13.18%) > *C. reticulata* (11.30%) > *S. expinosus* (8.04%) > *C. cornuta* (2.65%) > *D. Magna* (2.62%). In Moinidae family the distribution of species was 26.35% of *M. micrura* followed by 21.29% of *M. macrocopa*. Chydoridae family was having only one type of species i.e. *C. sphaericus* with 0.68% density (Fig 2). It has been reported that the density and biomass of cladocerans is primarily determined by food supply ^[18]. In the present study similar observations were recorded, as the food supply in the form of phytoplankton was maximum in village ponds than fish ponds and paddy fields. It was also observed that water was very clean and pollution free in village ponds and there was no natural population of any kind of fish. Thus this might be the reason that maximum population of cladocerans was found in village ponds. In spite of this fact, it has also been reported that the presence of Daphnia species in ponds suggesting its eutrophic nature and playing a role as bioindicators of pollution ^[7].

b) Fish ponds: The predominant family of cladocerans in fish ponds was Moinidae with an annual average composition of 62.95% followed by Daphnidae 34.61% and Chydoridae 1.29%. Species level composition of Moinidae family was 33.08% of *M. micrura* and 29.06% of *M. macrocopa*. In Daphnidae family the species composition pattern was found to be *C. reticulata* (25.43%) > *S. kingi* (4.46%) > *S. vetulooides* (1.89%) > *S. expinosus* (1.39%) > *C. cornuta* (1.34%). Only one species i.e. *C. sphaericus* with 1.29 % density from chydoridae family was observed (Fig 3). *D. magna* was not observed in fish ponds throughout the study period. The presence of large number of predators and less food supply in the selected fish ponds may have resulted in considerable decline of *D. magna*. Zooplankton diversity and density also depends on the inter-specific predation by invertebrates ^[10].

c) Paddy fields: In paddy fields only one type of cladoceran family i.e. Moinidae was observed. Species level composition of Moinidae family was calculated out to be 52% of *M. micrura* and 48% of *M. macrocopa* (Fig 4). Cladocerans belonging to other families were not found in paddy fields throughout the study period. It may be due the reason that population density of different types of zooplankton varies considerably between locations, stages of crop development and sampling methods ^[16].

Table 1: Diversity of cladocerans in different types of standing water bodies in Ludhiana (Punjab).

Type of water bodies	Family		
	Daphnidae	Moinidae	Chydoridae
Village ponds	<i>Daphnia magna</i> <i>Ceriodaphnia cornuta</i> <i>Ceriodaphnia reticulata</i> <i>Semocephalus expinosus</i> <i>Semocephalus vetuloides</i> <i>Scapholeberis kingi</i>	<i>Moina macrocopa</i> <i>Moina micrura</i>	<i>Chydorus sphaericus</i>
Fish Ponds	<i>Ceriodaphnia cornuta</i> <i>Ceriodaphnia reticulata</i> <i>Semocephalus expinosus</i> <i>Semocephalus vetuloides</i> <i>Scapholeberis kingi</i>	<i>Moina macrocopa</i> <i>Moina micrura</i>	<i>Chydorus sphaericus</i>
Paddy fields	-	<i>Moina macrocopa</i> <i>Moina micrura</i>	-

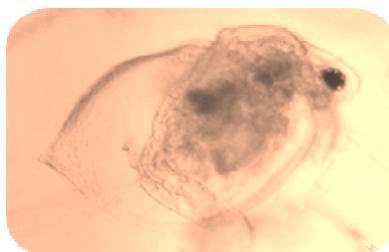
Table 2: Identification features of cladocerans collected from different types of standing water bodies in Ludhiana (Punjab).

Cladocerans	Carapace	Head	Rostrum	Eye	Ocellus	Apical spine
<i>D. magna</i>	Kidney shape	Compressed	Obtuse	Prominent	Present	Long
<i>C. cornuta</i>	Oval	Round	Pointed	Large	Absent	Very minute
<i>S. vetuloides</i>	Rhomboidal	Compressed	Reduced	Small	Elongated	Absent
<i>C. reticulata</i>	Subovate	Rounded	Absent	Large	Present	Absent
<i>S. kingi</i>	Oval-quadrangular (dark coloured)	Rounded	Short	Large	Small	Very minute
<i>S. expinosus</i>	Oval-sub rhomboidal	Small triangular	Small	Small	Small	Absent
<i>M. moina</i>	Absent	Round	Absent	Large	Absent	Absent
<i>M. macrocopa</i>	Absent	Round	Absent	Moderate	Absent	Absent
<i>C. sphaericus</i>	Ovate/spherical	Not distinct	Pointed	Small	Present	Absent

Family – Daphnidae



a) *Daphnia magna*



(b) *Ceriodaphnia cornuta*



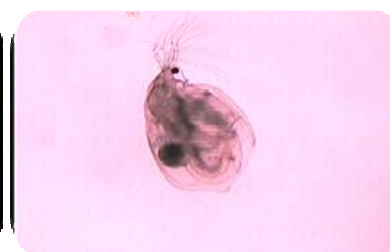
(c) *Semocephalus vetuloides*



(d) *Ceriodaphnia reticulata*



(e) *Scapholeberis kingi*

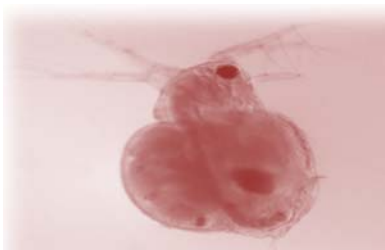


(f) *Semocephalus expinosus*

Family–Moinidae



(g) *Moina micrura*



(h) *Moina macrocopa*

Family – Chydoridae



(i) *Chydorus sphaericus*

Fig 1: Different species of cladocerans (a-i) collected from standing water bodies of Ludhiana (4x).

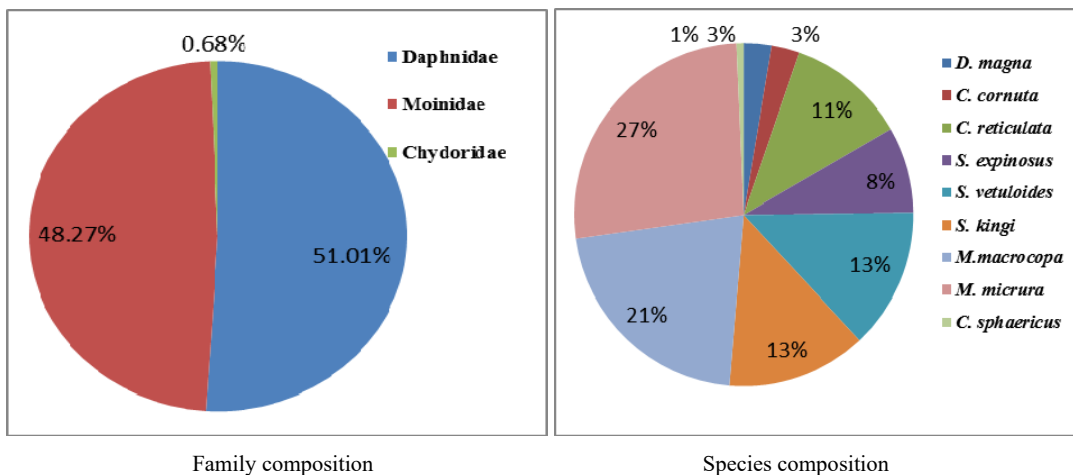


Fig 2: Percent composition of cladocerans (families and species) in village ponds.

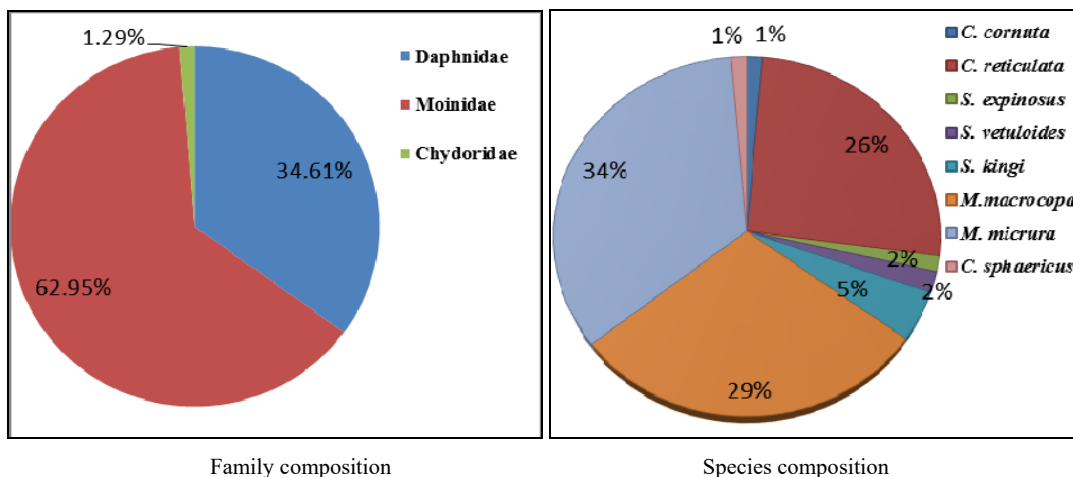


Fig 3: Percent composition of cladocerans (families and species) in fish ponds

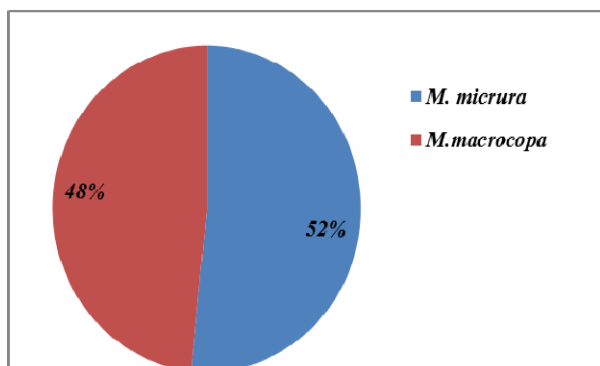


Fig 4: Species composition of cladocerans in paddy fields.

4. Conclusion

The results obtained during the present study demonstrated that village ponds of Ludhiana, Punjab (India) supported maximum diversity and density of cladoceran population than other types of water bodies i.e. fish ponds and paddy fields. This might be due to the favourable environmental conditions, availability of food and absence of natural predators of cladocerans.

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