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Seasonal Variations of Weed-inhabiting Fauna of a Dead Ox-bow Lake (Beel) of West Bengal

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A total of 43 taxas were recorded belonging to phylum Annelida, Arthropoda and Mollusca from different foreshore & offshore stations of the beel. The bulk of weed-inhabiting fauna was formed by ubiquitous molluscan followed by nymphs, larvae and adults of insects. Annelids were fewer in number (42 units m^{-2}) and were represented by three families viz. Aeolosomatidae, Naididae and Tubificidae. The nymphs, larvae and adults belonging to orders Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera were frequently encountered in the collections with annual average percentages of 5.31, 10.31, 51.53, 20.61 and 12.21 respectively during the two years study. The gastropods were dominant and their average monthly occurrence ranged between 52 and 1624 units m^{-2}. Diversity indices for each stations have also been studied.

Key Words : Seasonal variations, Weed-inhabiting fauna, Annelids, Arthropods, Molluscs

Introduction

Even though the macro-invertebrates inhabiting in association with weeds have a significant role in the trophic cycle and are important as food for fishes, they remain a poorly understood community. The animals remain largely hidden beneath the roots, stems and leaves of the vegetation. In recent years this group of animals is receiving greater attention, especially on the type of relationship between macrophytes and inhabiting fauna (Brudin 1951, Shrivastava 1955, Oliff 1960, Ulfstrand 1967, Petr 1967, Bechtal & Copeland 1970 and Cooster & Persoon 1970). Harlin (1973) and McRoy and Goering (1974) demonstrated the flow of nutrients from macrophytes to invertebrates whereas Fitzgerald (1969) compared growth and abundance of selected invertebrates growing on different types of macrophytes. Studies concerning ecological factors influencing the growth of population of macroinvertebrates, have been undertaken by several workers (Minshall 1968 and Cummins & Lauf 1969). However, quite a wide gap exist in our knowledge on the subject, especially the factors governing the seasonal distribution of macroinvertebrates, their diversity indices, biomass and preferences of substrates, in the weed choked tropical ecotopes.

Materials and Method

Weed inhabiting animals usually pose a problem for their accurate and systematic collections. In the present study Wisconsin trap method (Welch 1948) was employed after slight modification for the collection. The trap, in essence consists of a frame with inside dimension of 36×37 cm made from aluminium stripes 2.5 mm wide and 3 mm thick; two halves of frame independent and attached to each other with double hinge so that when doubled upon each other, the edges meet most evenly; one row of closely spaced small holes parallels edge opposite closing ones, affording means of attachment for net; an elongated net 85 cm long with transverse dimension approximately same as frame; sides made of canvas and bottom with square meshed cloth (figure 1).

For operation, the net is held in vertical position, jaws downward wide open and lowered carefully over macrophytes from bottom and jaw of trap is closed.

The position of trap is adjusted by inverting it and brought to surface after draining the water through its bottom.

Samples were collected each month from March 1982–February 1984 from pre-selected sites, viz., inshore and middle of the beel. The plants were drained on a sieve and all remaining animals were collected. Animals were identified as far as possible and grouped into species, genera or higher taxonomic categories. The abundance of macro-invertebrates was expressed as per square metre of plants. For biomass estimation, each month the animal life per unit area was dried to remove extra moisture on filter paper and weighed on a sensitive balance.

Results

Environmental Factors

Fortnightly observations of the physico-chemical factors of the water were recorded throughout the period of study. Table 1 incorporates the monthly information of the mean values of the major parameters.

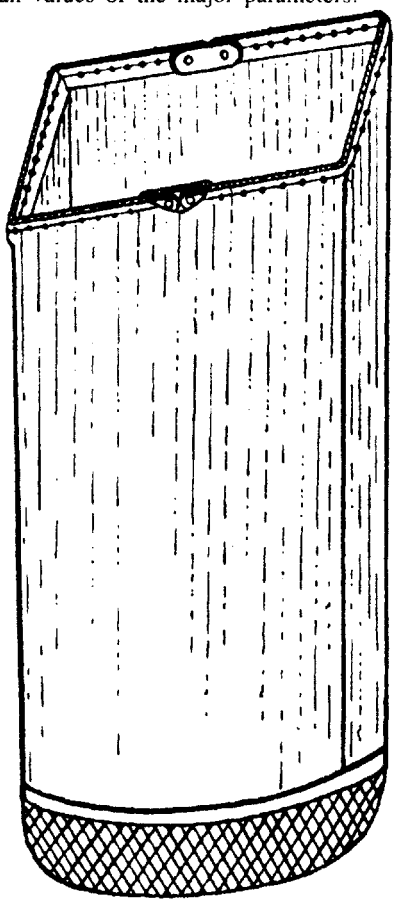

Figure 1 Weed-inhabiting animals, Wisconsin design

Species Composition

A total of 43 taxa were recorded belonging to phylum Annelida, Arthropoda and Mollusca with average availability of 34, 338 and 365 units m^{-2} during first year and 50, 186 and 711 units m^{-2} during second year respectively (figure 2). Comparatively speaking, annelids were fewer in number in the beel and were represented by three families of oligochaetes viz. Aeolosomatidae, Naididae and Tubificidae. The dominant forms encountered were: ***Branchiura*** **sp.,** ***Aeolosoma*** **sp.,** *Dero* sp., and *Chaetogaster cristallinus*. They were absent in the collections during certain months and did not show any distinct waxing or waning periods. They were mostly collected from the roots of *Eichhornia crassipes*. Among parasitic annelids, leaches were most common with an average availability of 3.0 units m^{-2}. The commonly encountered forms were ***Placobdella*** **sp.,** ***Helobdella*** **sp. and** ***Hirudo*** **sp. in order of abundance.**

Aquatic insects and molluscs form the major weed-inhabiting fauna of the beel. The nymphs, larvae and adults belonging to orders, Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera were frequently encountered in the collections with average percentages of 5.31, 10.31, 51.53, 20.61 and 12.21 respectively during the two years of study (figure 3).

Mayflies were represented by only two genera viz. *Cloeon* and *Caenis* and these were fewer in number even during their peak availability period (February–August). Their maximum number were recorded during July (31 units m^{-2}) and minimum during January (8 units m^{-2}). The average availability during the two years was 14 units m^{-2}. Dragon flies were represented by *Sympetrum* sp., *Libellula* sp., *Erythemis* sp., and *Pachydiplex* sp. belonging to family Libellulidae and *Anax* sp. belonging to family Aeshnidae. Their average availability was 27 units m^{-2} with maximum and minimum during October (29 units m^{-2}) and April (12 units m^{-2}) respectively. Hemipterans were represented by *Diplonychus annulatum*, *Ranatra filiformes*, *Lethocerus indicus*, *Plea* sp., *Gerris nitida*, *G. spinolae*, *Anisops* sp., *Micronecta proba* and *M. merope*. The average number of Hemipteran in the samples ranged from 36–622 units m^{-2} (Av. 135 units m^{-2}) during the two years. These water bugs were available throughout the year with maximum and minimum occurrence during October (622 units m^{-2}) and August (56 units m^{-2}) during the two years of study. The order Coleoptera was represented mainly by families Dytiscidae, Curculionidae, Hydrophilidae and Gyrinidae. The common forms encountered were *Canthydrus morsbachi* (Wehnuu), *Canthydrus laetabilis* (Walker), *Hydrocoptus subvittulus* (Mots), *Hydrovatus confertus* (Sharp) and *H. bonvouloiri* (Sharp) belonging to family ***Dytiscidae;*** ***Regimbartia attenuata*** **(F.),**

Berosus indicus (Mots) *Helochares* sp. and *Sternolophus* sp. and *Sternolophus rufipes* belonging to Hydrophilidae; *Bagous* sp., under Curculionidae; and *Dineutus* sp. under family Gyrinidae. The average number of coleopterans was 54μm^{-2}. Their maxima and minima were recorded during October (114 units m^{-2}) and August (15 units m^{-2}) during the two years. The dipterans were represented by *Tendipes* sp., *Culex* sp., *Stratiomys* sp., *Probassia glabra* and *Tabanus* sp. and were available throughout the year with average monthly occurrence of 32 units m^{-2} during the two years. Their maximum and minimum numbers were recorded during April (35 units m^{-2}) and November (14 units m^{-2}) during the two years of study.

Table 1 *Monthly variations of major physico-chemical parameters of the beel water during two years (March 1982–Feb. 1983)*

Months	Water temp. (C°)	Transparency (Cm)	Dissolved oxygen (ppm)	Free CO_2 (ppm)	*p*H	Nitrates (ppm)	Phosphates (ppm)	Sp. conductivity (μ/mohs/cm)	Organic matter (ppm)	Silicates (ppm)
1	2	3	4	5	6	7	8	9	10	11
1982-83										
March 1982	25.0	0.25	5.2	—	8.2	0.21	0.12	400.0	0.80	18.9
April	28.7	0.35	7.2	2.4	8.4	0.28	0.12	380.0	1.22	22.0
May	31.0	—	6.0	—	8.6	0.33	0.16	320.0	0.90	24.0
June	33.0	0.12	6.4	11.4	8.4	0.39	0.20	340.0	1.86	16.2
July	33.7	0.32	8.2	3.2	7.8	0.41	0.22	298.0	2.10	18.2
August	30.0	0.42	7.4	5.2	7.6	0.38	0.30	360.0	1.23	17.4
September	30.5	0.32	8.8	1.6	7.8	0.40	0.26	388.0	0.90	16.0
October	31.5	0.48	9.8	—	7.8	0.34	0.34	388.0	1.55	15.1
November	26.0	0.35	8.2	4.6	7.8	0.24	0.26	410.0	1.30	24.6
December	22.0	0.60	6.0	—	8.4	0.21	0.11	388.0	0.76	28.3
January 1983	20.7	0.62	7.8	—	8.2	0.15	0.08	412.0	0.85	31.0
February	18.0	0.65	6.8	—	8.0	0.17	0.10	402.0	0.90	28.4
MEAN VALUES	27.5	0.37	7.4	2.3	8.0	0.29	0.18	316.0	1.19	22.5
1983-84										
March 1983	24.0	0.37	5.0	—	8.2	0.32	0.16	390.0	1.30	18.2
April	29.0	0.37	6.4	2.4	8.4	0.31	0.18	392.0	1.31	19.2
May	31.5	0.30	7.2	—	7.8	0.41	0.20	360.0	1.86	15.9
June	34.5	0.40	8.0	9.5	7.8	0.39	0.22	320.0	1.92	16.2
July	34.5	0.40	6.6	—	7.8	0.41	0.24	288.0	2.15	17.5
August	33.2	0.32	7.2	4.3	7.6	0.36	0.25	304.0	1.86	14.4
September	32.0	0.50	6.6	—	8.0	0.33	0.18	310.0	1.36	16.3
October	28.5	—	6.6	—	8.2	0.28	0.24	312.8	1.80	20.8
November	25.0	0.72	7.2	—	8.6	0.26	0.21	366.4	1.76	19.2
December	23.5	0.70	9.0	—	8.8	0.28	0.14	390.6	0.90	19.0
January 1984	20.5	0.70	7.0	4.3	8.8	0.22	0.10	400.0	0.92	20.8
February	22.5	0.65	6.0	—	8.2	0.29	0.12	390.0	1.12	19.6
MEAN VALUES	28.2	0.45	7.0	1.7	8.2	0.32	0.19	351.8	1.52	18.0

Gastropods among molluscs were the most dominant among the macro-invertebrates collected from the beel. The average monthly occurrence of gestropods ranged between 365 and 711 units m^{-2} during first and second year respectively. The dominant forms enöuntered were *Gyraulus convexiusculus* (Hutton); *Gabbia orcula* (Frausenfeld); *Indoplanorbis exustus* (Deshayes); *Thiara (Malanoids) tuberculata* (Muller); *Lymnaea (Pseudosuccinea)* sp. and *Bellamya bengalensis* (Lamarck) in order of abundance.

Throughout the observation period, the bulk of the weed-inhabiting molluscs were the small to medium sized *Gyraulus convexiusculus* and *Gabbia orcula*. These two species together constituted 60.2% of the molluscan fauna of the beel. Other species which co-dominated in the molluscan population were *Thiara tuberculata* and *Indoplonorbis exustus* accounting 15.1 to 33.4% of the molluscan population.

The quantitative occurrence of the major encountered species of gastropods is given in figure 4. A striking feature is the negative correlation between densities of *G. convexiusculus* and *G. orcula* on the one hand and rest of the species on the other. During the warmer months of May/June, the number per square metre of *G. convexiusculus* have gone up while densities of both *G. convexiusculus* and *G. orcula* have dropped down with a parallel rise in the density of *Thiara tuberculata*.

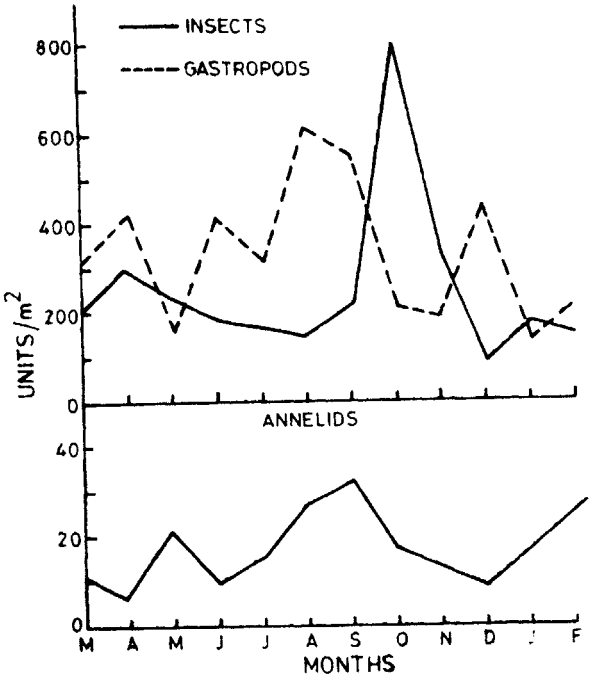

Figure 2 Seasonal fluctuations of weed-associated fauna in the beel

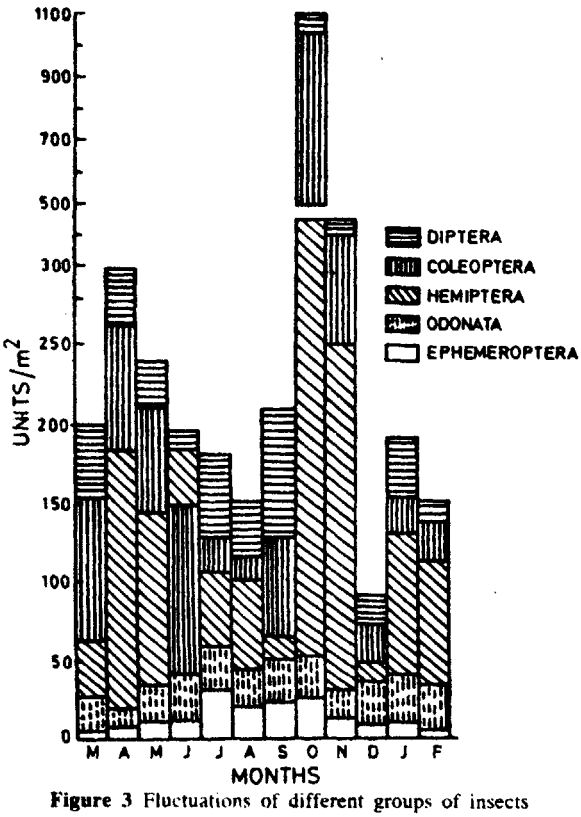

Figure 3 Fluctuations of different groups of insects

Wet Biomass of Animal Life

The wet biomass of Gastropods (including shells) and insects ranged from a minimum of 15.6 g m^{-2} in November to a maximum of 117.7 g m^{-2} in June. Generally, peak values were recorded during summer months though a minor peak was recorded in February also. A definite relationship was observed between the population densities and biomass production.

Diversity Indices

For each station, the Shanon-Weaver function (Shanon Weaver 1949) has been calculated to get the measure of the diversity of weed inhabiting fauna. The calculations were based on the percentage composition of the fauna. The equation used was in the following modified form:

$$H(S) = C \left(\log_{10} N - \frac{1}{N} \sum_{r=1}^{S} n_r \log_{10} n_r \right)$$

Table 2 *A list of the weed-inhabiting fauna of the beel*

Phylum/Taxa	Order/Family	Degree of availability
I. Annelida		
Aeolosoma sp.	Aeolosomatidae	P
Dero sp.	Naididae	P
Chaetogaster cristallinus	Naididae	P
Nais sp.	,,	P
Branchiura sp.	Tubificidae	C
Helobdella sp.	Rhynchobdellida	+ +
Placobdella sp.	,,	P
Hirudo sp.	Pharyngobdellida	R
II. Arthopoda		
Cloeon sp.	Ephemeroptera	P
Caenis sp.	,,	P
Leptocella sp.	Trichoptera	C
Sympetrum sp.	Odonata	P
Erythemis sp.	,,	R
Libellula sp.	,,	C
Pachydiplex sp.	,,	C
Anax sp.	,,	C
Diplonychus sp.	Hemiptera	P
Ranatra sp.	,,	D
Lethocerus sp.	,,	D
Plea sp.	,,	D
Gerris nitida	,,	D
G. spinolae	,,	D
Anisops sp.	,,	C
Micronecta proba	,,	D
M. merope	,,	D
Canthydrus morsbachi	Coleoptera	P
C. laetabilis	,,	C
Hydrocoptus subvittulus	,,	C
H. confertus	,,	D
Rigmbartia attenuata	,,	D
Berosus indicus	,,	D
Helochares sp.	,,	C
Sternolophus rufipes	,,	C
Bagous sp.	,,	C
Dineustus sp.	,,	C
Tendipes sp.	Diptera	P
Culex sp.	,,	C
Stratiomys sp.	,,	P
Probazzia glabra	,,	C
Tabanus sp.	,,	C
III. Mollusca		
Bellamya sp.	Mesogastropoda	+ +
Pila globosa	,,	+
Gabbia orcula	,,	D
Thiara tuberculata	,,	C
Lymnaea sp.	Basommatophora	C
Indoplanorbis exustus	,,	C
Gyrulus convexiusculus	,,	D

P, present; *C*, common; *D*, dominant; *R*, rare
+, less than 50 individuals/m^2
+ +, 50–100/m^2 individuals/m^2
+ + +, more than 100 individuals/m^2

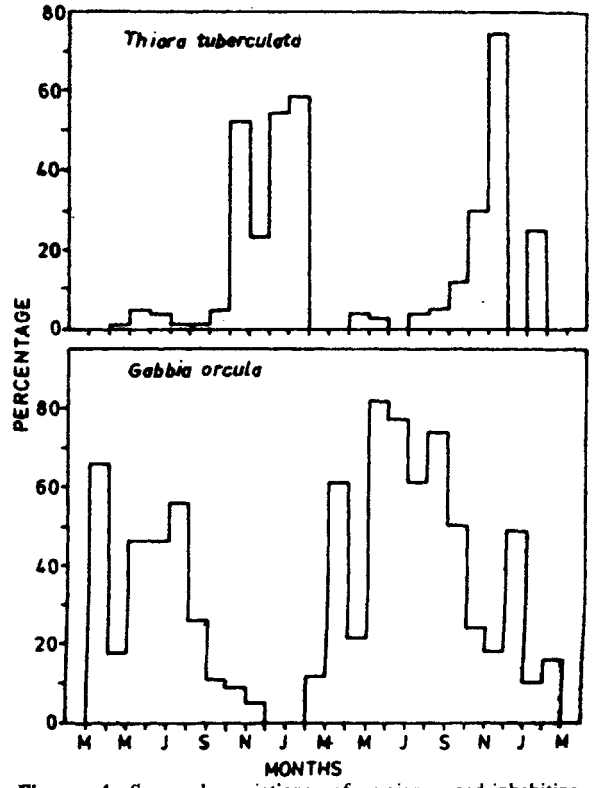

Figure 4 Seasonal variations of major weed-inhabiting gastropoda

where N is the total number of individuals; n_r the number found in rth species; S the total number of species; and $C = 3.3219$ to convert the base of logarithms from 10 to 2.

The results are given in table 3 which also gives the equitability component. As shown, the equitability component for all the samples is less than one. The highest diversity was found in inshore station A.

Table 3 *Diversity and equitability of weed-inhabiting fauna at different stations*

Sampling station	Number of species (S)	Diversity 'H'	Equitability component
'A'	43	3.490	0.76
'B'	34	2.805	0.57
'C'	31	0.551	0.67
'D'	27	1.338	0.27

Discussion

The invertebrate fauna associated with aquatic weeds provide an important source of food for fishes especially for their juveniles. The factors which determine the

colonising preferences of macro-invertebrates are poorly understood and vary from species to species. Ulfstrand (1967) and Rai and Datta Munshi (1979) held interplay of various edaphic and hydrological factors responsible for the growth and abundance of macro-invertebrates. Barber and Kervern (1973) conducted detailed studies on the influence of substrate, macrophyte growth and detritus on the growth of macroinvertebrates. According to Petr (1967) the choice of oviposition sites by adults and availability of food are two decisive criterias for macro-invertebrate population growth.

The annelids didn't show any distinct waxing or waning periods. Their availability was generally low throughout the period of study. It was observed that during the night the benthic fauna usually leave the bottom due to hypoxic or anoxic conditions prevailing therein and mingles with the macrophytes.

The insect fauna of the beel is constitued by nymphs, larvae and adults belonging to orders Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera. The general trend in population fluctuations of insects revealed that in both the years maximum number of individuals were recorded during February–March and September–October. It has been observed that algal mat on the surface hindered the surfacing activity of the free swimmers. Each year weeds are removed partially from the beel during February and September to facilitate netting operation. Maximum concentration of insects have been recorded following de-weeding operations (817 units m^{-2} in October and 300 units m^{-2} in April).

Gastropods especially belonging to lymnaeidae and planorbidae were dominant in the beel throughout the period of observation. No correlation could be drawn between molluscan density and water quality parameters. The invertebrate community of the beel may be conveniently divided into two groups—'loosely attached' oligochaetes and insects and the 'firmly attached' molluscs. The loosely attached assemblage have low occurrence compared to firmly attached component.

The average number of macroinvertebrates differed markedly in the foreshore and offshore areas of the beel with density ranging from 2-3 times. Oligochaetes and chironomids were more in the offshore region while molluscan were dominant in the inshore region. Rai and Datta Munshi (1978) have also studied the unit area abundance of annelids and dipterans in different zones of a water body and reported that dipterans are always relatively abundant near the inshore area. Laal (1981) while working on the ecology and productivity of north Bihar swamps reported the dominance of gastropods near the littoral areas.

Being active breathers, the population of nymphs, larvae of insects is generally attributed to the dissolved oxygen values of the ambient water. The ephemeropteran were quantitatively more in the middle of the beel than in the littoral zones while the respresentative belonging to diptera, coleoptera and odonata were more in the inshore areas. The hemipteran are good fliers and as such their percentage composition was quite misleading.

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