INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
Volume-3, Issue-1, Jan-Mar-2013 ISSN 2231-4490

Coden : IJPAES www.ijpaes.com

Received: 20th Dec-2012 *Revised: 29th Dec-2012* *Accepted: 30th Dec -2012*

Research article

IMPACT OF AQUATIC MACROPHYTES ON CRUSTACEAN ZOOPLANKTON POPULATION IN A VEGETATED POND AT ALIGARH, INDIA.

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ABSTRACT: A study on the Impact of aquatic macrophytes on crustacean zooplankton population in Chautal pond which is distinguished as macrophyte-dominated pond at Aligarh, India was carried out from May, 2010 to April, 2011.Of five aquatic macrophytes recorded, water hycinth *Ecchorina crassipes* (43.09 %) was the most dominant species followed by *Typha angustata* (26.02 %).The highest total number of crustacean zooplankton was recorded during June (247 No./L) while the highest macrophytes abundance was recorded during July (48 No/m^2). Among three crustacean groups recorded, Cladocera constituted the highest percentage (54 %) and the highest number of species (13 species). The lowest crustacean zooplankton numbers were recorded during August, 2010 being 67 No./L .This might be attributed to the impact of the macrophyte which recorded the highest abundance during the same months being 48 No/m^2. The highest negative correlation was recorded between macrophytes *E. crassipes* and the ostracods *Cyìpris* sp. (-0.77) while the highest positive correlation was recorded between the macrophytes *Polygonum* sp. and the cladocerans *Chydorus spherics* (0.77).
Key words: Aquatic Macrophytes, Crustacea, Cladocera, Copepoda, Ostracoda.

INTRODUCTION

Aquatic plants beds are important fish spawning and nursery areas and provide cover for many species. Microorganisms living on the plant material form a food base for macro invertebrates which in turn support other lake dwelling species through a diverse food web. It provides shelter to many organisms, protection from grazers, habitat for breeding, nesting for birds etc. They are having a higher economic and commercial importance for food, fodder, fiber, medicine, insecticides, fertilizers etc. In spite of having a number of utilities, they are sometimes weed in many aquatic systems causing troubles for fishing, recreation, navigation etc. Aquatic macrophytes are a fundamental element of aquatic ecosystems [3, 6, 34] and provide habitats for several key components of sub arctic food webs [7, 11]. They integrate environmental conditions for a longer time [26]. Aquatic plants are often an integral component of aquatic ecosystems and can be of ecological importance since they represents the major structural component of littoral habitat, acting as shelter, nesting and feeding grounds for a wide variety of micro organism, fish and water fowl [20]. The nature of these plant communities has been shown to affects light, temperature, turbulence water and sediment chemistry, and the abundance and composition of other biotic assemblages from epiphytes to phytoplankton [21].The abundance of native plant communities typically maintain a balance within the ecosystem encouraging the success of these communities as well as the success of the other species of varying trophic levels that interact with it. Macrophytes have different types of relationship with other organisms viz; Symbiosis, Parasitisims, Commensalisms etc. Crustaceans of freshwater ecosystems play an important role in the aquatic food web. They contribute to a high reduction of the phytoplankton biomass since the majority of them are filter feeders and hence they may in this way greatly improve the water quality. Crustaceans are able to consume great quantities of phytoplankton from the open water zone thereby influencing the primary production [19, 32]. Among a multiplicity of factors which influence crustacean community structure in shallow dominated lakes the architecture of a plant habitat plays a very important role [6]. It is supposed that in natural ecosystems significant interaction effects may occur between plant and crustacean species.

The level of predation upon herbivorous prey may often depend more upon plant architecture than on the particular species of natural enemies present or the physical-chemical features within a plant habitat. Plant architecture provides zooplankton with varying protective conditions whose effectiveness reflects the great heterogeneity of the macrophyte substratum [12, 15]. Since dense and complex vegetation of more complicated build and with dissected stem patterns (like *Chara tomentosa*) more effectively prevents the access of large fish than sparse and morphologically simplified vegetation like *Typha angustifolia* (Blindow *et al.*, 2000). Nowadays there is increasing agreement among researchers that biotic factors are more likely to be responsible for short-term variation in plankton populations. It was in this back drop that present work was under taken to study the impact of aquatic macrophytes on crustacean zooplankton population in a vegetated pond (Chautal pond) at Aligarh.

MATERIAL AND METHODS

Study Area

Present study was under taken on Chautal pond. It is also a perennial sewage fed, eutrophic pond situated at distance of 1.5 km from department of Zoology in north -west of Aligarh Muslim University campus. The pond is triangular with irregular shoreline. The depth of the pond varies from 0.5 to 2.5 meters at different place. The main source of its water supply is sewage water from adjoining residential areas in addition to surface run-off from surrounding catchment area. The surface of the pond is densely covered by the water hyacinth (*Ecchornia crassipes*) and other macrophytes.

Collection and analysis of samples

Chautal pond was surveyed on monthly basis from May, 2010 to April, 2011. Aquatic macrophytes were counted in ten randomly selected quadrants of area 1 x 1 m each and average no macrophytes in one quadrate. For Identification, macrophytes were hand picked from the pond and sorted out and taxa were identified with the help of literature published [29, 37, 23, 22, 10, 17, 27, 36]. For crustacean zooplankton about 30 liters of water sample was collected and filtered by passing through plankton net made up of bolting silk cloth having mesh size of 55 micrometer and concentrated sample (about 100 ml) was preserved in 5% formaldehyde solution for qualitative [13, 25, 31, 27] and quantitative analysis. Counting of crustacean taxa was done by putting 1 ml of the preserved sample on a Sedgwick-Rafter cell under an inverted microscope and results were expressed in No./L. Correlation coefficient matrix was established between the recorded macrophytes species and the crustacean zooplankton species by using SPSS software version 13.

RESULT AND DISCUSSION

A total of 27 crustacean zooplankton species were identified (13 cladocerans, 7 copepods and 7 ostracods – Table 2). Present study indicated that Ostracoda and Cladocera recorded high abundance in a vegetated water body while the copepods species recorded low density. The present study coincided with Bozkurt and Guven (2009) who stated that the abundance of Cladocera in the vegetated areas was higher than unvegetated areas and El-Enany (2009) who mentioned abundance of Copepoda due to the decreasing of eutrophication level.

Among all the aquatic macrophytes five were recorded to be abundant in the pond during the investigation period. The water hyacinth *Ecchorina crassipes* (43.09 %) were dominated followed by *Typha angustata* (26.02 %). *E. crassipes* was the only floating macrophytes species while *T. angustata*, *Polygonum* sp., *Rorripa* sp., *Nasturtium* sp. were emergent species. The absence of submerged macrophytes during study may be due to the effect of high organic matter and effect of sewage effluent in the pond. El- Serafy *et al.* (2007) found that the dominance of submerged macrophytes and absence of floating macrophytes in Lake Nasser (Egypt) was attributed to the good water quality and the absence of drains. The highest macrophytes abundance was recorded during July (48 No/m2) while the lowest was recorded during January (37 No/m2) (Table No1).

Table 1: Monthly variations of aquatic macrophytes (No/m^2) in Chautal pond during May, 2010 to April, 2011.

Macrophytes Months	*Ecchornia crassipes*	*Typha angustata*	*Polygonum* sp.	*Rorripa* sp.	*Nasturtium* sp.	Total
May 2010	7	11	21	4	0	43
June	10	29	4	1	0	44
July	11	15	6	5	11	48
August	19	12	6	0	7	44
September	22	9	0	0	9	40
October	21	16	0	0	3	40
November	31	8	0	0	0	39
December	22	16	0	0	0	38
January 2011	18	3	5	4	7	37
February	21	3	5	7	4	40
March	25	3	0	10	2	40
April 2011	14	3	0	20	2	39
Average	**18**	**11**	**4**	**4**	**5**	**41**
Percentage	**43.09**	**26.02**	**9.55**	**10.37**	**10.98**	**100**

The Ostracods genera *Canadona* and *Cypris* showed higher densities among crustacean plankton in the pond studied being 46 and 41 No./L respectively. *Diaphanosoma* sp., *Daphnia carinata, Daphnia magna, Daphnia pulex, Daphnia similis, Moina micura, Simocephalus vetulus, and Sida crystellina* were the cladoceran species recorded during the study while seven species for each Copepoda (*Cyclops* sp., *Diaptonus* sp, *Eucyclops, Mesocyclops* sp, *Metocyclops , Noto diaptomus, Thermo Cyclops*) and Ostracoda (*Canadona favelota, Canadona hylina, Cypris* sp, *Cypriodopsis* sp, *Cyrinotus scytoda, Eucypris, Heterocypris and Physocypria*) were recorded. Genus *Daphnia* recorded four species and was dominated by *D. carinata* during May (24 No./L) and March (21 No./L). It decreased during the rest of months while it was not recorded during July and August. Similar observation of two months peaks for *D. carinata* was recorded by [33]. Nevertheless, the highest number of crustacean zooplankton were recorded during June (247 No./L) and the lowest in August being 67 No./L. Abundance might be due to high temperature, which causes fast development and least abundance in monsoon i.e. August might be due to the dilution of water. Also, the wide variations in the density of crustacean zooplankton might be attributed to the effect of tropical climate. Lewis (1987) emphasized that tropical aquatic lakes are more unstable, because of the disturbance effect caused by the action of winds, with consequent abiotic changes in the water mass; changes that exercise a regulatory action on the number of species. In many studies [2, 22] high crustacean density was recorded in macrophytes dominated water bodies. Present observations also show crustacean population density coincidence with the macrophytes abundance (table 1 and 3) and it might be due to the pollution of water and decomposition of the plant leaves because of pond coverage by floating aquatic macrophytes.

Table 2: Abundance of crustacean zooplankton species (No/L) in Chautal Pond May, 2010 to April, 2011.

Months **Genera**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**
Cladocera												
Alona rectangular	0	0	5	8	0	0	5	9	0	0	0	11
Alonella sp.	6	7	5	2	5	8	0	2	0	2	2	5
Bosmina longirostris	18	7	18	16	12	13	0	4	15	12	0	0
Cerodaphnia corunata	11	28	4	5	6	3	2	0	2	18	6	12
Chydorus sphaericus	21	0	0	2	2	2	1	0	7	2	4	8
Diaphanosoma sp.	3	2	0	0	18	9	4	3	5	6	7	4
Daphnia carinata	24	5	0	0	8	6	4	3	4	2	21	12
Daphnia magna	16	11	2	2	28	4	4	12	2	1	11	42
Daphnia pulex	2	18	0	0	0	28	2	21	28	5	22	29
Daphnia similis	0	0	0	4	21	12	18	0	6	3	3	14
Moina micura	11	17	8	8	17	43	9	0	0	0	12	0
Simocephalus vetulus	3	2	5	7	3	2	1	0	13	22	5	4
Sida crystellina	2	2	0	0	0	0	0	0	0	0	0	0
Copepoda												
Cyclops sp.	0	0	0	0	7	2	0	0	0	0	0	0
Diaptonus sp	0	0	2	3	1	0	0	0	2	0	1	1
Eucyclops	0	4	0	0	0	2	1	1	6	3	2	1
Mesocyclops sp	0	11	5	2	0	2	1	1	12	0	0	0
Metocyclops	0	0	2	1	11	1	0	0	3	2	2	0
Noto diaptomus	13	17	5	2	1	0	0	7	19	6	2	21
Thermo Cyclops	2	2	2	0	22	12	23	9	0	10	8	0
Ostracoda												
Canadona favelota	46	51	10	2	0	3	1	0	0	0	0	15
Canadona hylina	23	0	0	0	5	7	2	1	19	0	0	15
Cypris sp	14	5	0	0	2	2	17	4	3	2	41	10
Cypriodopsis sp	2	2	2	0	0	2	1	2	11	5	21	4
Eucypris	2	2	1	0	0	2	2	22	21	13	8	2
Heterocypris	21	0	0	0	2	2	2	0	0	0	18	31
Physocypria	6	3	2	1	0	17	9	2	3	2	2	4

Correlation coefficient between the macrophytes species density and crustacean zooplankton species abundance was also worked out (Table 4) and it was found that crustaceans species are affected by macrophytes differently as highest negative correlation was recorded between macrophytes *E. crassipes* and the ostracods *Cyipris* sp. (-0.77), while the highest positive correlation was recorded between the macrophytes *Polygonum* sp. and the cladocerans *Chydorus sphearics* (0.77). However, total macrophytes recorded a negative correlation with all the recorded species except *Ceriodaphnia corunata*, *Moina micura* and *Cypris* sp. This indicated that these crustacean species can survive in high abundant macrophytes environment. The data of correlation revealed that, a significant positive correlations were recorded between the macrophytes *T. angustat* and the crustacean *Cypris* sp., the macrophytes *Polygonum* sp. And the crustacean *Chydorus sphaericus* and the macrophytes *Nasturtium* Sp. and the crustacean *Diaptomus* sp. being 0.64, 0.77 and 0.72 respectively.

Table 3: Monthly variations of crustacean zooplankton groups (No/L) in Chautal pond May, 2010 to April, 2011.

. Group	Month	M	J	J	A	S	O	N	D	J	F	M	A
Copepoda	No	117	99	47	54	120	130	50	54	82	73	93	141
	%	40	40	53	81	67	69	45	52	45	63	47	54
Cpoepoda	No	15	34	16	8	42	19	25	18	42	21	15	23
	%	5	14	18	12	24	10	23	17	23	18	8	9
Ostracoda	No	114	63	15	3	9	35	34	31	57	22	90	81
	%	39	26	17	4	5	19	31	30	31	19	45	31
Total	No	292	247	88	67	178	189	110	103	181	116	198	260
	%	100	100	100	100	100	100	100	100	100	100	100	100

M: May, J: June, J: July, A: August, S: September, O: October, N: November, D: December J: January, F: February, M: March, A: April, respectively.

Table 4: Correlation coefficient between the dominant macrophyte species and the abundant crustacean zooplankton species during the study.

Macrophytes *Crustacea	Total Macrophyte	*Echornia crassipes*	*Typha angustata*	*Polygonum* Sp.	*Rorripa* Sp.	*Nasturtium* Sp.
Bosmina longirostris	0.46	-0.49	0.23	0.61*	-0.46	0.56
Cerodaphnia corunata	0.21	-0.47	0.47	0.17	0.16	-0.43
Chydorus sphaericus	-0.11	-0.47	-0.26	0.77**	0.27	-0.35
Daphnia pulex	-0.52	-0.01	-0.10	-0.37	0.45	-0.30
Moina micura	0.08	0.10	0.53	-0.19	-0.48	-0.13
Total Cladocera	-0.36	-0.26	-0.01	-0.03	0.36	-0.33
Cyclops sp.	-0.17	0.22	0.02	-0.29	-0.32	0.39
Diaptomus sp.	0.25	-0.07	-0.18	-0.04	0.03	0.72*
Total Copepoda	-0.47	0.07	0.03	-0.29	-0.16	0.13
Cypris sp.	0.42	-0.77**	0.64*	0.60	-0.01	-0.50
Cypriodopsis sp.	-0.25	0.33	-0.33	-0.10	0.34	-0.51
Canadona favelota	-0.37	0.24	-0.47	-0.19	0.41	-0.12
Total Ostracoda	-0.20	-0.37	-0.11	0.41	0.49	-0.67*

* Correlation is Significant at the 0.05 level; ** correlation is Significant at the 0.01 level.

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