ECOLOGY AND DIVERSITY OF INTERTIDAL COLEOPTERAN INSECTS IN PURBA MEDINIPUR COASTAL BELT, WEST BENGAL, INDIA.

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Abstract

13 species of intertidal coleopteran insects have been recorded from the Purba Medinipur District. Population density, physico– chemical and meteorological factors have been recorded and it is found that abundance of coleopteran insect fluctuated from season to season as well as between different study sites. In post monsoon, coleopteran insects recorded highest density but diversity and organic carbon are the lowest. The biomass, sand and silt are highest in pre monsoon where as clay is lowest. But in monsoon, diversity, relative humidity, organic carbon and clay are highest but density, biomass, sand, silt are lowest. Maximum species are recorded from high tide level.

Key Words: Coleoptera, Intertidal belt, Purba Medinipur, Diversity, Physico- chemical parameters.

Introduction

Insect fauna constitutes an important benthic faunal component in the food web of estuarine- marine coastal environment. Out of 0.9 million species of insects so far been described from different corners of globe (Varshney, 1998), only about 3% species are aquatic or have aquatic larval stages. Of these, only a fraction, several hundred species are marine or intertidal.

Coastal belts of Purba Medinipur District have been degraded during last three decades considerably due to intensive aquaculture and some other major developments like Digha tourism center, Sankarpur fishing harbour, Kolaghat thermal power plant, Haldia petrochemicals and other industrial complex.

Very scanty research works have so far been conducted on intertidal insects all over the world (Cheng, 1976; Williams and Feltmate, 1992; Dudley and Hamm, 2002). In India, very little information is available on the insects in general and coleopteran in particular from the

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marine-coastal environment, excepting the works of Poddar and Choudhury (1985) from intertidal belt of Sagar Island of Sundarbans Mangrove Estuarine complex, West Bengal, India. Some littoral beetle species of sand flats and mud flats were reported from Hooghly estuary (Chakroborty *et. al*., 1990) but almost no such studies have been made from coastal tract of Medinipur District (east). The present investigation has attempted to record the diversity, density and community interactions of coleopteran insects in three contrasting study sites

(study site – I, study site – II and study site – III) along the coastal tract of Purba Midnapore District, West Bengal with special emphasis to find out the role of density dependent factors and density independent factors on insects community.

Materials and methods

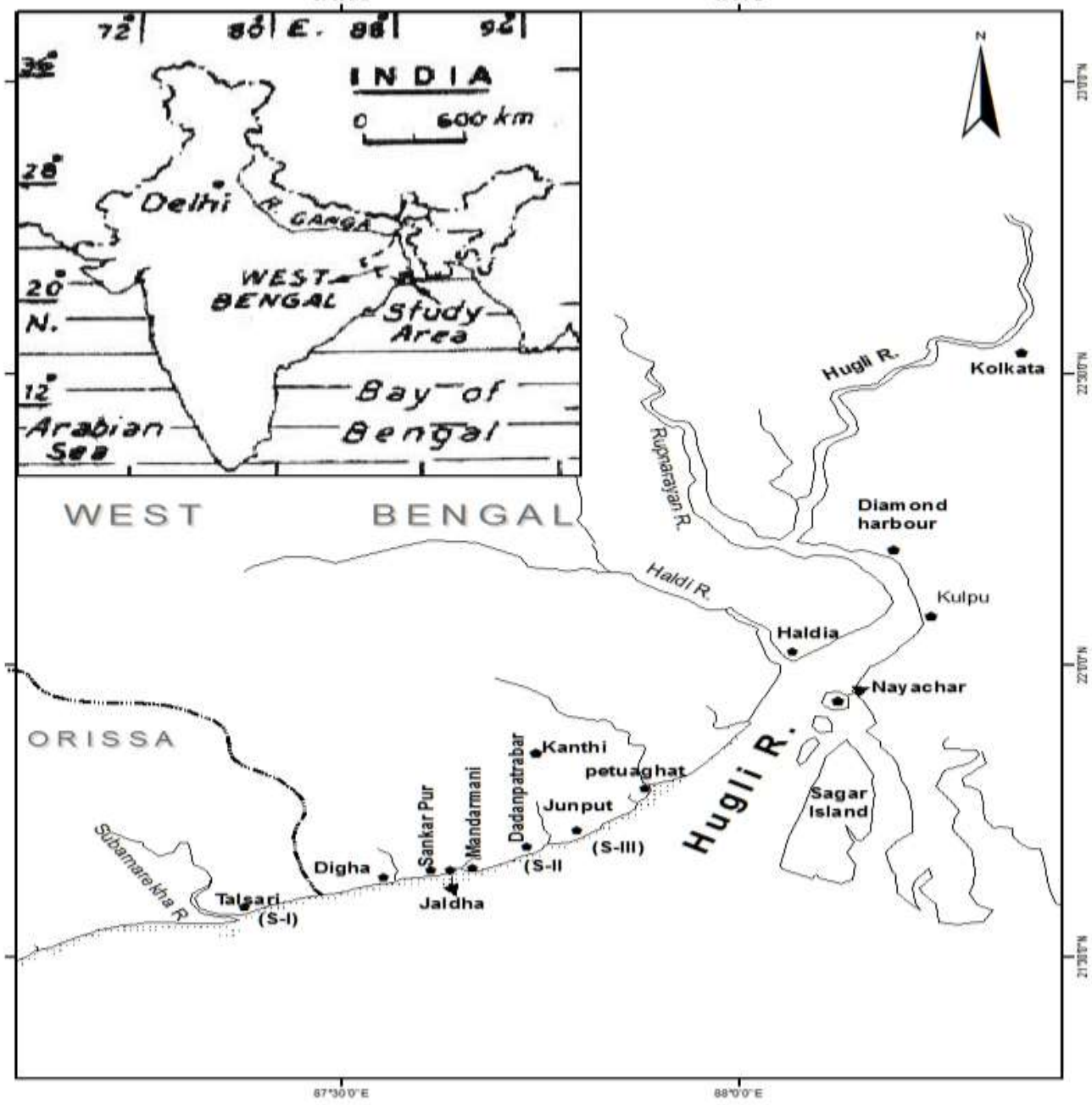
Study sites : The coastal tract of Purba Medinipur District extends over 60 Km, representing 27% of the coastal environment of West Bengal (longitudinal extension $87^0$5' E to $88^0$5' E and latitudinal extension $21^0$30' N to $22^0$2' N) extending along the Hoogly estuary from New Digha (at the confluence of Subarnarekha with Hoogly) at the extreme South-West point of the Purba Medinipur District and then curving around Sankarpur, Dadanpatrabar, Junput, Rasulpur, Khejuri and Haldia on the East to the further North-East upto Tamluk (earstwhile-Tamralipta) or even Kolaghat on the bank of river Rupnarayan. Three study sites in coastal tract of Purba Medinipur were selected for the investigation (Fig. 1).

Talsari (Study site – I): - This study site is located at the confluence of Subarnarekha estuary. Extensive salt marshy tract and vegetation exist around this estuary. The beach plan shape of Talsari is barrier beach. The width of the beach is 170m and run up distance of swash is30m. Sand and mud flats are present in this study site.

Dadanpatrabar (Study site – II): - This sandy study site is situated around 23km away from contai. A patch of old degraded mangroves were found in this study site. The beach plan shape is shore line beach. The width of the beach is 195m and run up distance of the swash is 16m.

Junput (Study site –III): - This study site is characteristics of mud flat. The beach plan shape is detached and shore line. The width of the beach is 280m and run up distance of the swash is 22m.

Fig. 1: Map showing location of study sites



Seasons: In this coastal belt seasons are vary pronounced, each with four months duration. The pre-monsoon (March to June) is the summer season. The mon-soon season (July to October) is accompanied by heavy rain fall and the post-monsoon (November to February) comprised partly the winter season, comparatively with lower temperature.

Sampling method :-Quantitative analysis of population density from different zones of selected intertidal belts, viz. Low tide level (LTL); Mid tide level (MTL) and High tide level(HTL) of three selected study sites of intertidal belts of Talsari, Dadanpatrabar and Junput were done with the help of random quadrate samplings with metallic corer (3”x3”x6”). Five quadrats (1m x 1 m) were placed in each zone vis- a- vis a transect along either LTL, MTL and HTL of three study sites.

Ten samples were collected from each quadrat by a corer (3”x3”x6”). Each sample consisted of 3”x3”cut sediment neatly to a depth of 6” by the corer. Each corer sample was divided into three parts- upper (0”- 2”),

middle (2"- 4") and lower one (4"- 6") and were kept in separate polythene packets in order to count the population density of inhabiting insects in different vertical strata of the soil. Each sample was taken to the laboratory from the field for recovering the adults and larvae from the soil samples by standardized magnesium sulphate flotation technique (Davies and Linley, 1966). Similarly, insects inhabiting the plants were collected separately from upper, middle and lower parts of the plants (mostly shrubs, mangroves and creepers) inhabiting in HTL (supra littoral zones of back shore regions). For quantitative analysis of insects inhabiting in plants, the density of different species of insects were counted as number of insects /100 leaves or branches. Sampling of insects was conducted from dawn to dusk. The average population density of coleopteran insects was expressed as no/m^2.

Random collections of coleopteran insects from different intertidal biotopes along the stretch of Purba Midnapore coastal belt were made by hand picking and by using forceps and sweeping nets. Such nets were made of thick cotton cloth with a diameter of 30 cm. Then the collected specimens were transferred into polythene bags containing a cotton pad dipped in chloroform. The specimens were immediately placed in70% alcohol. The collected samples were properly preserved and their simultaneous identifications were made following standard literatures (Cheng, 1976), and also through getting technical assistance from the scientists of Zoological Survey of India, Kolkata.

Physico-Chemical Parameters:-

1. Organic Carbon (Walkley & Black, 1934).
2. Salinity (Strickland & Parsons, 1968)).
3. Relative Humidity (From meteorological Dept. Kolkata)
4. Textural component (International pipette method as illustrated by Banerjee and Chottopadhay, 1980).

Mathematical analyses: - Species diversity index (Shannon Wiener, 1963) was calculated by using the following expressions.

a) Species diversity index (H) = -□Pi log Pi

Or = -□ (ni/ Ni) log (ni /Ni)

Where, ni = importance value for each species.

Ni= total of importance value.

Pi = importance probably for each species = ni / Ni

Results:-

A) Population density of Intertidal Coleopteran insect: -

Population density of coleopteran insect (no/m^2) at different study sites were recorded through 24 months and six seasons of two consecutive years, and it were found out that abundance of coleopteran insect fluctuated from season to season as well as in between different tidal levels and different study sites.

The diversity of coleopteran insects from the intertidal belts of three study sites of Midnapore District included 13 species of insects belonging to 12 genera of 9 families. Among them, 7 species were recorded from

each study site in which two species *Cicindela biramosa* and *Micraspis discolor* were found to inhabit in all the three study sites, namely Talsari, Dadanpatrabar and Junput. 4 species were found to be common in two study sites. *Cicindela quadrilineata* and *Canthydrus laetabilis* were encountered in Dadanpatrabar and Junput, *Paederus fuscipes* was recorded from Talsari and Junput, *Gonocephalum* sp was found to inhabit in Talsari and Dadanpatrabar. The rest of the species such as, *Aulacophora foveicollis*, *Haltica* sp and *Scymnus ceylonicus* were recorded from the study site – I (Talsari). The other two species *Cyclosomus* sp and *Hypocaccus sinae* were found to inhabit in study site – II (Dadanpatrabar). 2 coleopteran species viz. *Diplocheila polita* and *Sternolophus rufipes* were recorded only from the study site – III (Junput) (Table – 1).

Table: 1. Distribution of different intertidal coleopteran insect species of three study sites - I, II and III.

Sl.No.	Species	Talsari (Site – I)	Dadanpatrabar (Site – II)	Junput (Site – III)
1	*Cicindela biramosa*	+	+	+
2	*Cicindela quadrilineata*	-	+	+
3	*Cyclosomus sp*	-	+	-
4	*Gonocephalum sp*	+	+	-
5	*Paederus fuscipes*	+	-	+
6	*Aulacophora foveicollis*	+	-	-
7	*Haltica sp*	+	-	-
8	*Micraspis discolor*	+	+	+
9	*Scymnus ceylonicus.*	+	-	-
10	*Hypocaccus sinae*	-	+	-
11	*Canthydrus laetabilis*	-	+	+
12	*Diplocheila polita*	-	-	+
13	*Sternolophus rufipes*	-	-	+

+ = Present - = Absent

The highest percentage of coleopteran population density was found during post-monsoon and lowest population density was noticed during monsoon period. The total population density was found maximum in Dadanpatrabar but minimum in Junput. The seasonal biomass is highest in pre-monsoon but lowest in monsoon. (Fig. 2).

B) Diversity Index of Intertidal Coleopteran insect: -

The species diversity index is more in Dadanpatrabar during monsoon season but lowest in post monsoon in Dadanpatrabar (Fig- 2).

C) Biogenic structure: Coleoptera – sediment interactions:

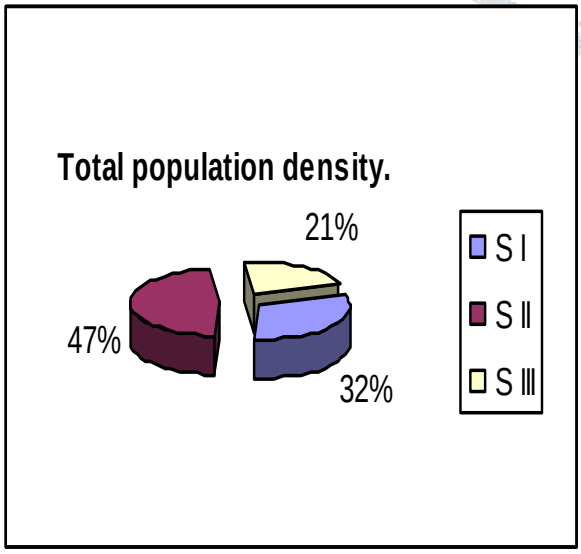
In the studied mud flats and sand flats of Junput , Dadanpatrabar and Talsari, bioturbation structures have been identified as proportional to the faunal abundance and to their potential disturbing effects on the sediments. The different insect species of the present study have been coded and scored using scheme for various attributes (Swift, 1993). *Cicindela biramosa, Cicindela quadrilineata* and *Gonocephalum* sp showed highest score followed by *Cyclosomus* sp, *Diplocheila polita, Haltica* sp, *Paederus fuscipes, Aulacophora foveicollis, Sternolophus rufipes, Micraspis discolor, Canthydrus laetabilis, Hypocaccus sinae* and *Scymnus ceylonicus.* Highest scores by the respective species were due to its active mobile, feeding, making tunnel in soil and removing the lower soil to the upper. These species influence sediment structure, bioturbation, and the fluxes of nutrients and contaminates between the sediment and the water column. Observation indicates that the vertical movement of adult and larvae disturbs surface sediments there by contributing to bioturbation.

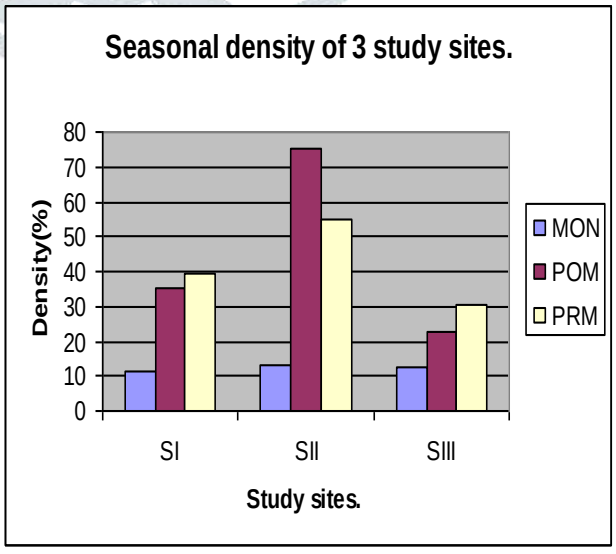
D) Physicochemical Parameters:

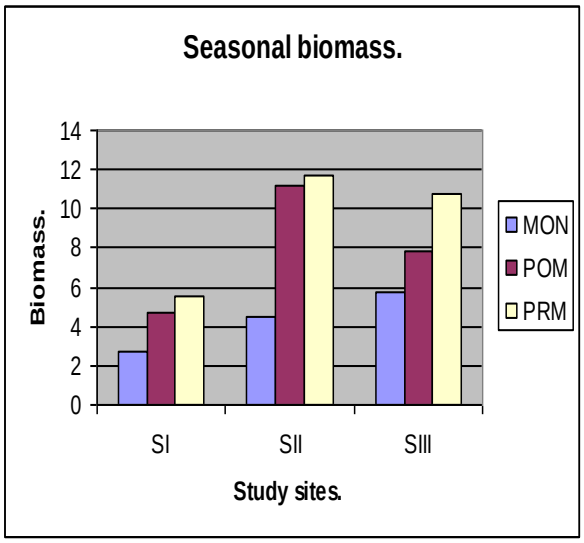
Different physicochemical parameters displayed a wide range of temporal and spatial variation. Organic carbon was found to be highest in Junput but it was lowest in Talsari during all seasons. Salinity was highest in Talsari but lowest in Junput during pre-monsoon, monsoon and post-monsoon. The post-monsoon season was characterized in having highest salinity but monsoon having lowest salinity.

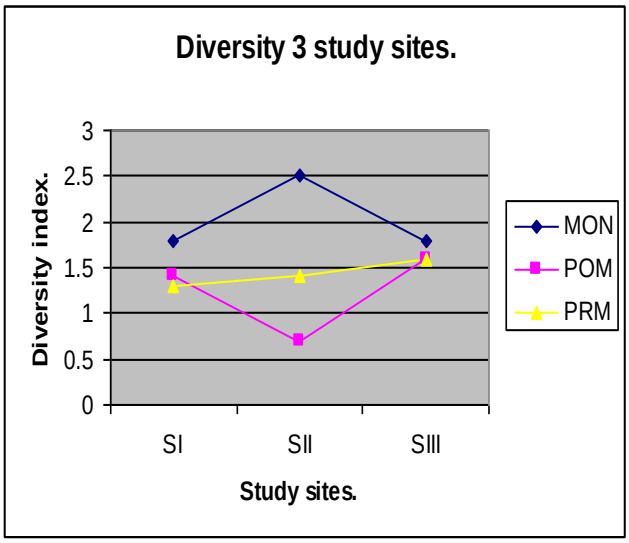
During pre-monsoon, monsoon and post- monsoon the sand was highest to be found in Talsari but silt and clay was highest in Dadanpatrabar. The relative humidity was highest during monsoon but lowest in post-monsoon period (Fig. 2).

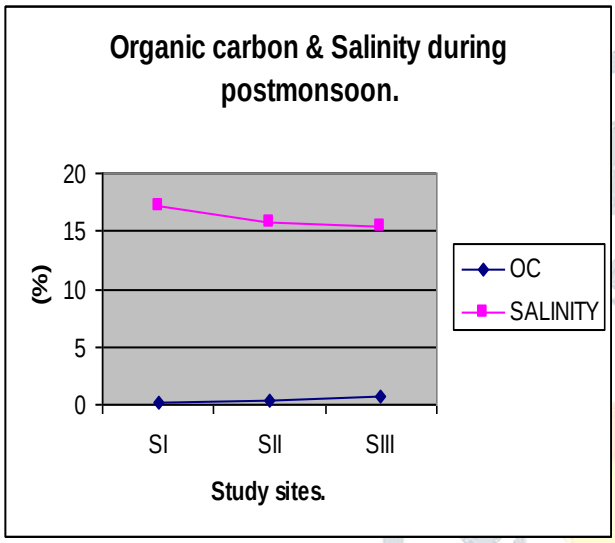
Fig: 2.

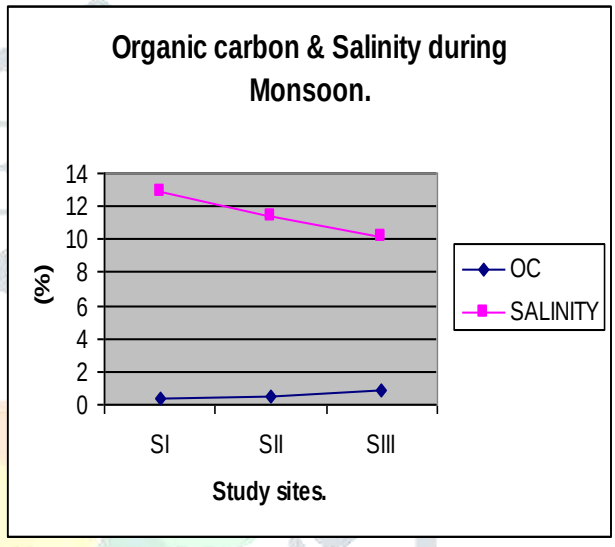


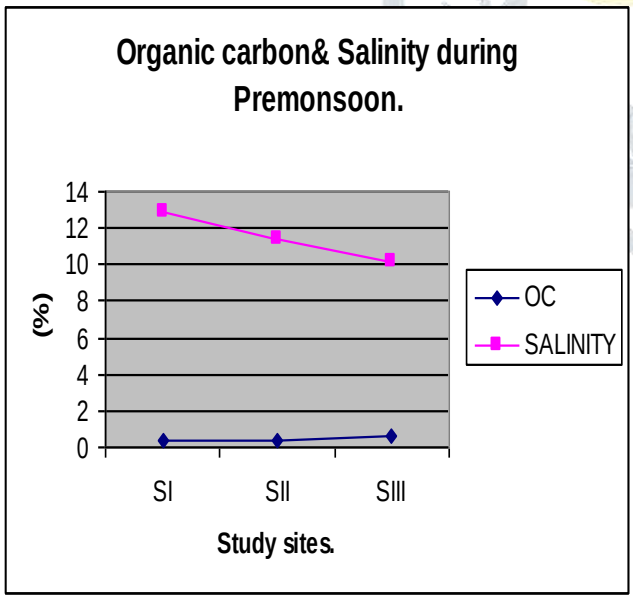


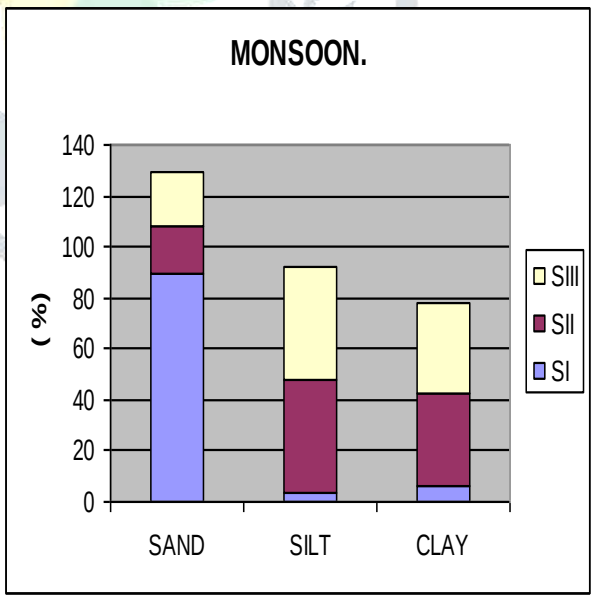

Seasonal biomass.
Biomass.
14
12
10
8
6
4
2
0
SI
SII
SIII
Study sites.
MON
POM
PRM

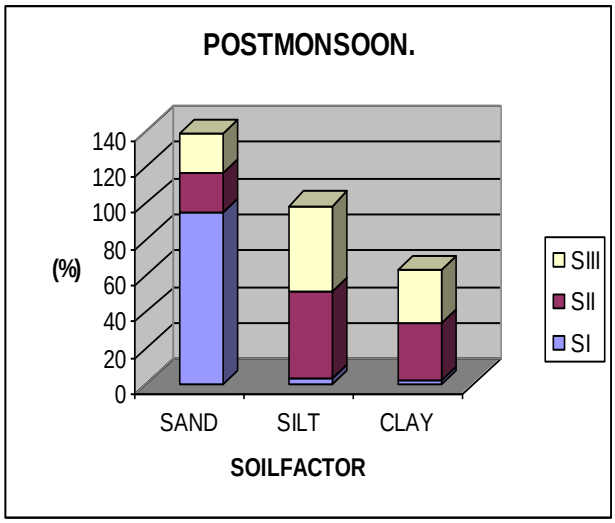

Diversity 3 study sites.
Diversity index.
3
2.5
2
1.5
1
0.5
0
SI
SII
SIII
Study sites.
MON
POM
PRM

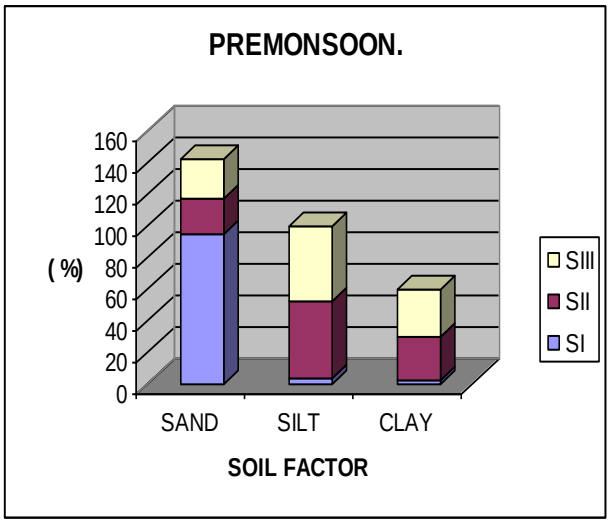

Organic carbon & Salinity during postmonsoon.
(%)
20
15
10
5
0
SI
SII
SIII
Study sites.
OC
SALINITY

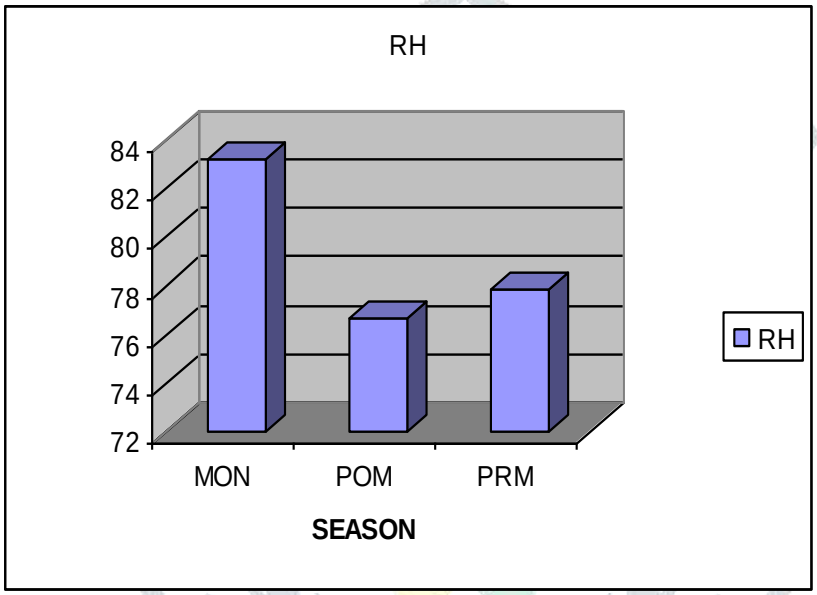

Organic carbon & Salinity during Monsoon.
(%)
14
12
10
8
6
4
2
0
SI
SII
SIII
Study sites.
OC
SALINITY


Organic carbon& Salinity during Premonsoon.
(%)
14
12
10
8
6
4
2
0
SI
SII
SIII
Study sites.
OC
SALINITY


MONSOON.
(%)
140
120
100
80
60
40
20
0
SAND
SILT
CLAY
SIII
SII
SI



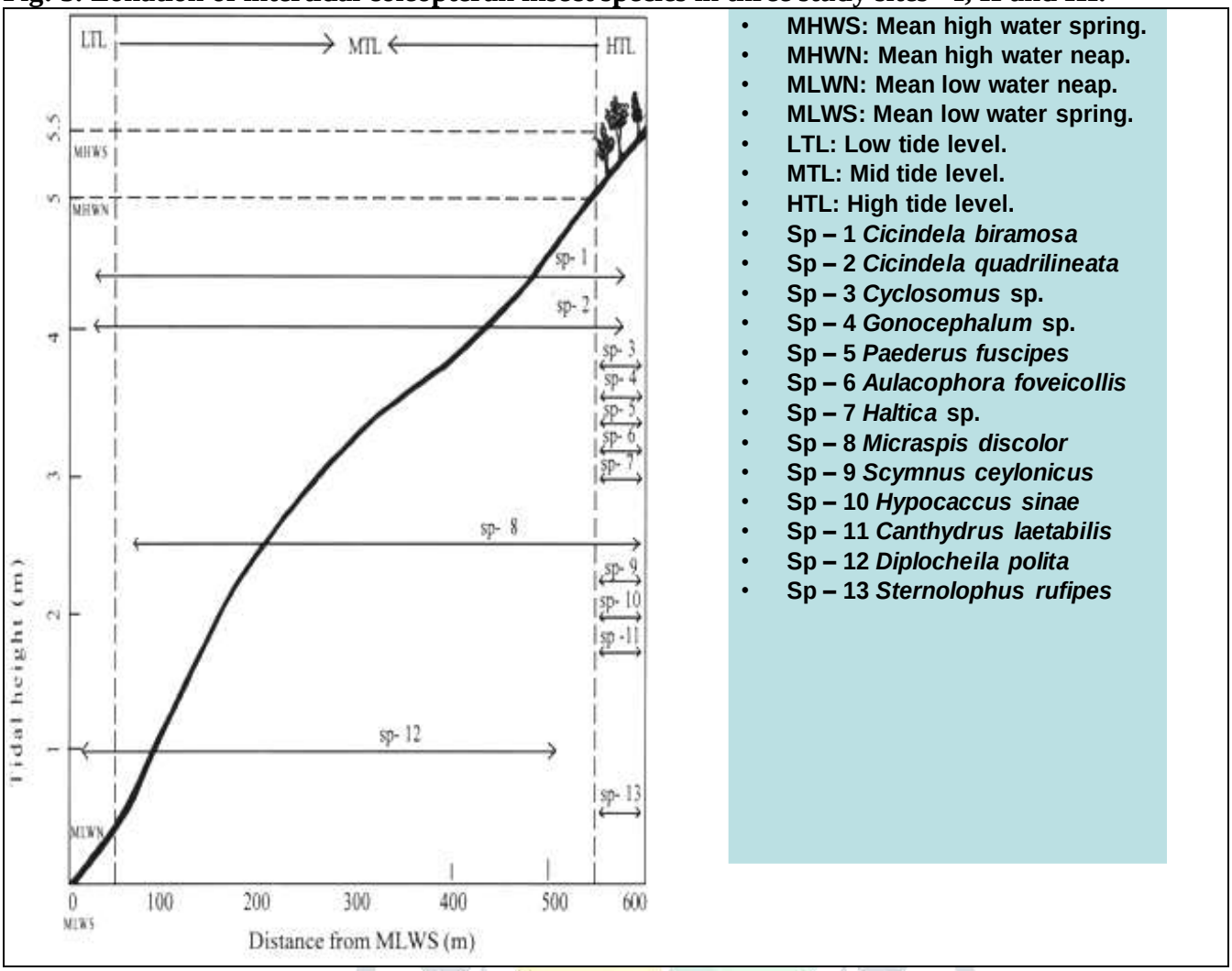




E) Zonation pattern of Intertidal Coleopteran insect: -

A distinct zonation pattern was observed with regard to the species composition, density and distribution of different coleopteran insects. Two coleopteran species viz. *Cicindela biramosa* and *Cicindela quadrilineata* were recorded from all the tide levels of intertidal belts viz. high tide level (HTL), mid tide level (MTL) and low tide level (LTL). *Micraspis discolor* was recorded only from HTL and MTL while *Diplocheila polita* restricted its abundance in MTL and LTL but remaining 9 species were recorded only from HTL (Fig- 3).

Fig: 3. Zonation of intertidal coleopteran insect species in three study sites - I, II and III.



Discussion

The three study sites of the coastal tract of Purba Midnapore District were found to be contrasting with regard to their physico-chemical properties of water, soil and fauna. Study site – III (Junput) was very much prone to the anthropogenic stresses because of different activities occurred at Junput relating to fishing with the help of crafts, fish processing, fish drying and transportation followed by study site-I (Talsari) and study site- II (Dadanpatrabar. Although, all documented insects (no. of species – 25) were not true intertidal, 15 species were recorded exclusively from intertidal belt. Overall 15 coleopteran insects have been recorded from the coastal tract of Midnapore district. Among these, 13 coleopteran species have been recorded in three study sites. 7 species were documented from each study site. Out of these, 2 species viz. *Cicindela biramosa,* and *Micraspis discolor* were found to be common in all the three study sites while other 2 species viz. *Cicindela quadrilineata* and *Canthydrus laetabilis* were found to be common in study site – II and study site III, One species, *Paederus fuscipes* was found to be common in between study site – I and study site – III and another one species (*Gonocephalum* sp) was found to be common in between study site – I and study site – II.

Different coleopteran species exhibited distinct zonation pattern reflecting their adaptation to different degrees of terrestriality.

Climatological factor and physico-chemical parameters of interstitial water recorded through different months and seasons of two consecutive years and was found to regulate and determine the population dynamics of different coleopteran species. Study site – II (Dadanpatrabar) has been established to be the most favourable habitat for the coleopteran insects, as maximum number of coleopteran insects was recorded from this study site in comparison to other two study sites.

Present study indicates that coastal *Cicindela* spp. and *Diplocheila polita* prefer bare area (LTL and MTL) which were devoid of vegetation.

According to the diversity scores, study site – III (Junput) was found to be more pollution stress, as least number of coleopteran insect's species was present. Community structure analysis (species diversity index) has revealed that the study site – III (Junput) was proved to be severely polluted which on the other hand sustained the lives of more tolerant coleopteran species belonging to the family cicindelidae. Environmental harshness reduces the number of species and individuals, but one or two species increases in number as tolerant species. Niche segregation was reported to be a phenomenon quite common in the perspective of population ecology. During the present investigation, both temporal and spatial separations of niche were observed among the coleopteran insect community in all the three study sites. Different biogenic structures formed by the different coleopteran species have been encountered in this present study and categorized as per the different scores put forward by swift, 1993. Coleopteran insects could play a role in the redistribution of superficial sediment particles in intertidal regions and thereby influence fluxes of nutrients and contaminants across the sediment water interface. The results of the present study, highlighting the important findings relating to density, diversity, distribution and community interactions of coleopteran insects through different seasons and years have generated considerable baseline information which can be compared with other investigations on similar lines in order to assess the stability and biological potentiality of the studied environment.

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