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Diversity of ants (Hymenoptera: Formicidae) in the mangrove patches of reclaimed Sunderbans, West Bengal, India

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Abstract

Ants are highly diverse social insects distributed in every terrestrial habitat except the north and south poles. Even though they are a dominant group in the mangrove ecosystem the study of ant diversity in Sunderbans mangrove, the world's largest mangrove ecosystem is yet to start. The objective of this study was to understand the ant diversity in mangrove patches in the villages of Indian Sunderbans. Ants were collected from the reclaimed areas of Indian Sunderbans. Total of 35 species, 21 genera of ants belonging to 5 subfamilies were found in this study. The highest number of species was found in the subfamily Myrmicinae. *Dilobocondyla gasteroreticulatus* reported first time from West Bengal. Ant species *Paratrechina longicornis*, *Crematogaster spp.*, *Monomorium spp*, *Camponotus spp.* and *Tetraponera rufonigra* were the most abundant species in the mangrove habitat. Most of the ants were found from the mangrove associate plant, *Excoecaria agallocha*. The ant species diversity index in this study is moderate ($H' = 2.37$), while the evenness index classified as moderate ($E = 0.5$), and no species of ants dominate this area ($D = 0.1$).

Key words: ants, mangrove, biodiversity, Sunderbans

Introduction

Ants are most impressive group of social insects. They belong to the order Hymenoptera and class Insecta and are placed in a single family of Formicidae. They are abundant in most of the habitats and trophic levels in several terrestrial ecosystems. Ants play important roles in terrestrial ecosystem as predators, detritivores, mutualists, herbivores and sometime pollinators (Holldobler and Wilson, 1990). Many species of ants contribute

to pest suppression in agricultural systems (Way and Khoo, 1992). Although there are 17 subfamilies, about 344 genera and about 14,150 described species of ants in the world (www.antwiki.org).

Sunderbans is the active deltaic complex of Ganga- Brahmaputra estuarine system which covers an area of approximately 10,000 sq. km. of which 62% lies within Bangladesh and 38% in India (ref). In India, the land area measures about 9,629 sq. km of

which 4,493 sq. km. is inhabited by people and rest is reserve forest. During high tide vast areas are inundated with brackish water, covered by halophytic herbs, shrubs and trees called mangroves. Mangrove swamps occur on the intertidal mudflats of estuaries, creeks and inlets. Mangrove habitats are among the most productive and biologically diverse wetland ecosystem on earth. In comparison to Bangladesh, Indian portion of Sunderbans has a poor formation of mangrove due to higher salinity and human interference (Naskar, Guha & Bakshi, 1987). In spite of these problems, Sunderbans in West Bengal still possess 34 true mangrove plants and 62 mangrove associate plants (Mandal & Nandi, 1989). The most common floras are *Avicennia alba*, *A. officinalis*, *Bruguiera gymnorhiza*, *Ceriops decandra*, *Excoecaria agallocha*, *Rhizophora apiculata*, *Sonneratia apetala*. Beyond this, Sunderbans have rich aquatic and terrestrial faunal diversity. More than 40 species of mammals, 163 species of birds, 56 species of reptiles, 165 species of fish, 23 species of molluscs, 15 species of prawns, 67 species of

crabs have so far been reported in Sunderban Biosphere Reserve (www.UNESCO.org).

Ants are often regarded as the most abundant and influential insect group in mangroves (Hogarth, 2007). It is reported that they play an important role in predation of insect pest on *Sonneratia*, *Rhizophora* and *Bruguiera* (Dakir, 2009). Ants and their pheromone could deter herbivorous insects and can reduce crab herbivory (Offenberg, 2006). Many studies of ants from India have been conducted previously except ant diversity in mangrove ecosystem of Sunderbans. By this study a baseline data is generated on ant biodiversity in Sunderbans mangroves which will bring out more of its associations and activities in further studies.

Material and Methods

Sampling sites

Sampling sites selected from inhabited areas of eastern, central and western parts of Indian Sunderbans are given below (Fig.1):

Location	Block	District	Coordinates
Sahebkhal	Hingalganj	24 Parganas North	22°20'4.000"N/88°58'18.000"E
Dayapur	Gosaba	24 Parganas South	22°7'44.040"N/88°50'24"E
Bhagabatpur	Patharpratima	24 Parganas South	21°43'28.39"N/88°18'35.54"E
Bakkhal	Namkhana	24 Parganas, South	21° 33'40.57"N/88°16'4.49"E
Radhakrisnapur	Sagar	24 Parganas, South	21°42'56 "N/88°03'30"E

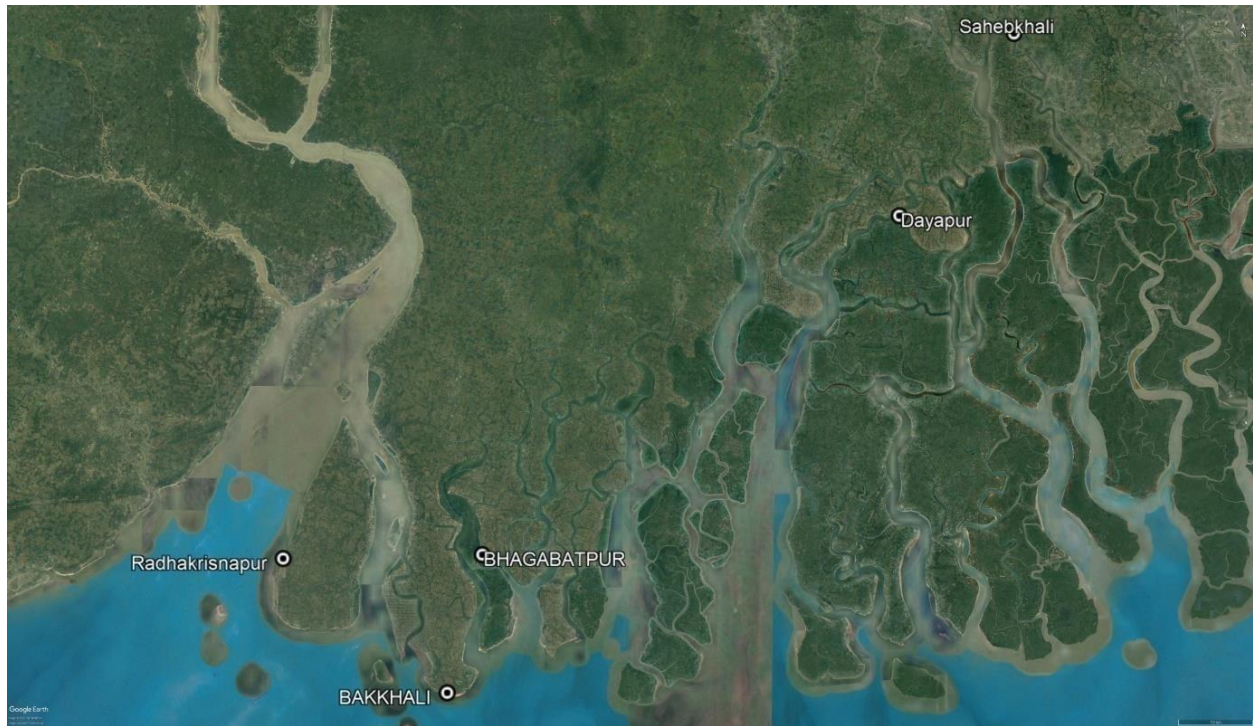


Fig. 1: A satellite image showing five locations of ant sampling in Indian Sunderbans

Methodology

Ants were collected directly by forceps and brush soaked in alcohol from stems, leaves and hollow branches of trees, from the soil, leaf litter and lower vegetation during pre-monsoon (April-June) and post-monsoon (October-November) during 2019-2020. The specimens were identified by referring to Bolton (1995), Bingham (1903), Tiwari (1998) and various keys available.

Results and discussion

A total of 35 species of ants were collected from mangrove patches of reclaimed areas of Indian Sunderbans belonging to 5 sub families, 21 genera and 752 individuals (Table1). The highest number of species were found in Myrmicinae (16 species, 46%),

followed by Formicinae (8 species, 23%), Ponerinae (11%) and Pseudomyrmicinae (11%) both had 4 species while Dolichoderinae had 3 species (9%) (Table 2 & Fig.2). *Monomorium* was most common genus with highest number of species collected. The genus *Tetraoponera* is usually an arboreal species which represents two common species, *T. rufonigra* and *T. allaborans*. Here we found two more species *T. nitida* and *T. nigra* in which *T. nitida* is not a common species and reported in India, only from Andamans. The most abundant genus were *Paratrechina* (RA=18%), *Crematogaster* (RA=17%), *Monomorium* (RA=14%), *Camponotus* (11%) and *Tetraoponera* (9%) (Table3). We identified *Dilobocondyla gasteroreticulatus* (the species is so named due to the presence of fine

reticulations on the gaster) from Patharpratima CD block of South 24 Parganas district on the stem of mangrove trees. *Dilobocondyla gasteroreticulatus* was first reported from Northwest Shivalik range of the Northwest Himalayas (Bharti & Kumar, 2013). We identified four tramp species named *Tetramorium simillimum*, *Paratrechina longicornis*, *Trichomyrmex destructor* and *Solenopsis geminata* from mangrove forest. Primarily these tramp species are closely associated with human and have a detrimental effect on the original inhabitants of ant species of mangroves. We also found that *Excoecaria agallocha*, a mangrove plant is most preferred microhabitat of ants (Table 4 and 5). It was observed that a total 18 genera of ants were using this plant for various purposes. Furthermore, *Camponotus compressus* lives exclusively in twigs of Acacia in a mutualistic relationship with tree hoppers (Fig. 3). *Crematogaster anthracina* found in a small nest cavities and hollow branches of Gum Arabic tree (Fig. 4). Dakir (2009) conducted a study on diversity of ants in mangrove forest of Kolaka, South-East Sulawesi and Muare Angke, Jakarta but he found 18 species. Arryanto *et al.* (2018) studied mangrove forest of North Kayong and recorded only 8 species. Further, Roy *et al.* (2018) reported 12 species from mangroves of Purba Medinipur district, West Bengal.

We calculated species diversity by using Shannon Diversity Index (H'), dominance by using Simpson's Dominance

Index (D) and Evenness by Shannon Evenness Index (E) (Pielou 1966; Shannon & Weaver 1963; Simpson 1949). We found that the ant species diversity index is moderate ($H' = 2.37$), while the evenness index classified as moderate ($E = 0.5$) and no species of ants dominate this area ($D = 0.1$). Therefore, the diversity index indicates that the mangrove areas are rich in biodiversity of ants and this will impact the floral and faunal diversity of mangrove ecosystem.

Conclusions

Mangroves are diverse and highly productive ecological communities at the land-sea interface. The paper deals with the Formicidae fauna collected from five different localities like Sagar Island, Bakkhali, Patharpratima, Gosaba and Hingaljanj in Sunderban delta of West Bengal during 2019-2020. The study revealed that ants are very much diverse in mangrove habitat with highly diverse vegetation. They can adapt to extreme physiological condition during high tide and cyclonic storms. Consequently, it is evident that the biological resources rely one another to sustain a functioning environment.

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Table 1. List of ant species recorded from mangrove patches of Indian Sunderbans

Sub family	Genus	Species	
Dolichoderinae	<i>Tapinoma</i>	<i>Tapinoma indicum</i> Forel	
		<i>Tapinoma melanocephalum</i> Fabricius	
	<i>Iridomyrmex</i>	<i>Iridomyrmex anceps</i> Roger	
Formicinae	<i>Camponotus</i>	<i>Camponotus compressus</i> Fabricius	
		<i>Camponotus sericeus</i> Fabricius	
	<i>Lepisiota</i>	<i>Lepisiota sericea</i> Forel	
		<i>Lepisiota opaca</i> Forel	
		<i>Nylanderia</i>	<i>Nylanderia indica</i> Forel
	<i>Oecophylla</i>	<i>Oecophylla smaragdina</i> Fabricius	
	<i>Paratrechina</i>	<i>Paratrechina longicornis</i> Latreille	
	<i>Polyrachis</i>	<i>Polyrachis rastellata</i> Latreille	
Myrmicinae	<i>Crematogaster</i>	<i>Crematogaster anthracina</i> Smith	
		<i>Crematogaster rogenhoferi</i> Mayr	
		<i>Crematogaster aberrans</i> Forel	
		<i>Carebara</i>	<i>Carebara affinis</i> Jerdon
	<i>Monomorium</i>	<i>Monomorium atomum</i> Forel	
		<i>Monomorium indicum</i> Forel	
		<i>Monomorium latinode</i> Mayr	
		<i>Monomorium floricola</i> Jerdon	
		<i>Trichomyrmex</i>	<i>Trichomyrmex destructor</i> Jerdon
	<i>Trichomyrmex scabriceps</i> Mayr		
		<i>Pheidole</i>	<i>Pheidole watsoni</i> Forel
	<i>Pheidole sagei</i> Forel		
	<i>Pheidole parva</i> Mayr		
		<i>Solenopsis</i>	<i>Solenopsis geminata</i> Fabricius
		<i>Meranoplus</i>	<i>Meranoplus bicolor</i> Guerin-Meneville
	<i>Dilobocondyla</i>	<i>Dilobocondyla gasteroreticulatus</i> Bharti & Kumar	
Ponerinae	<i>Anochetus</i>	<i>Anochetus madaraszi</i> Mayr	
	<i>Diacamma</i>	<i>Diacamma rugosum</i> Le Guilou	
	<i>Leptogenys</i>	<i>Leptogenys hystericus</i> Forel	
	<i>Pseudoneoponera</i>	<i>Pseudoneoponera rufipes</i> Jerdon	
Pseudomyrmicinae	<i>Tetraponera</i>	<i>Tetraponera allaborans</i> Walker	
		<i>Tetraponera nigra</i> Jerdon	
		<i>Tetraponera nitida</i> Smith	
		<i>Tetraponera rufonigra</i> Jerdon	

Table 2. Percentage contribution of various subfamilies of mangrove ants in Sunderbans

Subfamily	Genus (%)	Species (%)
Dolichoderinae	2(10%)	3(9%)
Formicinae	6(29%)	8(23%)
Myrmicinae	8(38%)	16(46%)
Ponerinae	4(19%)	4(11%)
Pseudomyrmicinae	1(5%)	4(11%)
Total	21	35

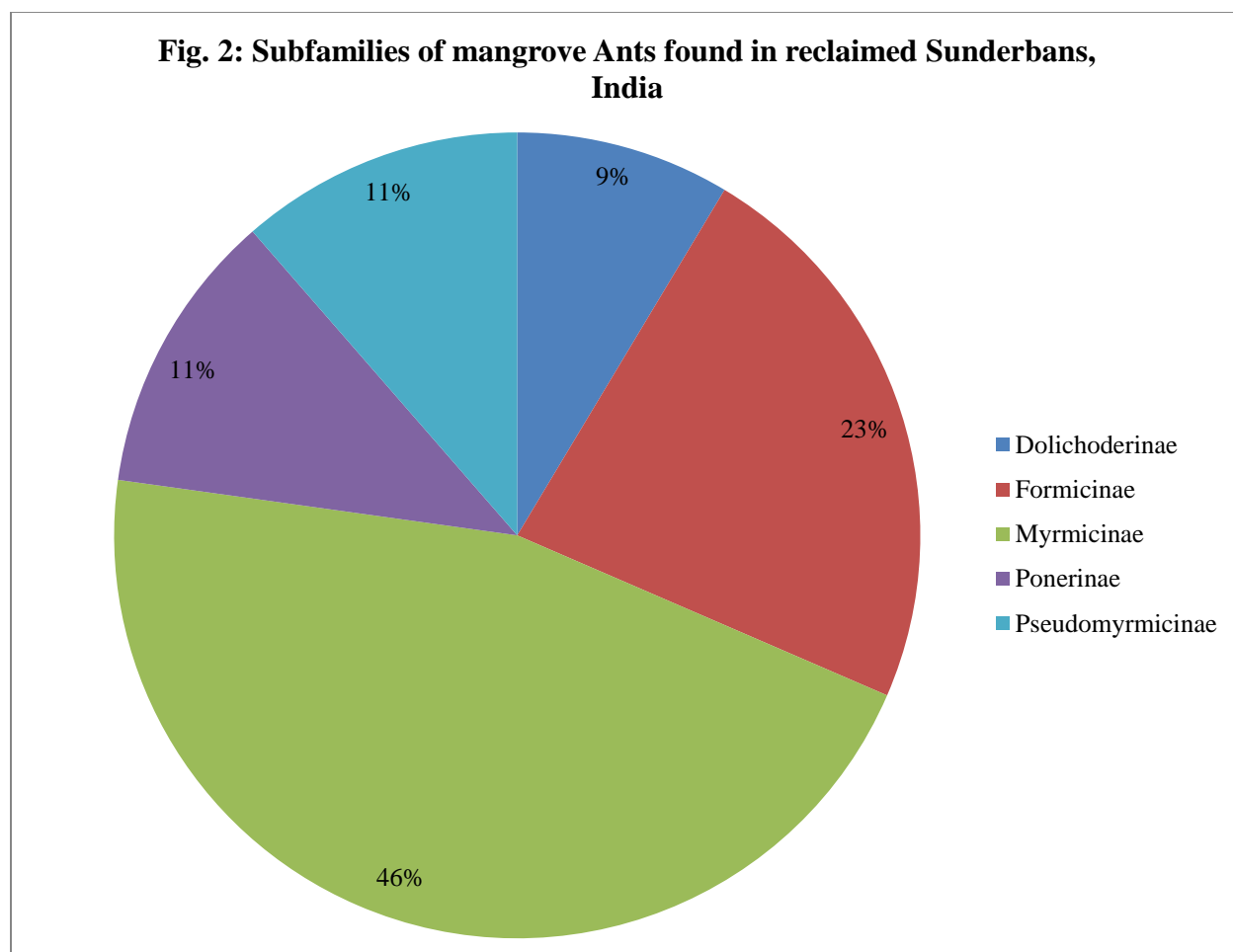


Table 3: Calculation of Relative abundance (RA), Simpson Dominance Index (H'), Shannon Diversity Index (D) and Evenness Index(E) of ants in Sunderbans mangrove

Genus	Relative Abundance	Simpson Dominance Index(H')	Shannon Diversity Index(D)	Shannon Evenness Index (E)
<i>Paratrechina</i>	18.21809	0.116395	2.37236	0.5106
<i>Crematogaster</i>	17.42021			
<i>Monomorium</i>	13.56383			
<i>Camponotus</i>	11.03723			
<i>Tetraoponera</i>	8.510638			
<i>Pheidole</i>	7.845745			
<i>Lepisiota</i>	6.117021			
<i>Nylanderia</i>	4.654255			
<i>Tapinoma</i>	4.255319			
<i>Diacamma</i>	2.792553			
<i>Pseudoneoponera</i>	1.06383			
<i>Solenopsis</i>	0.930851			
<i>Trichomyrmex</i>	0.930851			
<i>Leptogenys</i>	0.531915			
<i>Carebara</i>	0.398936			
<i>Meranoplus</i>	0.398936			
<i>Anochetus</i>	0.265957			
<i>Calalaucus</i>	0.265957			
<i>Dilobocondyla</i>	0.265957			
<i>Iridomyrmex</i>	0.265957			
<i>Tetramorium</i>	0.265957			

Table 4: Preferred host plants of ants in Sunderbans mangrove

ANT GENUS \ PLANT	Gewa (<i>Excoecaria</i> sp.)	Baen (<i>Avicennia</i> sp.)	Kankra (<i>Bruguiera</i> sp.)	Gum Arabic tree (<i>Vachellia</i> sp.)	<i>Casuarina</i>	Ear leaf acacia (<i>Acacia</i> sp.)
<i>Anochetus</i>	P	-	-	-	-	-
<i>Catalacus</i>	P	-	-	-	-	-
<i>Camponotus</i>	P	P	P	P	P	P
<i>Carebara</i>	P	-	-	-	-	-
<i>Cardiocondyla</i>	P	-	-	P	-	-
<i>Crematogaster</i>	P	P	-	P	P	-
<i>Diacamma</i>	P	-	P	-	-	-
<i>Dilobocondyla</i>	P	-	-	-	-	-
<i>Iridomyrmex</i>	P	-	-	-	P	-
<i>Lepisiota</i>	P	P	-	P	-	P
<i>Leptogenys</i>	P	-	-	-	-	-
<i>Monomorium</i>	P	P	-	P	P	P
<i>Meranoplus</i>	-	-	-	P	-	-
<i>Nylanderia</i>	P	-	-	P	P	-
<i>Paratrechina</i>	P	P	-	-	P	P
<i>Pheidole</i>	P	P	-	P	P	P
<i>Pseudoneoponera</i>	P	-	-	P	P	-
<i>Solenopsis</i>	-	P	-	-	-	-
<i>Tapinoma</i>	P	P	-	P	P	P
<i>Tetramorium</i>	-	-	-	P	-	-
<i>Tetraoponera</i>	P	P	-	P	P	-
<i>Trichomyrmex</i>	P	P	-	-	-	-

Table 5: Species richness of ants in different pants in Sunderbans mangrove

Microhabitat	Species richness
Gewa tree (<i>Excoecaria agallocha</i>)	18
Gum Arabic tree	12
Casuarina tree	10
Baen tree (<i>Avicennia</i> sp.)	10
Ear Leaf Acacia tree	6



Fig. 3: *Camponotus compressus* feeding on the excretion of tree hoppers i at Bakkhali, Sunderbans



Fig. 4: *Crematogaster antracina* nest in cavity of gum Arabic tree at Patharpratima, Sunderbans

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