Zoology

COMMUNITY COMPOSITION AND SEASONAL DYNAMICS OF AQUATIC INSECTS IN A FRESHWATER LENTIC SYSTEM OF WEST BENGAL, INDIA

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ABSTRACT This study examines the composition and seasonal variation of aquatic insect communities in a selected aquatic habitat. A total of 23 aquatic insect species belonging to three orders—Coleoptera, Odonata, and Hemiptera—were recorded during the study period. Among these, Hemiptera was the most dominant order, accounting for 44% of the total insect population, followed by Odonata (32%) and Coleoptera (24%). Coleoptera was represented by the lowest number of species (six), distributed across two families, Dytiscidae (79%) and Hydrophilidae (21%). Odonata included eight species under three families, with Coenagrionidae being the most abundant (60%), followed by Libellulidae (34%) and Aeshnidae (6%). Hemiptera comprised nine species belonging to four families, where Belostomatidae (37%) and Nepidae (35%) showed higher dominance compared to Corixidae (16%) and Notonectidae (12%). Sixteen species were identified as subdominant, while seven species were categorized as recedent. Seasonal analysis indicated a decrease in total aquatic insect abundance from October to December, followed by a gradual increase up to February. In contrast, species richness, diversity, and evenness displayed a different pattern, with the lowest values observed in December 2022 and the highest in March 2023, along with a slight decline during February. Overall, the findings highlight the dominance of Hemiptera and emphasize the role of seasonal variation in shaping the structure of aquatic insect communities.

KEYWORDS : Aquatic insects;Community composition;Seasonal variation

Introduction :

Insects constitute about four-fifth of the world fauna and considered to be the most diverse and successful group of the animal kingdom. Quite a large number of insects spend for at least a part of their cycle, in water and are commonly considered as aquatic. At present, eleven insect orders are known to have such aquatic forms. Of these, only water bugs and water beetles inhabit the water throughout their lives, although they are dependent on surface air for respiration. The rest are truly amphibious and live in water only during their immature stages.

Insects are more prevalent in shallow water bodies because of their partial adaptation to aquatic life. As a principal group of pond fauna they constitute a significant part of the biota of aquatic community. Generally speaking, insects are desirable in pond farming as they form an important article of natural food of fishes and also serve as reliable indicator of ecological characteristics of water. But at the same time, prevalence in stocking ponds, especially in nurseries, is highly injurious. They, in general, act as competitors of young fishes for food and the predaceous ones among them cause heavy mortality to spawn and particularly the newly emerged hatchlings. As the aquatic insects and their immature stages have direct or indirect role on the survival and growth of young fishes in nurseries, an intimate knowledge about these insects and their proper management is deemed essential for remunerative fish culture.

Among various biological components of freshwaters, the aquatic insects play an important role not only in the tropic dynamics of the ecosystem but also in the indication of changes in the quality of water due to pollution or degradation because of their ability to respond quickly to such changes. While most of the aquatic insect species constitute the food of many commercially important fishes, some others are predaceous, feeding upon spawn and frys or competing with them directly for natural food. Besides, several species, particularly of Belostomatid Hemiptera are known to predate heavily upon the mosquito larvae and thereby limiting their population size.

Even though the insects are terrestrial in origin, a large number of species belonging to several orders have adapted to aquatic mode of life completely or partially. It is estimated that about 3% of the total insects are aquatic spending at least a part of their life cycles in the water, and these comprise about 25,000 to 30,000 species (Cheng, 1976). The highly diverse aquatic forms are spread over to 11 orders viz. Collembola, Plecoptera, Ephemeroptera, Odonata, Hemiptera, Neuroptera, Trichoptera, Lepidoptera, Coleoptera and Diptera. Out of these, taxa belonging to only a few groups like Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera form the dominant component of fauna of the freshwater wetlands of this region. The Orders Trichoptera, Plecoptera, Neuroptera and majority of the aquatic species of Ephemeroptera are mainly confined to high altitudes or colder climate. The taxonomy of the aquatic insects is not as properly worked out as those of their terrestrial counterparts because of difficulties in the identification of immature forms. Most of the aquatic insects pass their early part of life in water in immature condition and sometimes the immature duration covers major part of their life cycles. However, the taxonomy based on adults have fairly been worked out, particularly those belonging to temperate waters (Ushinger, 1971; Pennak, 1978).

MATERIALS & METHODS:
DESCRIPTION OF STUDY SITES:-
Location :- 22°09'05.8"N;88°05'20.5"E

Area :- 1451.4 sq.mt

Description :- The present study was conducted in natural perennial pond. The area of the pond is about 0.36 acres with an average depth about 1.56 meters. The water body is infested with many aquatic weeds like Neulmbo nucifera Gaertner, Alterhennther asessilios Linn, Eclipta alba Hassk, Monochoria hastate Solms., Scirpus articulates (Linn.), Cyanotis axillaries Roem and Sch., Aeschynomene ampere Linn. Hygrorryza aristata Nees., Hydrocotyla asiatica Nees.,Hydrophylla difformis L Utricularia stellaris L., Jussiaca repens Linn., Nymphea nouchali Burm. F., Marsilea minuta L., Nymphoide sindica (Linn.), Eichhornia crassipes (Mart.) Sloms, Commelina bengalensis Linn., Hydrilla vercillata Casp., Vallisneria spiralis LA. General Diversity Index (Shannon and Wiener, 1963):- Where A=-[(pi)x In(pi)] Pi-proportion of total sample represented by species ith. Divide no. of individuals of species I by total number of samples.

Collection:
Insects were collected from 3rd Oct,2022 to 3rd March,2023 between 8 a.m. to 4;00 p.m. The collection were made by hauling of a dip net with a mesh size 245micometer [(Nylobolt PA, Dukay Nilobolt Industries (pvt.) Ltd. Mumbai (India)]. The area of the circular net was 4208.0cm2. Sample were taken from four corners. Many aquatic beetles and bugs use aquatic vegetation as a shelter. Aquatic vegetation can be taken out to the shore with the pond net and vigorously searched for aquatic insects using a forceps.

Preservation:
Collected aquatic insects were put into bottle filled with 70% alcohol and taken to Animals Biosystematics and Ecology Laboratory for identification and analysis.

Identification:
Collected samples should be examined under a dissection or steriozoom microscope (10X and above) and identified using standard taxonomic literature samples can be assigned to a family or genus using the identification keys of Yule and Yong(2004) and Che Salmah et al.(2014).

Community Analysis:
Density of total aquatic insects, as well as species wise density is determined by the total number (N) of individuals / haul and number of

species / haul. Relative density of various species were estimated. Dominance status of various species were described on the basis of relative density following Engelmann's scale (Engelmann 1973) as given below.

Sub resident species- RD = <1%
Resident Species-   RD = 1.1-3.1%
Sub dominant species- RD = 3.2-10%
Dominant species-   RD = 10.1-31.6%
Eudominant species – RD = 31.7 – 100%

A. General Diversity Index (Shannon and Wiener, 1963):–
$H = -\Sigma[(pi) \times \ln(pi)]$

Where-
pi – proportion of total sample represented by species *ith*. Divide no. of individuals of species *i* by total number of samples.

Table–1 (Shannon Wiener Diversity Index)

Value of H	Wilham and Dorris (1996) Scale For Benthos	Value of H	Staub et al. (1970) Scale For Plankton
>3	Clean Water	>4.5	Clean Water
1–3	Moderate Pollution	3.5–4.5	Slight Pollution
<1	Strong Pollution	2–3.5	Light Pollution
		1–2	Moderate Pollution
		<1	Strong Pollution

B. Pielou Evenness Index:–
Calculates Pielou's measure of species evenness, i.e.–
$J = H / \ln(S)$

Where –
H is Shannon Wiener diversity index
S is the total number of species in a sample, across all samples in data set.

Table-2 (Pielou Evenness Index)

Pielou Evenness Index	Water Quality
>0.8–0.9	Balanced
>0.5–0.8	Semi-Balanced
≤0.5	Unbalanced

RESULT AND DISCUSSION
In total 23 Species of aquatic insects were recorded during the present study (Table-1). These belongs to 3 orders - Coleoptera, Odonata and Hemiptera. The order Coleoptera possesses least number of species (only6) while order Odonata comprised 8 species under 3 families and 9 species under 4 families belongs to order Hemiptera. There are sixteen subdominant species viz. Hydrocoptus subvitulus, Hydrovatus bonvouloiri, Lactophilus purvulus, Brachydiplax chalybea, Urothemis signata, Ischnura verticalis, Pseudogrion microcephalum, Pseudogrion rebriceps, Anisops bouvieri, Diplonychus annulatum, Diplonychus rusticus, Lethocerus indicus, Laccotrephes maculatus, Laccotrephes ruber, Ranatra filliformes, Micronecto scutellaris and seven recedent species viz. Helocheares anchoralis, Sternolophus rufipes, Cybister tripunctatus, Anaciaeschna jaspidea, Crocothemis servilla, Enallagma parvum, Ranatra veripes. Quantitative analysis revealed that among aquatic insect order Hemiptera is the most common group representing by 44% of the total aquatic insects in this aquatic body while Odonata and the order Coleoptera is represented 32% and 24% respectively (Fig-1). Among Coleoptera which is represented by only two families viz. Dystiscidae and Hydrophilidae comprising 79% and 21% respectively (Fig-2). Among Hemiptera Nepidae, Belostomatidae, Notonectidae and Corixidae, are represented by 35%, 37%, 12% & 16% respectively (Fig-4). Order Odonata comprised only 3 families viz. Aeshnidae (6%) Coenagrionidae (60%), and Libellulidae (34%) (Fig3). Total number of aquatic insects declined from October to December and there after it increased steadily till February (Table-3). However similar trend is not seen for number of species, species diversity and species evenness. Although number of species, species diversity and evenness of species were minimum and maximum in December (2022) and march (2023) respectively, also in February a slight drop in these have been recorded.

Table-3 Monthly Species Diversity & Evenness Index

Parameters	October	November	December	January	February	March
Number of Individuals	63	43	31	65	130	124
Number of Species	10	9	4	14	12	14
Species Diversity (H)	0.79	0.71	0.22	0.75	0.62	0.95
Evenness Index (e)	0.79	0.75	0.37	0.65	0.57	0.83

Table - 4: Dominance Status of Different Species of Aquatic Insects

Order	Family	Species	No.	Relative Abundance (%)	Dominance Status
Coleoptera	Hydrophilidae	*Helocheares anchoralis* Sharp, 1890	19	3.19	Recedent
Coleoptera	Hydrophilidae	*Sternolophus rufipes* (Fabricius, 1792)	12	2.01	Recedent
Coleoptera	Dytiscidae	*Hydrocoptus subvittulus* (Motschulsky, 1859)	51	8.56	Subdominant
Coleoptera	Dytiscidae	*Cybister tripunctatus* (Olivier, 1795)	10	1.68	Recedent
Coleoptera	Dytiscidae	*Hydrovatus bonvouloiri* Sharp, 1882	24	4.03	Subdominant
Coleoptera	Dytiscidae	*Lactophilus purvulus* Aube, 1838	29	4.86	Subdominant
Odonata	Aeshnidae	*Anaciaeschna jaspidea* (Burmeister, 1839)	12	2.01	Recedent
Odonata	Libellulidae	*Brachydiplax chalybea* Brauer, 1868	21	3.52	Subdominant
Odonata	Libellulidae	*Urothemis signata* (Rambur, 1842)	26	4.36	Subdominant
Odonata	Libellulidae	*Crocothemis servilla* (Drury, 1770)	19	3.19	Recedent
Odonata	Coenagrionidae	*Enallagma parvum* Selys, 1876	17	2.85	Recedent
Odonata	Coenagrionidae	*Ischnura verticalis* (Say, 1839)	31	5.20	Subdominant
Odonata	Coenagrionidae	*Pseudagrion microcephalum* (Rambur, 1842)	27	4.53	Subdominant
Odonata	Coenagrionidae	*Pseudagrion rebriceps* Selys, 1876	39	6.55	Subdominant
Hemiptera	Notonectidae	*Anisops bouvieri* Kirkaldy, 1904	32	5.37	Subdominant
Hemiptera	Belostomatidae	*Diplonychus annulatum* (Fabricius, 1781)	42	7.05	Subdominant
Hemiptera	Belostomatidae	*Diplonychus rusticus* (Fabricius, 1871)	32	5.37	Subdominant
Hemiptera	Belostomatidae	*Lethocerus indicus* (Lepelletier & Serville, 1825)	21	3.52	Subdominant
Hemiptera	Nepidae	*Laccotrephes maculatus* (Stål, 1866)	22	3.69	Subdominant
Hemiptera	Nepidae	*Laccotrephes ruber* (Linnaeus, 1764)	21	3.52	Subdominant
Hemiptera	Nepidae	*Ranatra veripes* (Stål, 1861)	13	2.19	Recedent
Hemiptera	Nepidae	*Ranatra filliformes* Fabricius, 1790	34	5.70	Subdominant
Hemiptera	Corixidae	*Micronecto scutellaris* (Stål, 1858)	42	7.05	Subdominant

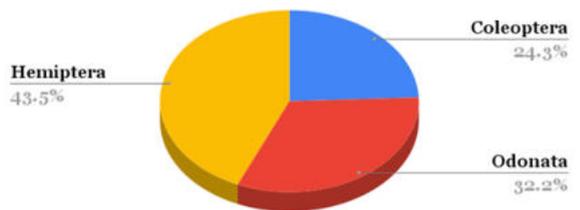*Fig. 1: Relative Abundance of Order of Insect Fauna*

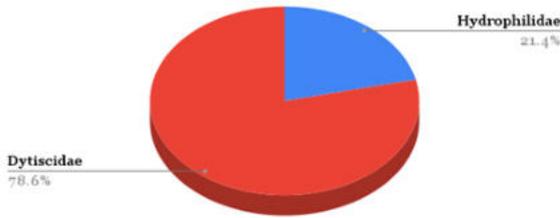**Fig. 2: Relative Abundance of Families of Order Coleoptera**

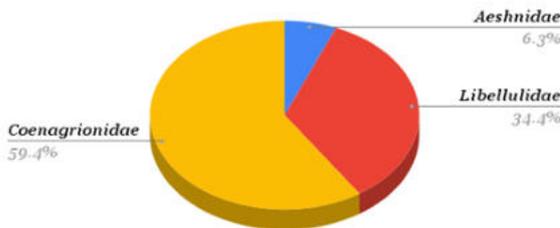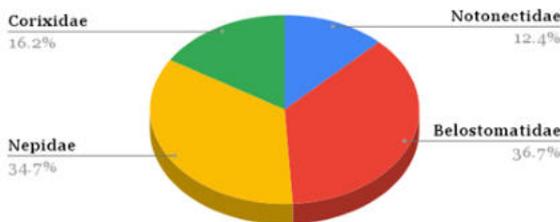**Fig. 3: Relative Abundance of Families of Order Odonata**

Fig. 4: Relative Abundance of Families of Order Hemiptera

CONCLUSION:

In total 23 species of aquatic insects showed variation in their species diversity and evenness index from one sampling site to another and from one month to other. Hemiptera is maximum in number and constitute of 44% of the total aquatic insects. Total aquatic insects, as well as three orders- Odonata, Hemiptera, Coleoptera and also individual species showed monthly population fluctuation and achieved their highest peak in February or March.

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