Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2015; 3 (2): 331-336

Received: 13-02-2015
Accepted: 14-03-2015

Debdas Jana
Department of Zoology,
Vidyasagar University,
Midnapore

Tapas Kumar Das
Department of Zoology,
Vidyasagar University,
Midnapore

Dipak Kumar Tamili
Egra S.S.B. College, Egra, Purba Medinipur

Susanta Kumar Chakraborty
Department of Zoology,
Vidyasagar University,
Midnapore

Correspondence:
Debdas Jana
Department of Zoology,
Vidyasagar University,
Midnapore

Diversity of Orthopteran insects in contrasting coastal environment of Midnapore (East), West Bengal, India

Debdas Jana, Tapas Kumar Das, Dipak Kumar Tamili, Susanta Kumar Chakraborty

Abstract
The order Orthoptera includes insects of commonly known species to human being such as grasshoppers, locusts, and crickets, mole crickets and grouse locusts. The members of this order occur almost throughout the physiographic zones of India. Orthopteran insects of coastal areas of Midnapore district were sampled from November 2007 to October 2010**.**Altogether 8 Orthopteran insect species belonging to 7genera and 5 families have been recorded from eight different study sites having contrasting ecological characters in the coastal areas of Midnapore(East) District of West Bengal, India. This study is the first attempt to document the insects under the order Orthoptera. The diversity and distribution of these insects have been studied. Some site specific species have been detected.

Keywords: Coastal area, Distribution, Diversity, Midnapore (East), Orthoptera.

1. Introduction
Insects are the most diverse groups of organisms on earth and have adapted to broad range of habitats, successfully enjoying their own niche [1-2]. Insects use plants for foraging, sucking, nesting, egg laying etc. According to Jana *et al*. [3] insects have the ability to differentiate the more polluted load of air pollution from the non-polluted one and change their host plant after being influenced by the non-conducive environmental condition. Insects being the most abundant and diversified faunal group [4] act as an important bioindicator of environmental changes [5].

Insects contribute important functional roles towards their respective ecosystem by way of pollinating the vegetation and controlling insect pests. They also decompose dead materials; thereby help nutrient cycling into the ecosystem. Density of insects has been threatened due to various environmental factors *viz*. urban sprawl, use of pesticides and increasing pollution loads [6]. Prebble [7] demonstrated that the variation in the distribution of the insect may be well linked with some characters of the environment or its host plants. Human activities at various levels are becoming real threat to conserve biodiversity resources in our country. Giri *et al*. [8] and Jana *et al*. [9] pointed out that the host specific interaction of herbivore insects is critical to explaining the overall diversity of plants and insects observed in tropical forest. But the concept of host specificity among insects has contributed to the stimulation of total arthropod species richness on the earth [10].

Grasshoppers, crickets and locusts belong to the order Orthoptera. Many insects of this order produce sound by rubbing their wings or their legs against each other, corrugated bumps are the characteristic features of their legs and wings [11]. The term Orthoptera comes from Greek word *Ortho* means straight and *pteron* - winged. They are generally cylindrical and their elongated hind legs are adapted for jumping. The number of known species till to date of this order is about 20,000, out of which 1,750 species are known from India [12]. Orthopteran insects are observed in all kinds of habitats. They can be found on low-growing plants and have worldwide distribution with their appearance on open grassland and abundant leafy vegetation. Most surprisingly, they are also found in deserts and coastal delta. Grasshoppers are considered as pests of crops. They devour succulent type of plants in their both nymph and adult stage. They make good fish bait. The eggs, nymphs and adults of grasshopper provide food for many animals which are in food chain and thereby maintaining the ecosystem balance. Grasshoppers are used as a source of proteinaceous food in some countries. They also

act as an intermediate host of some pathogens [13]. Here, we used three medicinal plants *viz. Calotropis procera*, *Croton bonplandianum* and *Clerodendron infortunatum* for quantitative study and for qualitative study plants of common vegetation were considered. In this context, the paper has attempted to document or record the occurrence of insect distribution in different biotopes of coastal and non-coastal zone of Midnapore (East).

Materials and Methods

Selection of the study sites:

For exploring the diversity of Orthopteran insects eight study sites (*Viz.* Petuaghat-site I, Junput-site II, Soula-site III, Mandarmani-site IV, Sankarpur-site V, Digha-site VI, Bajkul-site VII and Contai-site VIII) have been selected which are located in contrasting coastal areas (Fig.1). The coastal tract of Midnapore (East) extends over 60 km representing 27% coastal environment of West Bengal (Longitudinally $87^{0}5^{/}$E to $88^{0}5^{/}$E and Latitudinally $21^{0}30^{/}$N to $22^{0}2^{/}$ N) [14-15] .Six study sites (site-I to site-VI) have been selected within the 5 km of the shore and two (site-VII and site-VIII) beyond the 25 km towards the mainland. Out of the 8 study sites S-I, S-II, S-III may be regarded as virgin coastal belt while S-IV, S-V and S-VI are under places of tourism. S-VII and S-VIII has the semi urbanizing features.

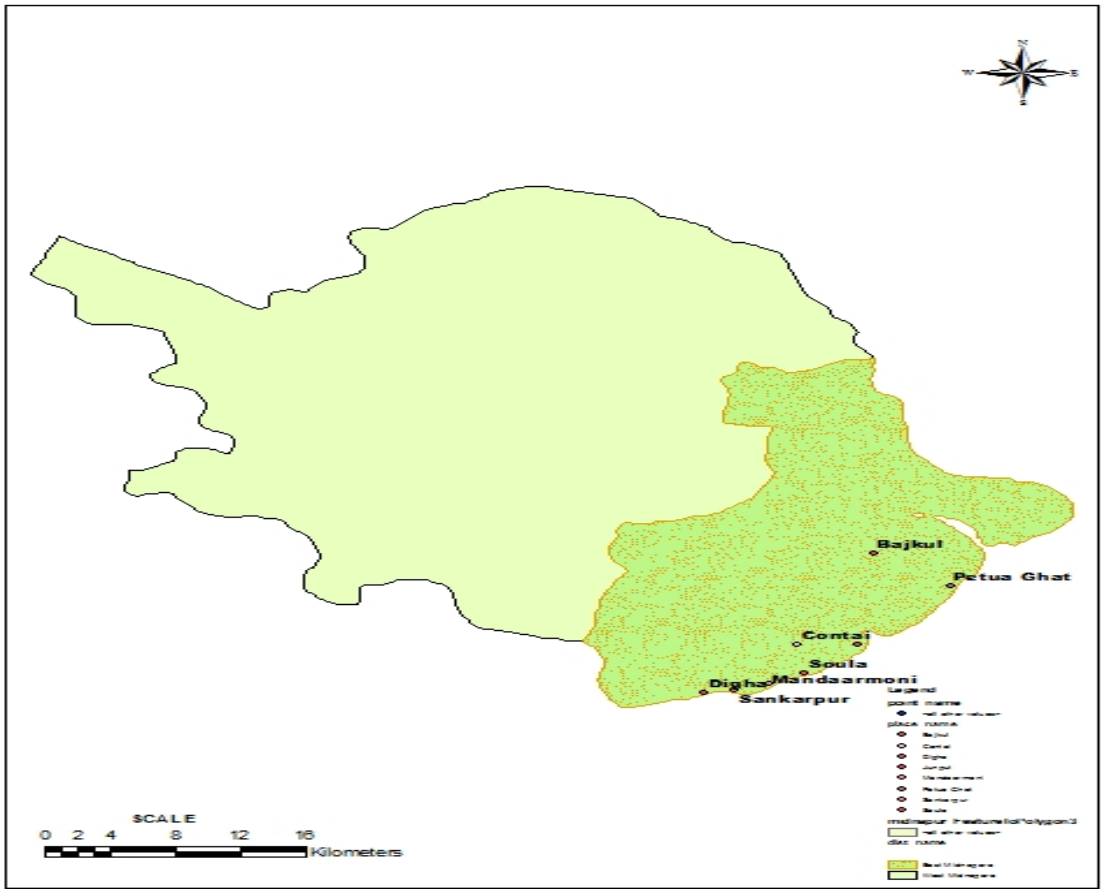

Fig 1: Map showing the eight study sites

Sample collection and species identification:

For qualitative assessment, the study was initiated during November 2007 with the plot survey for the collection and identification. However quantitative assessment was made from November 2008 to October 2010. Three transects were established in each proposed study sites [16].Visual observation is another method for sampling where the observer collects or counts *in situ* all the insects he can see in fixed area and this has been supported previously by Barnes and Barnes [17], Macan [18], Murray [19] and Duffey [20]. For quantitative analysis the documentation was made by counting the abundance of the insect fauna as number of insects per 100 leaves of host plant [21-22]. Orthopteran insects were collected by sweeping over the various types of vegetations and grasslands by means of butterfly net. Sometimes they were collected by hand picking with the help of a pair of forceps. After collection, specimens were killed in a killing jar using chloroform followed by removal of the specimen and were kept in oil paper envelopes and preserved in dry condition. Insects were pinned with entomological pin and identified subsequently by following standard literatures [23-32] and with the help of scientist of Zoological Survey of India, Kolkata. Recording of meteorological parameters like air temperature (dry and wet), relative humidity and rainfall, and physicochemical parameters like soil pH and soil salinity have been made during the study period in all the study sites.

Results

Altogether 8 Orthopteran insects under 5 families following Linnean system of hierarchial classification [33] have been recorded from the eight study sites which are being presented in the Table- 1 highlighting their distribution patterns .The systematic position is- Super Phylum-Arthropoda, Phylum-Entoma; Sub Phylum-Uniramia; Super class- Hexapoda and Class- Insecta.

Table 1: Distribution of Orthopteran insect species in different contrasting coastal areas of Midnapore (East)

Insects		Site of occurrence							
Family	**Species**	**S-I**	**S-II**	**S-III**	**S-IV**	**S-V**	**S-VI**	**S-VII**	**S-VIII**
1.Pyrgomorphidae	1. *Atractomorpha crenulata* (Fabr)	+	+	+	+	+	+	+	+
	2. *Atractomorpha* sp	+	+	+	+	+	+	+	+
2.Acrididae	3 *Spathosternum prasiniferum prasiniferum* (Walker)	-	-	-	-	+	+	-	-
	4. *Leva indica* (Bolívar)	+	-	+	-	+	+	-	-
	5. *Oxya fuscovittata* (Marschall)	-	-	-	-	+	-	-	-
3.Tetrigidae	6.*Thoracodonta* sp	-	-	-	-	-	-	-	+
4.Tettigoniidae	7. *Holochlora indica* (Kirby)	+	+	+	-	+	+	+	-
5.Gryllidae	8.*Gryllus* sp	+	+	-	-	-	+	-	-

S-I = Petuaghat; S-II = Junput; S-III = Soula; S-IV = Mandarmoni; S-V = Sankarpur; S-VI = Digha; S-VII = Bajkul; S-VIII = Contai

Order: Orthoptera
Family: Pyrgomorphidae
Species: 1. *Atractomorpha crenulata* Fabricius, 1793
1793. *Truxalis crenulata* Fabricius, *Ent. Syst*., 2:28
1861. *Atractomorpha crenulata*: Saussaure, Annls. Soc. ent. Fr., 4:475.

Materials Examined: 2 exs, from all the study sites.

Diagnostic characters: Tegmina and wings are well developed, greenish in color, rosy.

Habitat: Found to resides on the plant species such as *Oryza sativa, Calotropis procera, Brassica* sp*, Solanum melongena, Solanum tuberosum, Datura metel.*

Distribution: **India**: Andaman and Nicobar Island, Andhra Pradesh, Bihar, Assam, Kerala and West Bengal (Darjeeling, Kalyani, Midnapore).

Species: 2. *Atractomorpha* sp

Materials Examined: 2 exs., from all the study sites.

Diagnostic characters: Tegmina and wings are well developed.

Habitat: Found to inhabit on *Colocasia antiquarum* and *Calotropis procera*.

Distribution: India: Andhra Pradesh, Bihar, Assam, Kerala and West Bengal **(**Darjeeling, Kalyani, Midnapore**).**

Family: Acrididae
Species: 3. *Spathosternum prasiniferum prasiniferum* (Walker*)* 1871.
1871. *Heteracris prasinifera* Walker, Cat. Derm, Salt, Brit. Mus., 5:65

Materials Examined: 2 exs., from Sankarpur and 1 ex form Digha, Mandarmoni ..

Diagnostic characters: Small, green, integument finely rugose almost smith. Head conical fustigium of vertex absolutely, angular or Parabolic.

Habitat: Found to inhabit on *Calotropis procera.*

Distribution: **India**: Andaman and Nicobar Island, Andhra Pradesh, Bihar, Assam, Kerala and West Bengal (Darjeeling, Kalyani, Midnapore).

Species: 4. *Leva indica* Bolivar, 1902
1902. *Leva indica* Bolivar, I. 1902[1901]. Ann. Soc. ent. Fr. 70:596

Materials Examined: 2 exs., from Petuaghat, Soula and 1 ex form Digha, Sankarpur.

Diagnostic characters: Testacious varied with brown faveolae of the vertex sub quadrate.

Habitat: Found to inhabit on *Calotropis procera*
Distribution: India: Delhi, Uttar Pradesh, Tamilnadu, Assam, Kerala and West Bengal (Darjeeling, Midnapore)

Species: 5. *Oxya fuscovittata,* Marschall 1836
1836. *Gryllus fuscovittata* Marschall, ann, wien, veinna, 1(2), 211.

Materials Examined: 2 exs, from Sankarpur.

Diagnostic characters: Posterior margin of female sub genital plate almost straight and smooth.

Habitat: Found to inhabit on *Oryza sativa, Calotropis procera, Solanum melongena, Solanum tuberosum*

Distribution: **India**: Delhi, Uttar Pradesh, Madhya Pradesh, Orissa, Bihar, Kerala, Manipur and West Bengal (Derjeeling, Birbhum, South 24 Parganas, Kolkata, Midnapore)

Family: Tetrigidae
Species: 6. *Thoracodonta* sp

Materials Examined: 3 exs, from Contai.
Diagnostic characters: Less than 20 mm length, often smaller pronotum is highly elongated, tapered, usually covers abdomen.

Habitat: Found to inhabit on *Calotropis procera* and *Datura metel.*

Distribution: **India**: West Bengal (Midnapore)

Family: Tettigoniidae
Species: 7. *Holochlora indica* Kirby, 1906
1906. *Holochlora indica* Kirby, *Orthop Salt. Part I. Brit. Mus. (Natural History),* London 2:i-viii, 1-562

Materials Examined: 1 ex., from Petuaghat and Soula, 2 exs, from Junput, Sankarpur and Digha, 3 exs, from Bajkul. .

Habitat: Found to inhabit on *Cynodon dactylon, Calotropis procera* and *Clerodendron infortunatum.*

Distribution: India: Jammu, Kashmir, Tamilnadu, Kerala, Himachal Pradesh and West Bengal (Kolkata, Midnapore).

Family: Gryllidae
Species: 8. *Gryllus* sp

Materials Examined: 2 exs., from Petuaghat and Junput, 1ex., from Digha .

Diagnostic characters: Male genitalia is present.

Habitat: Found to inhabit on *Oryza sativa, Croton bonplandianum* and *Clerodendron infortunatum.*

Distribution: India: West Bengal (Midnapore)

Among the eight study sites, two study sites (Bajkul and Contai) are regarded as the semiurbanized areas based on the rapid conversion of agricultural lands for human settlement and other institutional developments. In these two semiurbanized areas, salinity of soil and dew drops was less in comparison to the other six study sites. Another three study sites *viz*. Digha, Sankarpur and Mandarmoni have been under the anthropogenic pressure from tourisms. Rest of the three study sites are the virgin coastal belt. Variations in air temperature, relative humidity and salinity have been noticed during the study period in all study sites.

Table 2: Distribution pattern of the insects belonging to the order Orthoptera in the study sites

Insects				Site of occurrence							
Family	**Species**	**Host plant**	**Family**	**S-I**	**S-II**	**S-III**	**S-IV**	**S-V**	**S-VI**	**S-VII**	**S-VIII**
Pyrgomorphidae	*Atractomorpha crenulata*	*Oryza sativa*	Poaceae	+	+	+	+	+	+	+	+
		Calotropis procera	Asclepiadaceae	+	+	+	+	+	+	+	+
		Brassica sp.	Cruciferae	+	+	-	-	-	-	-	-
		Solanum melongena	Solanaceae	+	+	+	+	+	+	+	+
		Solanum tuberosum	Solanaceae	+	-	-	-	-	-	+	+
		Datura metel	Solanaceae	+	+	-	-	-	-	+	-
	Atractomorpha sp.	*Colocasia antiquorum*	Araceae	+	+	+	+	+	+	+	+
		Calotropis procera	Asclepiadaceae	+	+	+	+	+	+	+	+
Acrididae	*Spathosternum prasiniferum prasiniferum*	*Calotropis procera*	Asclepiadaceae	-	-	-	-	+	+	-	-
	Leva indica	*Calotropis procera*	Asclepiadaceae	+	-	+	-	+	+	-	-
	Oxya fuscovittata	*Oryza sativa*	Poaceae	-	-	-	-	+	-	-	-
		Calotropis procera	Asclepiadaceae	-	-	-	-	+	-	-	-
		Solanum melongena	Solanaceae	-	-	-	-	+	-	-	-
		Solanum tuberosum	Solanaceae	-	-	-	-	+	-	-	-
Tetrigidae	*Thoracodonta* sp.	*Calotropis procera*	Asclepiadaceae	-	-	-	-	-	-	-	+
		Datura metel	Solanaceae	-	-	-	-	-	-	-	+
Tettigomidae	*Holochlora indica*	*Cynodon dactylon*	Poaceae	+	+	-	-	+	-	+	-
		Calotropis procera	Asclepiadaceae	+	+	+	-	+	+	+	-
		Clerodendron infortunatum	Verbenaceae	-	+	-	-	-	-	-	-
Gryllidae	*Gryllus* sp.	*Oryza sativa*	Poaceae	+	+	-	-	-	+	-	-
		Croton bonplandianum	Euphorbiaceae	+	+	-	-	-	-	-	-
		Clerodendron infortunatum	Verbenaceae	+	-	-	-	-	+	-	-

S-I = Petuaghat; S-II = Junput; S-III = Soula; S-IV = Mandarmoni; S-V = Sankarpur; S-VI = Digha; S-VII = Bajkul; S-VIII = Contai

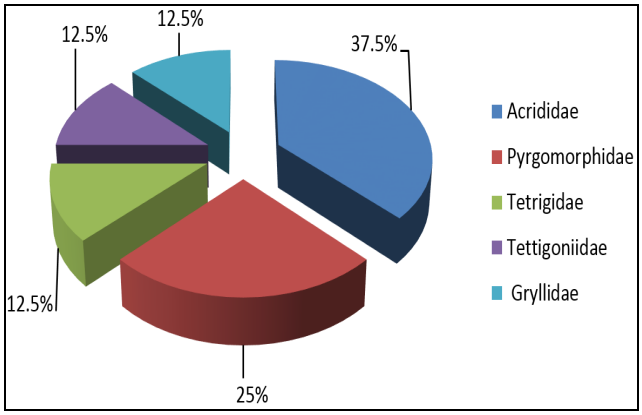

Fig 2: Insect species composition under different families belonging to the order Orthoptera recorded from different study sites (S-I to S-VIII), in and around coastal environment of Midnapore (East), West Bengal

Discussion

The present investigation was undertaken to record the diversity of different Orthopteran insect fauna in eight contrasting study sites (S-I to S-VIII) along the coastal tract of East Midnapore District, West Bengal, India.

The eight study sites of the coastal tract of East Midnapore were found to be contrasting with regard to their meteorological parameters (Air temperature, Relative humidity) and physicochemical parameters of water, soil (salinity and pH), flora and fauna [34] .

The insect species belonging to the order Orthoptera were recorded from 10 host plants comprising of 7 families (Table-2). Overall 8 species of insects were collected belongs to the order Orthoptera comprising with five families in my investigation. Maximum number of species (3) were recorded in the family Acrididae followed by 2 species under the family Pyrgomorphidae. One species of each family except the above two were recorded within the study sites (Tables-1-2, fig.-2).

Among these species of insects *Thoracodonta* sp and *Oxya fuscovittata* were recorded from Contai and Sankarpur respectively and these may be the site specific species. Insect species under the family Pyrgomorphidae were found to occur widely in the present study, indicating their ignorance to environmental changes [35]. Most of the insect species under this order inhabit on more than one or two families of host plants and thereby they are polyphagous in nature.

The ecological conditions in the coastal belt of Midnapore (East), particularly Digha, Sankarpur, Junput, Petuaghat, Haldia have been complicated by the effect of salinity fluctuation, anthropogenic activities and also by the increasing pollution stress. The increasing population in the urbanized sector and places of tourism of this coastal belt has resulted in an increased release of sewage and other waste products of both industrial and municipal origin. Biodegradation of this coastal belt has occurred at an accelerated rate due to the development of fishing harbor, tourism centre, thermal power plants and petrochemical industries and this Biodegradation may lead to the diversity of insect fauna along with their host plants [36].

According to Dunne *et al* [37], insects' biodiversity depends primarily on food web structure including secondary and cascading extinctions. In the present study it has been observed that insect host plant association were changed which provides new insight in the diversity patterns in study areas. *Thoracodonta* sp was found only in non-coastal zone indicating their salinity sensitivity in the coastal zone. *Oxya fuscovittata* was found to occur only in the study site-V (Sankarpur) which is under the places of tourism where anthropogenic perturbations and pollution levels are high and this insect species may be the positive indicator of pollution. Havoc human disturbance reduces species diversity and moderate levels of disturbance may increases the diversity of some community [38]. Possibility of the presence of high level of pollutant in tourism places (Site-IV, Site-V and Site-VI) and semiurbanized areas (Site- VII and S-VIII) disturbed the air qualities resulting in alteration in species richness. According to Alstad *et al* [39] air pollutant may help in increase in herbivorous insect population. It may assumed that in my study most of the insect population preferred virgin coastal belt and places of tourism than the semi urbanized area. Thus it can be proposed that studies on insect host plant association will provide more information towards the understanding of change in diversity pattern and establishment of bio indicator of these insects.

From the above study, it may be concluded that Midnapore (East) coastal tract harbours a good number of Orthopteran insects in its different diversity pattern in which need immediate step for their proper conservation.

Acknowledgement

We are thankful to the Director and scientists of Zoological Survey of India, Kolkata for confirming identification of species. We are also thankful to the authority of Vidyasagar University for providing the Laboratory and Library facilities.

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