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Diversity and community structure of aquatic insects in a pond in Midnapore town, West Bengal, India

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Abstract: *In total 20 species of aquatic insects have been recorded from a weed infested pond. Odonata was numerically the most abundant group constituting of 54% of the total aquatic insects even though these belonged to three species. Coleoptera though constituted only 22% of aquatic insects had 10 species. Urothemis signata and Ranatra filiformes were eudominant and dominant species respectively. Hydrometra butlen is recorded from West Bengal for the first time. Five species of Hemiptera, Ranatra filiformes, Ranatra elongata, Diplonychus rusticus, Micronecta merope, Gerris nitida and Hydrometra butlen; three species of Odonata, Urothemis signata, Agriocnemis pygmoea and Enllagma parvum and one species of Coleoptera viz., Coplatus indicus have been recorded from Paschim Medinipore district for the first time. Species diversity and evenness indices fluctuated from month to month and from one sampling site to other being <1 suggest a stressed and disturbed environment.*

Key words: *Aquatic insects, Coleoptera, Hemiptera, Odonata*
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Introduction

All over the world about 45000 species of insects are known to inhabit diverse freshwater ecosystem (Balaram, 2005). These are involved in nutrient recycling and form an important component of natural food web in aquatic ecosystem. These also serve as reliable indicators of ecological characteristics of water. Insects with their abundance and diversity dominate fresh water ecosystem. However, the aquatic insect fauna of this part in India is rather poorly documented. Limited number of studies have been carried out on the ecological aspects of aquatic entomofauna. Some recent works are those by Sharma and Rai (1991), Sivaramakrishnan *et al.* (1995, 1996, 2000), Thirumalai (1999), Anbalagan *et al*. (2004), Subramanian and Sivaramakrishnan (2005), Anbalagan and Dinakaran (2006), Dinakaran and Anbalagan (2007). Aquatic insects of West Bengal has been investigated by Bhattacharya and Gupta (1991), Srivasatava and Sinha (1995), Bal and Basu (1994a,b), Biswas *et al*. (1995a,b), Biswas and Mukhopadhyay (1995), Choudhury and Chattopadhyay (1997), Bhattacharya (2000), Pal *et al.* (2000), Khan and Ghosh (2001), Saha *et al*. (2007). Although Pahari *et al.* (1997, 1999) have studied the taxonomic aspects of the aquatic Coleoptera in two wetlands in West Midnapore District, so far no work has been done on the quantitative ecology of the aquatic insects in this districts.

In the afore-mentioned context the present study was carried out with the objective to identify the commonly occurring insect fauna and workout their abundance, relative abundance, diversity, evenness and degree of similarity in a pond in Midnapore town.

Materials and Methods

The study site is situated in Midnapore town (22°27´N, 87°20´E), near Midnapore railway station. It is a man-made pond and locally known as Poultry Pukur. The area of the water body is 2.5 acre with maximum depth of 6 meter. The pond is infested with many aquatic weeds and is subjected to various anthropogenic interferences. The main macrophytes found in the water body are *Alterhennthera sessilis* Linn., *Eclipta alba* Hassk., *Monochoria hastate* Solms., *Scirpus articulatus* (Linn.), *Cyanotis axillaries* Roem and Sch., *Aeschynomene ampera* Linn., *Typha domingensis* Pers., *Hygrorryza aristata* Nees., *Hydrocotyla asiatica* Nees., *Hydrophylla difformis* L.f., *Utricularia stellaris* L.f., *Jussiaca repens* Linn., *Nymphaea nouchali* Burm. f., *Marsilea minta* Linn., *Nymphoides indica* (Linn.), *Eichhornia crassipes* (Mart.) Solms*, Commelina bengalensis* Linn., *Azolla* sp*., Hydrilla vercillata* Casp*., Vallisneria spiralis* Linn*., Chara* sp*., Nitella* sp*., Trapa* sp*., Salvinia* sp. and *Learsia* sp.

Insects were collected at monthly interval from October 2004 to March 2005 between 8.00 to 10.00 a.m. The collection were made by hauling of a dip net with a mesh size of 245 µm (Nylobolt PA, Deekay Nylobolt Industries (Pvt.) Ltd. Mumbai, India).

The area of the circular net was 4208.0 cm^2. Samples were taken from four sites at four corners of the pond *viz.,* A, B, C and D. Insects thus collected were preserved in 4% formaldehyde in specimen bottles.

For community structure analysis abundance, relative abundance, species diversity index and evenness index were

Table - 1: Dominance status of different species of aquatic insects in a pond of Midnapore town

	Number	Relative abundance (RA) %	Dominance status
Order – Odonata			
Family – Libellulidae			
Urothemis signata (Rambur)	219	50.00	Eudominant
Family – Coenagrionidae			
Enallagma parvum Selys	16	3.65	Subdominant
Agriocnemis pygmoea (Rambur)	3	0.68	Subrecedent
Order – Hemiptera			
Family – Nepidae			
Ranatra filiformes Fabricius	44	10.05	Dominant
Ranatra elongata Fabricius	2	0.46	Subrecedent
Laccotrephes ruber Linn.	19	4.34	Subdominant
Family – Belostomatidae			
Diplonychus rusticus (Fabricius)	28	6.39	Subdominant
Family – Gerridae			
Gerris nitida Mayr	1	0.23	Subrecedent
Family – Corixidae			
Micronecta merope Dist.	1	0.23	Subrecedent
Family – Hydrometridae			
Hydrometra butlen Hungesford and Evans	8	1.83	Recedent
Order-Coleoptera			
Family – Dytiscidae			
Cathydrus laetabilis (Walker)	17	3.88	Subdominant
Hydrovatus accuminatus Motschulsky	28	6.39	Subdominant
Hydrovatus confertus Sharp	6	1.37	Subrecedent
Hydrocoptus subvittulus Motschulsky	9	2.05	Recedent
Cybister convexsus Sharp	2	0.46	Subrecedent
Laccophilus parvulus d'Orchymont	1	0.23	Subrecedent
Coplatus indicus Sharp	19	4.34	Subdominant
Family – Hydrophilidae			
Helochares ancholaris Aube	8	1.83	Recedent
Berosus indicus Sharp	4	0.91	Subrecedent
Coelostoma subditum Motschulsky	3	0.68	Subrecedent

RA <1 = Subrecedent; 1.1-3.1 = Recedent; 3.2-10% Subdominant; 10.1-31.6 = Dominant and >31.7% = Eudominant

determined. Dominance status of various species were described on the basis of relative abundance following Engelmann's scale (Engelmann, 1973) as mentioned under Table 1. Species diversity index ($\bar{H}$) was estimated following Shannon and Wiener (1963) and Evenness index (e) was estimated following Pielou (1975). Coefficient of similarity was estimated following Bray and Curtis (1957) and degree of similarity or otherwise was inferred on the basis of following scale : <0.3 = strongly dissimilar, 0.3 - 0.4 = moderately dissimilar, 0.4 - 0.5 = slightly dissimilar, 0.5-0.6 = slightly similar, 0.6-0.7 = moderately similar and >0.7 = strongly similar.

Results and Discussion

In total 20 species of aquatic insects were recorded during the present study (Table 1). These belong to 3 orders - Coleoptera, Hemiptera and Odonata. Order Coleoptera had 10 species, Hemiptera had 7 species and Odonata only 3 species.

Not withstanding the least number of species Odonata was the most common group quantitatively representing 54% of the total aquatic insects in this pond. Hemiptera and Coleoptera were represented by 24 and 22% of the total aquatic insects respectively (Fig. 1). Unlike as in the present investigation where Odonata was the most common aquatic insect, Khan and Ghosh (2001) in West Bengal and Sharma and Rai (1991) in Bhagalpur, Bihar found Coleoptera to be the most common order quantitatively.

Insect of Dytiscidae and Hydrophylidae family comprised 85 and 15% of total Coleoptera (22%) respectively (Fig. 2). Such preponderance of Dytiscidae over Hydrophylidae indicates the

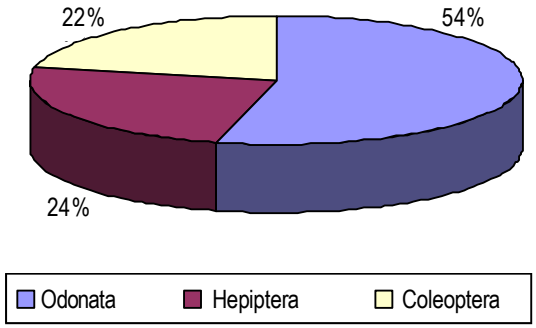

Fig. 1: Relative abundance of the orders of aquatic insect in a pond of Midnapore town

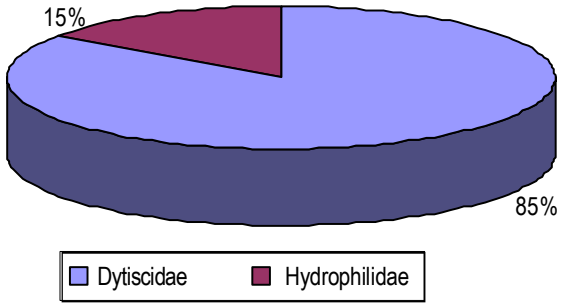

Fig. 2: Relative abundance of the families of order Coleoptera in a pond of Midnapore town

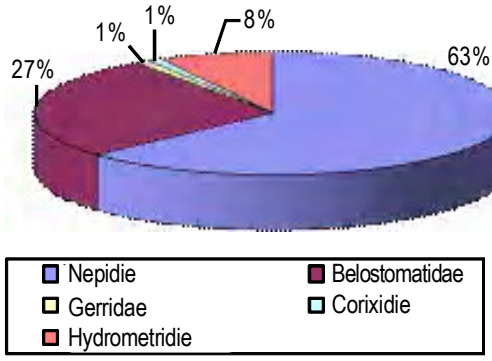

Fig. 3: Relative abundance of the families of order Hemiptera in a pond of Midnapore town

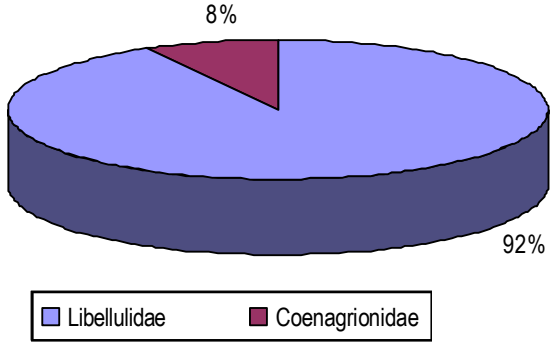

Fig. 4: Relative abundance of the families of order Odonata in a pond of Midnapore town

Table - 2: Monthly variation in number, species diversity and evenness indices in a pond of Midnapore town

	Oct	Nov	Dec	Jan.	Feb	Mar
Number of individuals	63	42	31	65	113	124
Number of species	10	9	4	14	12	14
Species diversity ($\overline{H}$)	0.80	0.72	0.22	0.75	0.62	0.95
Evenness index (e)	0.79	0.75	0.37	0.65	0.57	0.83

Table - 3: Species diversity and Evenness Indices of the sampling sites (A–D) in a pond of Midnapore town

	A	B	C	D
Species diversity ($\overline{H}$)	0.57	0.43	0.74	0.97
Evenness index (e)	0.57	0.51	0.72	0.80

Table - 4: Similarity test between sampling sites in a pond of Midnapore town

AB	AC	AD	BC	BD	CD
0.87 Strongly similar	0.49 Slightly dissimilar	0.33 Moderately dissimilar	0.51 Slightly similar	0.31 Moderately dissimilar	0.60 Slightly similar

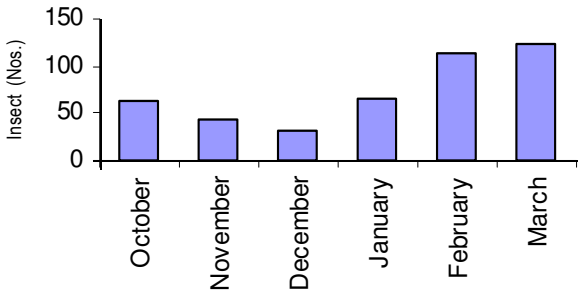

Fig. 5: Monthly variation in abundance of aquatic insects in a pond of Midnapore town

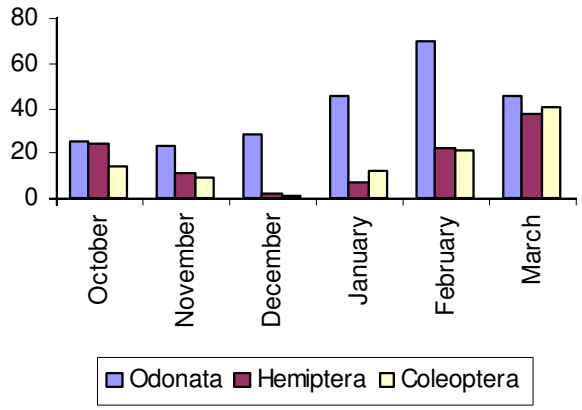

Fig. 6: Monthly variation in abundance of three orders in a pond of Midnapore town

ecological condition of aquatic body. Dytiscidae family generally inhabits leaf of bottom macrophytes of the clean freshwater and are predacious in nature. Hydrophylidae family on the contrary, are water scanvenger beetles and generally occur in shallower regions of the wetland with abundant macrophytes particularly emergent ones and feed mainly on detritus, algae and decaying vegetative matter (Khan and Ghosh, 2001).

Hemiptera was represented by 5 families *viz.,* Nepidae, Belostomatidae, Hydrometridae, Gerridae and Corixidae constituting 63, 27, 8, 1 and 1% of this order respectively (Fig. 3). Nepidae was numerically the most common family of Hemiptera. Family Hydrometridae which was represented by only one species *Hydrometra butlen* is being reported from West Bengal for the first time. This species prefers weed infested aquatic body.

Odonata was dominated by family Libellulidae (92%), the naid of which is mud dwelling. Family Coenagrionidae was represented by 8% only (Fig. 4). Nymphs of this family remain attached to macrophytes and are generally not collected during hauling.

Out of 20 species, only one species, *Urothemis signata* was eudominant and one species, *Ranatra filiformes* was dominant species. These species appear to be good exploiters of resource in weed infested aquatic system. There were six subdominant species *viz., Diplonychus rusticus, Hydrovatus accuminatus*, *Enallagma parvum*, *Laccotrephes ruber*, *Canthydrus laetablis*, *Coplatus indicus*, three recedent species *viz., Hydrometra butlen*, *Hydrocoptus subvittulus* and *Helochares ancholaris* and nine subrecedent species *viz., Hydrovatus confertus*, *Agriocnemis pygmoea*, *Ranatra elongata*, *Gerris nitida*, *Micronecta merope*, *Cybister convexsus*, *Berosus indicus*, *Coelostoma subditum* and *Laccophilus parvulus.*

Total number of aquatic insects declined from October to December and there after the number increased steadily till February (Fig. 5). However, similar trend could not be seen for number of species, species diversity and species evenness. Species diversity and evenness were lowest in December and highest in March (Table 2). In the present investigation, species diversity index was always less than one. Staub *et al.* (1970) proposed that $\overline{H}$ value < 1 indicates heavy pollution of water. High species diversity indicates that such community has their resources more finely distributed among individuals of many species (Smith, 1977). Diversity index can also be used to measure environmental stress (Mason, 1981). Iwasaki (1999); however, opined that environmental stability rather than spatial heterogeneity has greater influence on $\overline{H}$.

When species diversity and evenness of sampling sites were compared (Table 3) it was noted that these were maximum in Site D and minimum in Site B. Index of similarity (Table 4) revealed that Site A and B were strongly similar. Other sites were dissimilar in faunal composition. Minimum dissimilarity was between A and Site D. Lower species diversity in sites A and B as compared to sites C and D further support this contention. These sites (A and B) were used for washing automobiles and hence were more polluted and perturbed. This was also the reason why these two sites have strong faunal similarity. Species which are found in these sites are perhaps exploiter type of bioindicators which predominate in the polluted environment (Spellerberg, 1993).

The minimum and maximum number of insects (N/haul) were recorded in December and March respectively (Fig. 5). While Odonata were maximum in number in February and minimum in November. Hemiptera and Coleoptera were maximum in number in March and minimum in December (Fig. 6). The maximum number of individuals of insects in March and minimum number of individuals in December might be due to hibernation or retardation of development process due to low temperature or perhaps these keep themselves hidden within rotten weeds and mud and as such are difficult to collect by dip net. Increased predation and competition for space and lack of the availability of food during winter may also be the reason for numerical scarcity during December. Different groups, however, increase in number in different months for example Odonata in February and not in March. This indicates some sort of temporal niche separation. Profuse aquatic vegetation in this pond provide spatial heterogeneity which help in harbouring different species without severe competition in the form of ecological guild. So it may be concluded that, the water body under investigation was under stress and perturbed. In the present study, it was seen that both species diversity and evenness indices decreased when number of species was low but number of individuals was high as in February.

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