Journal of Environmental Biology
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May 2008, 29(3) 353-356 (2008)
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Study of zooplankton emergence pattern and resting egg diversity of recently dried waterbodies in North Maharashtra Region

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(Received: November 05, 2005; Revised received: September 15, 2006; Re-revised received: December 21, 2006; Accepted: January 10, 2007)

Abstract: *Seasonal patterns of temperature, pH, conductivity, dissolved oxygen, phosphate and sulphate have been studied on the basis of physico-chemical characteristics of pond ecosystem. Importance of soil egg banks and their contribution to the diversity in freshwater ecosystem has been studied. We have focussed our attention on soil egg bank diversity and zooplankton emergence patterns of some recently dried aquatic habitats, comparing to that of neighbouring temporary pools with the permanent ponds. The emergence pattern from the soil egg bank followed an orderly succession from Protists-Rotifers and Crustaceans have been investigated. Dominant Protists emerged from the egg bank were Lacrymaria within rotifers. They were the first to emerge followed by Hexarthra blooms. The diversity of zooplankton in permanent ponds was significantly higher (i.e. 19) than the diversity in the ephemeral pools (i.e. 08). However, the zooplankton abundance in the ephemeral pools was higher with more than an order of magnitude, than that in ponds. Interestingly the number of species recorded in the egg bank was more than those present in the water columns of the pools. We have recorded 08 species of rotifera i .e. Lecane sp L. curvicornis, L. bulla, K. quadrata, B. patulus, B. rubens, Branchionus calyciflorus, Testudinella sp which were not present in the neighboring permanent or ephemeral waterbodies during that period. Unequivocally suggest that in order to understand the zooplankton biodiversity; it is also important to evaluate the diversity of egg bank present in the sediment. A total 19 species were recorded including Copepoda 06 sp***,*** *Cladocera 05 sp and Rotifera 08 sp.*

Key words: *Egg bank, Zooplankton, Zooplankton diversity, Pond ecosystem*
PDF of full length paper is available with author ***(*srt118@yahoo.co.in)***

Introduction

North Maharashtra is a temperate region; temporary aquatic habitats contribute to overall diversity of the ecosystem and plays an important role in the economy of the region together with the permanent waterbodies. In recent years, the abundance and ecological importance of these ephemeral waterbodies have drawn attention of scientists in the management of aquatic ecosystem through out the world (Williams, 1987; Zacharias *et al.,* 2007). During the drying up phase, many aquatic organisms produce resting egg or stages hence leaving an egg bank, which would emerge when environmental conditions became favorable again (Ramkumar and Prasad, 2004). Habitat destruction is a primary threat to invertebrates. Many temporary aquatic habitats face temporal distribution in geographic isolation. The implication is that historical losses of temporary aquatic habitats may place some species at high extinction risk, specially, if there is little opportunity for colonization and genetic exchange between habitats. Hence, keeping in view the conservation biology of aquatic organism, the study of such habitats is essential. The present investigation was undertaken to see the soil eggs bank diversity and zooplankton emergence patterns of some recently dried aquatic habitats and compare it to that of neighboring temporary pools and the permanent ponds. This investigation is a new step to develop comparative approach with diverse systems.

Materials and Methods

Physico-chemical parameters of wetland studies of river Girna was carried out during March to May 2005. For this purpose two ephemerical ponds and two permanent ponds (Table 1) in the neighboring areas were selected adjacent to north Maharashtra University and Bhambori village of river Girna in Jalgaon district, Maharashtra as a part of this study. At the time of drying phase of imperial water bodies, plankton samples were collected and water quality parameters were analyzed from each sampling site. Samples were analyzed from March to May 2005 at the time interval of one month (permanent and temporary). The plankton samples preserved in the field and were analyzed in the laboratory. Species identification was done with the help of the key of Michel and Sharma (1988). Species diversity for the plankton was estimated using Shannon-weaver Index (Krebs, 2000). Physico-chemical parameters such as temperature, pH, nitrate (NO_3-N), phosphate, chloride level *etc.,* were measured using standard methods (APHA, 2005).

As per egg bank experiment is concerned, a quadrate of size (10x10x10 cm) was used to take 3 replicates of the soil samples from pond/temporary pools that had just dried in the Bhambori village adjoining the temporary pools with water selected for our study. The soils were brought to the lab, air dried and homogenized before being set up for hatching experiments. 100 g of soil from each sample was taken and submerged (~5 cm water depth was maintained using autoclaved tap water) in 250 ml beaker. All experimental beakers were placed in a BOD incubator at a set temperature of 25 ± 1.5^{o} C for sediment eggs to hatch. The zooplankton merging from the sediment was filtered using a 35 um nytex sieve and observed under a stereomicroscope. The emergence of the zooplankton species was recorded daily until asymptote was reached.

Table - 1: Shows detailed general studies of wetland in river Girna

Sr. No.	Position / Pond no.	Perennial Pond 1	Perennial Pond 2	Perennial Pond 3	Temperate Pond 4	Temperate Pond 5	Temperate Pond 6
1	Water sources	Rain water	Rain water	Canal water	Canal and seepage	Rain / canal / seepage	Rain / canal/ seepage
2	Depth cm	150 ± 14	2.60 ± 36	85 ± 10	6.5 ± 3.2	4.5 ± 1.9	5.8 ± 1.6
3	Temp in air ^{0}C	32	32	30	33	32	30
4	Temp in water	28	28	29	28	29	29
5	pH	7.0	7.2	7.6	8.2	9.6	9.0
6	Conductivity	0.68	0.78	0.53	0.72	0.93	0.42
7	PO_4	0.05	4.6	2.4	1.8	1.2	0.8
8	NO_3	4.2	2.8	2.6	122.5	5.8	6.5
9	Cl	28.4	26.66	34.89	99.5	110	102.6
10	DO	8.0	7.6	6.5	7.5	6.0	7.8
11	TDS	465	655	385	840	1230	265

Note: All values are expressed in mg/l except depth, temperature and pH

Table - 2: Correlation coefficient values among physico-chemical parameters of different ponds from river Girna

Sr. no.	Parameter	N/P	Temp	pH	Conductivity	PO_4	NO_3	Cl	DO	TDS	Species
1	Temp.°C	-0.6309*	X								
2	pH	-0.3122	-0.987	X							
3	Conductivity	0.3515	-0.5082*	0.0741	X						
4	PO_4	-0.596	-0.0883	0.1534	0.1196	X					
5	NO_3	0.934	-0.7090	0.3345	-0.2329	-0.630	X				
6	Cl	0.533	-0.6818*	-0.3750	0.1299	0.516	0.789	X			
7	DO	-0.3609	-0.1294	0.0969	0.0956	0.489	-0.824	0.861	X		
8	TDS	0.1426	-0.0969	-0.9870	0.2212	0.363	-0.764	-0.920	-0.0538	X	
9	Species	0.738	0.5623	0.4669*	0.2719	-0.682	0.833	0.611	0.4408	0.124	X

Note: Tabular r = 0.444, significant at p<0.05% at df = 18 (n = 2), significant values

Results and Discussion

Monthly mean variations of certain physico-chemical characteristics are quoted in Table 1 shows variables in both perennial and ephemeral water bodies sample. In Table 2 the list of common and unique species of zooplanktons was recorded from the experimental water bodies.

A positive correlation was found between hydrogen concentrations and temperature with species diversity, beside temperature variation of ponds has a positive correlation with pH and dissolved oxygen contents. Neither diversity nor evenness significantly correlated with the phosphate values but a weak negative correlation was observed (Table 2) between the total zooplankton abundance and the phosphate level. Same trend was also observed in chloride level and pH values. The nitrate concentration in different ponds has a negative correlation with species diversity and dissolved oxygen contents. Electrical conductivity has a highly positive correlation with total dissolved solids in different ponds as shown in Table 2.

Table 3 lists the common and unique species of zooplankton recorded from the experimental water bodies. A total 19 species were recorded including Copepoda (06 sp) *Aspanchna*, *Brachinous, Keratella, Copepodite, M. aspericornis, Mesocyclops thermocyclopoides* Cladocera (05 sp) *Diaptomus, Cyclops, Daphnia carinata, Macrothrix laticornis, Monia micrura* and Rotifera (08 sp). *i .e. Lecane* sp *L. curvicornis, L. bulla, K. quadrata, B. patulus, B. rubens, Branchionus calyciflorus, Testudinella* sp. Total zooplankton abundance was significantly higher. Same type of result were also observed by Ramkumar and Prasad (2004).

Table 4 lists different species emerged from the sediment egg bank of the empherial waterbodies were significantly higher than recorded in the water column on the sampling day. The *Protista tetrahymena* and *Lacrymaria* were dominant for the initial 6 days of submergence and thereafter the evasive rotifer *Hexarthra* because the most dominant species emerged from the sediment.

Physico-chemical condition changed markedly and unpredictably in temporary habitats and organisms must cope with such fluctions as well as the transient habitat. For instance, higher chloride level, alkalinity and nitrate level in ephemeral waterbodies may be attributed to the excessive water evaporation and drastically reduced water level (Jana and Kandu, 1993) in temporary puddles. It is evident that the effect of prolonged drought observed earlier in similar to that of the phenomenon observed in the transient ponds

Table - 3: Occurrence of zooplankton species in wetlands *i.e.* 1,2 and 3= permanent ponds, 4,5 and 6= temporary ponds

Sr. no.	Species	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6
(I)	**Copepoda**						
1	*Aspanchna*	+	+	_	+	+	_
2	*Brachinous*	-	-	-	-	+	+
3	*Keratella*	+	-	+	+	+	-
4	*Copepodite*	+	-	-	-	-	-
5	*M. aspericornis*	+	+	-	-	-	+
6	*Mesocyclops thermocyclopoides*	+	+	-	-	-	-
(II)	**Cladocera**						
1	*Diaptomus*	-	-	+	-	-	-
2	*Cyclops*	-	-	-	-	-	-
3	*Daphnia carinata*	+	-	+	-	-	-
4	*Macrothrix laticornis*	-	-	+	-	-	-
5	*Monia micrura*	+	+	-	-	-	-
(III)	**Rotifera**						
1	*Lecane* sp	+	-	-	-	-	+
2	*L. curvicornis*	+	-	-	-	-	+
3	*L. bulla*	-	-	+	-	-	-
4	*K. quadrata*	+	+	+	+	-	+
5	*B. patulus*	+	-	+	+	+	-
6	*B. rubens*	+	-	+	-	-	-
7	*Branchionus calyciflorus*	+	+	+	-	-	-
8	*Testudinella* sp	+	+	-	-	-	-

Note: '+' = Indicates presence of species, '-' = Indicates absence of species

Table - 4: Species emergence pattern of zooplankton from the sediment collected at river Girna, Jalgaon

Sr. no.	Group	Species	Days											
			1	2	3	4	5	6	7	8	9	10	11	12
(I)	**Protista**													
1		*Euglena*	-	-	-	-	-	+	+	+	+	+	+	+
2		*Litonotus*	-	-	-	+	+	+	+	+	+	+	+	+
3		*Vorticella*	-	-	-	-	-	-	-	+	+	-	-	-
4		*Lacrymaria*	-	-	+	+	+	+	+	+	+	+	+	+
5		*Unidentified* (1)	-	+	+	+	+	-	+	+	-	-	-	-
6		*Unidentified* (2)	-	-	-	-	-	-	-	+	+	+	+	+
7		*Tetrahymena*	-	+	+	+	+	+	+	+	+	+	+	+
8		*Blepharisma*	-	-	+	+	+	-	+	-	+	-	-	-
(II)	**Rotifera**													
9		*B. rubens*	-	+	+	+	+	+	+	+	+	+	+	+
10		*Anuraeopsis*	-	+	+	+	-	-	+	-	-	-	-	-
11		*Hexarthra*	-	-	-	-	-	+	-	-	-	-	-	-
12		*Rotaria*	-	-	-	+	+	+	+	+	+	+	+	+
13		*Filinia opoliensis*	-	-	-	-	-	-	-	+	+	-	-	-
14		*Cephalodella*	-	-	-	-	-	+	+	+	+	+	+	+
15		*Brachionous angularis*	-	-	-	+	+	+	+	+	+	+	+	+
(III)	**Crustacea**													
16		*Ostracod*	-	-	-	-	-	+	+	+	+	+	+	+

Note: '+' = Indicates presence of species, '-' = Indicates absence of species

(Kelly *et al.,* 2000). Appreciably higher value of chlorides and nitrates clearly indicates the greater productive potential of these ephemeral ponds. The rotifer zooplankton, *Branchionus dimidiatus* was by far the most potential and adaptive in such extreme environmental conditions. The unique branchionid rotifer (*B. dimidiatus*) present in appreciably high densities in all three transient water bodies studied was not found in permanent ponds, which may be attributed to their adaptability to extreme physico-chemical conditions. Species composition can vary widely among nearby temporary aquatic habitats. (Schneider and Frost, 1996).

Resting eggs can occur in high densities in lakes and hatching is possible from egg population which may be even hundred of year old (Hariston *et al.*, 1995**)**. However, organisms inhabiting ephemeral aquatic habitats have been used as useful models for ecological interactions (Blaustein, 1997) but the focus of this study has been to understand the temporary aquatic habitats in general.

We thus predicted that the sediment of the drying pools might have the egg density comparable to the diversity in the neighboring permanent ponds. This prediction was confirmed in our egg bank hatching experiments and when the emergence and succession patterns of zooplankton were followed, we found that the sediment egg bank represents a greater diversity than that of recorded in the open water. Noticeably seven species of rotifers recorded in the egg bank, were not represented in the column of either permanent ephemeral ecosystem in that region during the sampling period. Ephemeral habitats availability delineates these habitats, sets their ecological boundaries and determined the unique adaptive nature of organism in response to the extreme conditions of temporary waters has long attracted attentions and remains to be an important part of research on the evolutionary ecology of temporary waters. It is further concluded that our present study convincingly suggests for the zooplankton diversity and the importance of ephemeral water bodies. The main objectives was to compare the zooplankton diversity emerged with that of ephemeral ponds which are subjected to episodic drying and the permanent ponds in the adjacent areas used for human and cattle bathing. It is necessary to evaluate the sediment and analyze its egg bank composition in addition to observing the live organisms present in the water-bodies. Further research that couples laboratory and field investigations is needed to understand fully the termination of dormancy in the field.

References

APHA.: Standard methods for the examination of water and wastewater. 21st Edn., Washington D.C. (2005).

Blaustein, L.: Non consumptive effects of larval salamandra on crustacean prey; can eggs detect predators. *Oecologia*, **110**, 212-217 (1997).

Destasio, B.T.: The role of dormancy and emergence patters in the dynamics of a freshwater zooplankton community. *Limnol. Oceno,* **35**, 1079-1090 (1990).

Hariston, N.G., R.A. Van Brunt, C.M. Kearns and D.R. Engstram: Age and survivorship of displacing eggs in a sediment egg bank. *Ecology,* **76**, 1706-1711 (1995).

Jana, B.B. and G. Kandu: Influence of prolonged summer on the limnology and chlorophyll a content of phytoplankton in two tropical fish ponds. *Arch. Hydrobiol.*, **4**, 507-532 (1993).

Kelly, R., J. Jack and M. Fant: A survey of the physico-chemical characteristics and the zooplankton communities in an ephemeral karst lake. *Aquatic. Ecol.*, **34**, 77-89 (2000).

Krebs, C.J.: Ecology: The experimental analysis of distribution and abundance. 5th Edn. Benjamin Cummings, C.A. USA. pp. 695 (2000).

Michel, R.G. and B.K. Sharma: Fauna of India: Indian Cladocera (*Crustaces: Brabehipoda: Cladocera*). *Ecol.,* **68**, 675-683 (1988).

Ramkumar and Priyanesh Prasad: Resting egg diversity and zooplankton emergence patterns from soil egg bank of recently dried waterbodies. *J. Ecol.,* **2**, 19-30 (2004).

Schneider, D.W. and T.M. Frost: Habitat duration and community structure in temporary ponds. *J. North Am. Benthol. Soc.*, **15**, 64-84 (1996).

Williams, D.D.: The Ecology of temporary waters. Timber press, Portland. p. 205 (1987).

Zacharias, Ierotheos, Elias Dimitriou, Angela Dekker and Edith Dorsman: Overview of temporary ponds in the Mediterranean region : Threats, management and conservation issues. *J. Environ. Biol.*, **28**, 1-9 (2007).