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Habitat Preference of Crabs in Pichavaram Mangrove Environment, Southeast Coast of India

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Abstract: The diversity of the crabs in the Pichavaram mangroves for the first time has shown that there are 46 species of crabs from the five different stations. The neritic zone (Chinnavaikal) was rich in species composition (35 species). The freshwater zone was poor in species composition (14 species) and population density. Among the crab species *Sesarma* and *Uca* species were dominant in almost all the stations. Grapsid crabs were the most dominant species. Neritic and *Avicennia* zones showed more number of crab species but less number of species was noted in slightly saline zone. The substrate suitability, tidal inundations mangroves distribution and salinity were the possible factors for distribution of crabs in Pichavaram mangroves.

Key words: Mangrove crabs, habitat preference, diversity, zonation, richness, evenness

INTRODUCTION

Biodiversity issues in coastal zones are important for conservation of species and habitats. Brachyuran crabs, which contribute a bioenergetically significant faunal component, play a significant role in maintaining a steady state of the mangrove ecosystem. Zonation, distribution and salinity tolerance of both mangrove vegetation and brachyuran crabs was described in many mangrove forests crabs constitute maximum number of macrofaunal biomass in this environment (Augusto *et al*., 2005; Dahdouh-Guebas *et al*., 2004; Sean *et al*., 2005; Nordhaus *et al*., 2006; Diele and Smith, 2006). Two families of crabs are particularly associated with mangrove ecosystem, the Grapsidae (63 species) and the Ocypodidae (30 species) (Jones, 1984). However studies on biodiversity of crabs in Indian mangroves have not much attempted so far. Hence, the present study reports for the first time data on the number of crab species occurring in five different sites of the Pichavaram mangroves, their distribution, relative abundance and also zonation in relation to the mangrove species.

MATERIAL AND METHODS

Pichavaram mangrove (Lat. 11° 27' N; Long 79° 47' E) represents a heterogeneous mixture of mangrove elements. It lies between the Vellar and Coleroon estuaries, located at 250 km south of Chennai City on the southeast coast of India. Field study was carried out in the Pichavaram mangrove from February 2004 to January 2005 at monthly intervals. The study was undertaken in both creek and fringe mangroves in five sampling sites, varying in microclimatic niche (Fig. 1). Crab burrow density was recorded in 5 randomly placed one square meter quadrates as per Jones (1984). Crabs were collected at low tide and preserved in 70% alcohol for identification (Rathburn, 1918, 1930; Chhapger, 1957; Sakai, 1976; Williams, 1965, 1984).

The general survey involved, collection of various species of crabs from the creek and fringe mangrove vegetations to describe their species richness. Density of the crabs were estimated random

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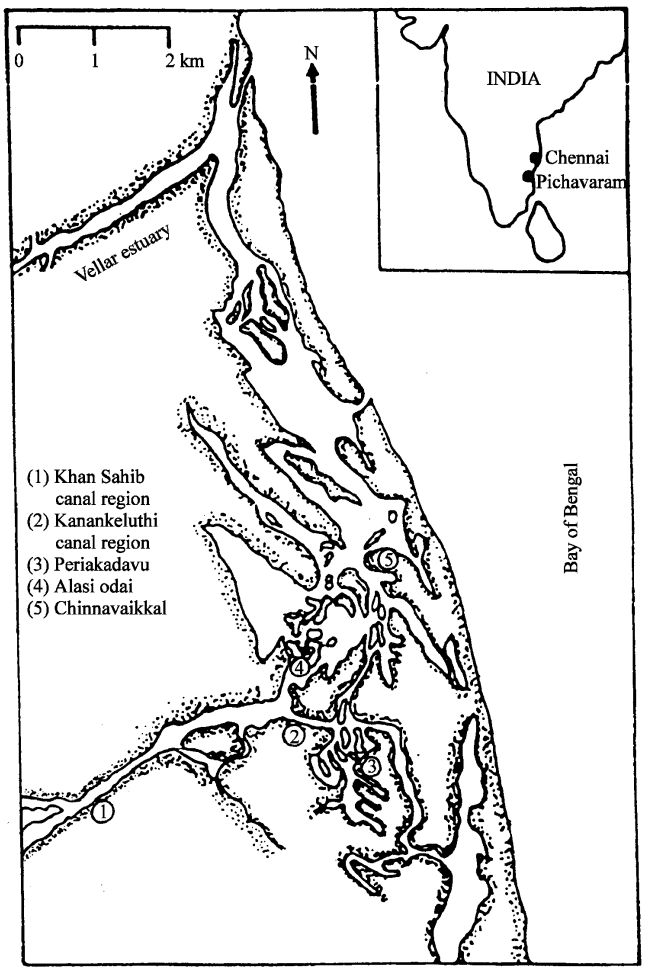

Fig. 1: Sampling stations in Pichavaram mangrove

sampling in the Pichavaram islands by number of crabs active on the substrate enclosed within the quadrant or by digging the crabs from their burrows. The atmospheric temperature, surface water temperatures were recorded using a Celsius thermometer and salinity also estimated (Stickland and Parsons, 1968).

To assess the species diversity of the crabs in the environment, the formula of Shannon and Wiener (1949) was used the species richness was calculated by simpson's and evenness or equitability, in the distribution of individuals among various species was calculated using the program written by Bakus (1989).

RESULTS

Species Composition

A total of 46 species of crabs were recorded from five sites (Table 1). Maximum number of species (31) was observed during the postmonsoon especially in January (31) and minimum (12) during the summer particularly in May.

Number of crab species recorded was maximum at station 5 (35) and minimum number (14) at station 1 (Table 1). Among the crab species *Sesarma* and *Uca* species were the most dominant in almost all the islets. *Sesarma brockii*, *S. plicatum*, *Neoepisesarma tetragonum*, *Metapograpsus messor*, *Pseudograpsus intermedius*, *Macropthalmus depressus*, *Uca triangularis* and *U. annulipes* were commonly found in all the five stations. But, *Plugusia depressa*, *Graspus tenuicrustatus* and *Neoepisesarma medri* were observed only in the core mangrove site (Periyakadavu station) and *Portunus*, *Podapthalmus*, *Ocypods*, *Dotilla*, *Dromia* and *Leptodius* species only in the neritic zone (Chinnavaikkal station) in the present study. The abundance of crab species among the stations is given in the following order.

Chinnavaikkal > Periyakadavuu >Alasi odai > Kanankeluthi canal > Khan Sahib canal.

Population Density

The crab population density varied between 595 and 885 individuals among the stations. Minimum (595) was documented at station 4 and the maximum (885) in station III (Table 1). Crab population varied significantly between months and station-wise analysis.

Zonation

Higher number of crab species was observed in the Neritic zone (36) and core mangrove zone (29). Very less number of species was noticed in the freshwater zone (14). Among all the zones, dominant representative was Sesarmid group of crabs (Table 3).

Based on vegetation, Pichavaram mangrove is divided into *Rhizophora* zone, *Avicennia* zone, back mangrove zone and non-saline or slightly saline zone. Among these zones, *Avicennia* zone was found to have more number of crab species (22) and very less number (1) of crabs in the non-saline zone (Table 4). *Cardisoma carnifex* was found commonly in all the zones except in *Rhizophora* zone while, *Charybdis* species were seen only in the *Rhizophora* zone (Table 5).

Salinity and Temperature

The salinity ranged from 0.6 to 36.2% during the study period (February 2004 to January 2005). The maximum salinity of 36.2% was reported in the month of April and minimum salinity of 0.6% in December. Salinity varied significantly between month and station-wise analysis.

The atmospheric temperature ranged between 18. 2 and 37. 6°C. The surface water temperature varied from 16 to 36. 2°C. Maximum atmospheric temperature was recorded in the month of May 2004 and minimum in the month of December 2004. The highest surface water temperature was recorded during May, 2004 and the lowest during December 2004. Atmospheric and surface water temperature varied significantly between month of analysis but not station-wise analysis.

The statistical analysis indicates that the environmental variables such as salinity, atmospheric temperature and surface water temperature have tremendous influence on the population density of the crabs.

Species Diversity Index

The species diversity index varied between 2.674 and 3.388 among the five stations. High species diversity index was noticed in station III and low species diversity index at station II. The evenness values varied between 0.644 and 0.701 minimum value (0.644) was recorded at station IV and the maximum value (0.791) at station III. The richness index in the stations fluctuated from 0.744 to 0.846. Minimum (0.774) was recorded at station I and the maximum (0.846) at station III (Table 2).

Table 1: Station wise distribution of crabs

Name of the species	Total I	II	III	IV	V	Total
Sesarma brockii	71	68	104	122	107	472
S. plicatum	30	69	41	27	33	200
S. andersoni	4	7	13	4	-	28
S. bidens	-	-	7	-	5	12
Neoepisesarma tetragonum	30	19	51	5	26	131
N. medri	-	1	2	-	-	3
Nanosesarma minutum	-	-	4	8	-	12
N. batavicum	1	3	5	-	1	10
Plugusia dentipes	-	-	2	-	13	15
P. depressa	-	-	3	-	-	3
Grapsus strigosus	-	-	10	2	-	12
G. tenuicrstatus	-	-	3	-	-	3
Metapograpsus maculatus	11	-	27	5	-	43
M. messor	16	7	34	26	14	97
Ptychognathus altimanus	-	-	2	2	-	4
Pseudograpsus intermedius	5	3	9	2	3	22
Cardisoma carnifex	23	7	21	7	-	58
Ocypode macrocera	-	-	7	9	32	48
O. platytarsus	-	-	-	-	5	5
Uca(celuca)lactea annulipes	197	193	252	170	210	1022
Uca triangularius bengali	187	197	198	137	186	905
Macopthalmus depressus	31	28	33	24	20	136
M. erato	-	-	3	-	9	12
Dotilla myctiroides	-	-	-	-	6	6
Metaplex elegans	-	6	-	-	3	9
M. distincta	-	4	-	-	3	7
Heteropanope indica	5	1	6	-	-	12
Galene bispinosa	6	14	7	-	11	38
Charybdis feriata	-	-	-	2	5	7
C. granulata	-	-	-	-	2	2
C. lucifera	-	-	-	6	2	8
C. helleri	-	-	2	5	4	11
Scylla settata	-	14	21	12	17	64
S. tranquebarica	-	-	9	3	5	17
Portunus sanguinolentus	-	-	-	-	4	4
P. pelagicus	-	-	-	5	13	18
P. gladiator	-	-	-	2	4	6
Thalamita crenata	-	-	4	7	11	22
T. chaptali	-	-	5	1	6	12
Pinnotheres sinensis	-	-	-	-	3	3
Varuna altimana	-	-	-	2	-	2
Podapthalmus vigil	-	-	-	-	8	8
Dotilla clepsydrodactylus	-	-	-	-	4	4
Leptodius crassimanas	-	-	-	-	3	3
Dromia dehanni	-	-	-	-	2	2
Dorippe facchino	-	-	-	-	4	4
Total	617	641	885	595	784	3522

(No. of individuals in one square meter)

Table 2: Biodiversity indices obtained for crabs at different stations

Parameters	Stations I	II	III	IV	V
Species diversity	2.674	2.729	3.388	2.830	3.296
Richness	0.774	0.784	0.846	0.796	0.834
Evenness	0.684	0.682	0.690	0.644	0.701

Table 3: Zonation of crabs based on the environment

Fresh water zone	Muddy zone	Core mangrove zone	Oyster zone	Neritic zone
Cardisoma carnifex	*Sesarma brockii*	*Sesarma brockii*	*Grapsus strigosus*	*Scylla serrata*
Neoepisesarma tetragonum	*S. plicatum*	*S. plicatum*	*G. tenuicrstatus*	*S. tranquebarica*
N. medri	*S. andersoni*	*S. andersoni*	*Metapograpsus maculatus*	*Portunus sanguinolentus*
Nanosesarma minutum	*S. bidens*	*S. bidens*	*M. messor*	*P. pelagicus*
Ocypode macrocera	*Macopthalmus depressus*	*Neoepisesara tetragonum*	*Scylla serrata*	*P. gladiator*
O. platytarsus	*M. erato*	*N. medri*	*S. tranquebarica*	*Podapthalmus vigil*
Uca (celuca) lacta annulipes	*Nanosesarma minutum*	*Nanosesarma minutum*	*Thalamita crenata*	*Pinnotheres sinensis*
Uca triangularius bengali	*N. batavicum*	*N. batavicum*	*T. chaptali*	*Varuna altimana*
Sesarma brockii	*Plugusia dentipes*	*Plugusia dentipes*	*Macopthalmus depressus*	*Leptodius crassimanas*
Metapograpsus maculatus	*P. depressa*	*P. depressa*	*M. erato*	*Dromia dehanni*
M. messor	*Grapsus strigosus*	*Grapsus strigosus*	*Charybdis lucifera*	*Charybdis feriata*
S. andersoni	*G. tenuicrstatus*	*G. tenuicrstatus*	*C. helleri*	*C. granulata*
Macopthalmus depressus	*Metapograpsus maculatus*	*Metapograpsus maculatus*	*Plugusia dentipes*	*C. lucifera*
M. erato	*M. messor*	*M. messor*	*P. depressa*	*C. helleri*
	Scylla serrata	*Scylla serrata*		*Ocypode macrocera*
	S. tranquebarica	*S. tranquebarica*	*Ptychognathus altimanus*	*O. platytarsus*
	Thalamita crenata	*Thalamita crenata*	*Pseudograpsus intermedius*	*Metapograpsus maculatus*
		Uca(celuca) lactea annulipes	*Portunus gladiator*	*M. messor*
		Uca trianularius bengali	*Nanosesarma minutum*	*S. andersoni*
		Dotilla myctiroides	*Metapograpsus maculatus*	*Macopthalmus depressus*
		Metaplex elegans	*M. messor*	*M. erato*
		Macopthalmus depressus	*Sesarma andersoni*	*Neoepisesarma tetragonum*
		P. pelagicus	*Heteropanope indica*	*N. medri*
		P. gladiator	*Galene bispinosa*	*Nanosesarma minutum*
		Podapthalmus vigil		*N. batavicum*
		Pinnotheres sinensis		*Plugusia dentipes*
		Varuna altimana		*P. depressa*
		Leptodius crassimanas		*Grapsus strigosus*
		Dromia dehanni		*G. tenuicrstatus*
				Metapograpsus maculatus
				M. messor
				Ptychognathus altimanus
				Pseudograpsus intermedius
				Dotilla myctiroides
				Metaplex elegans
				Neoepisesarma tetragonum

Table 4: Zonation of crabs based on the mangrove environment

Rhizophora zone	Avicennia zone	Back mangrove zone	Non saline zone
Sesarma brockii	*Sesarma brockii*	*Cardisoma carnifex*	*Cardisoma carnifex*
S. plicatum	*S. plicatum*		
S. andersoni	*S. andersoni*		
S. bidens	*S. bidens*		
Neoepisesarma tetragonum	*Neoepisesarma tetragonum*		
N. medri	*N. medri*		
Nanosesarma minutum	*Nanosesarma minutum*		
Charybdis feriata	*N. batavicum*		
C. granulata	*Plugusia dentipes*		
C. lucifera	*P. depressa*		
C. helleri	*Grapsus strigosus*		
Scylla serrata	*G. tenuicrstatus*		
S. tranquebarica	*Metapograpsus maculatus*		
Thalamita crenata	*M. messor*		
T. chaptali	*Scylla serrata*		
Macopthalmus depressus	*S. tranquebarica*		
M. erato	*Thalamita crenata*		
	Uca(celuca) lactea annulipes		
	Uca triangularius bengali		
	Dotilla myctiroides		
	Metaplex elegans		
	Macopthalmus depressus		

Table 5: Zonation of crabs in Pichavaram mangroves

Cardisoma zone	Sesarma zone	Ocypode zone	Uca zone	Mixed zone
Cardisoma carnifex	*Sesarma brockii*	*Ocypode macrocera*	*Uca(celuca) lactea annulipes*	*Charybdis feriata*
	S. plicatum	*O. platytarsus*	*Uca trianularius bengali*	*C. granulata*
	S. andersoni	*Uca(celuca) lactea annulipes*		*C. lucifera*
	S. bidens	*Uca triangularius bengali*		*C. helleri*
	Neoepisesarma tetragonum	*Macopthalmus depressus*		*Scylla serrata*
	N. medri	*M. erato*		*S. tranquebarica*
	Nanosesarma minutum			*Portunus sanguinolentus*
	N. batavicum			*P. pelagicus*
	Plugusia dentipes			*P. gladiator*
	P. depressa			*Podapthalmus vigil*
	Grapsus strigosus			*Pinnotheres sinensis*
	G. tenuicrstatus			*Varuna altimana*
	Metapograpsus maculatus			*Leptodius crassimanas*
	M. messor			*Dromia dehanni*
	Thalamita crenata			
	T. chaptali			
	Podapthalmus vigil			

DISCUSSION

Of all benthic macrofauna inhabiting the mangrove swamps, brachyuran crabs are among the most important taxa with regard to species diversity and total biomass. Crabs depend directly on mangrove for survival and are adapted to the special sediment conditions, tidal fluctuations and varying salinities found in mangroves (Cocelho, 1967). The abundance and species richness of crab were examined in a subtropical mangrove forest in Moreton Bay Australia (Skilleter and Warren, 2000).

In the present study, as many as 46 species of crabs were recorded in the five different stations of Pichavaram mangrove. High number (35) of species was found distributed in the Chinnavaikal region and very less number (14) of species in Khan Sahib canal region. Chinnavaikal is a neritic zone, which

promotes crab diversity. Sesarmid crabs are common in all the five stations but they are abundant in Peryakadvau is a dense mangrove area. But interestingly *Portunus*, *Podaphthalmus*, *Ocypods*, *Dromia*, *Dorippe* and *Dotilla* were observed only in the Chinnavaikkal region, which has more neritic influence.

Species composition and diversity were high during postmonsoon and less during summer. High floral and faunal diversities during postmonsoon season increase the availability of food along with maximum organic carbon due to rain, optimum salinity, also temperature and physical changes in the substrate composition. Ocypodid and Grapsid crabs are the dominant forms in the Pichavaram mangrove but in the intertidal zones of Hoogly estuary, Sundarbans *Metaplex intermedia* constitutes the dominant faunal component (Chakaraborthy *et al*., 1992). However, in the present study, *Uca triangularis*, *U. annulipes* and *S. brockii* are found to be the dominant species in the Pichavaram mangrove. The minimum density was observed during the summer is related to high temperature and salinity which may reduce availability of nutrients (Kathiresan, 2000; Ravichandran and Kannupandi, 2004). An increasing trend was reported in macrobenthic population towards postmonsoon in the tidal creeks of Sagar island (Bhunia and Choudhury, 1981) but the lowest population during the premonsoon from Sundarban mangrove (Chakaraborthy and Choudhury, 1994). Parulekar *et al*. (1980) also recorded more benthic faunal population in the estuaries and backwaters of Sagar island of Sundarban mangrove during the postmonsoon season.

Distribution and zonation of crabs are based on the substratum, waterlevel and floral distribution. The species components were dissimilar among the stations studied. The Ghost crab *Ocypode macrocera* preferred sandy substratum, whereas *Macropthalmus* species preferred only muddy substratum. *Uca* species was found in dry or grassy, elevated and muddy substratum. The Ocypode was found above the high water mark, while members of the sub family Ocypodidae were dwellers in the mud below high water neap (Snelling, 1959). In the present study high population density was noticed in station 3, which has dense mangrove and low population density was observed in station 1 lacking forest cover.

Habitat structural complexity influences the density and diversity of marine organisms and contributes to zonation, where the level of complexity varies significantly with tidal height (Loheer *et al*., 2000). Chinnavaikkal region is divided (Pichavaram) into five different zones based on crab species (Ravichandran *et al*., 2000; Ravichandran and Kannupandi, 2004a). In the present study also, maximum number of species was observed in the neritic zone and very less number of species in freshwater zone. Similarly in the *Avicennia* zone more number of species were recorded and least number of crabs in the slightly or non-saline zone. The leaves of *A. marina* contain rich nutrients and more palatable compared to other mangrove leaves (Lee, 1989; Rajendran and Kathiresan, 2000; Ravichandran and Kannupandi, 2004b; Ravichandran and Kannupandi, 2005). This perhaps may be the reason for maximum number of grapsid crabs present in the *Avicennia* zone.

In the present study, as many as 46 species of crabs were present in five stations. Species composition and population density were maximum in the core mangrove region (Periyakadvu region) and less in the fresh water zone (Khan Sahib canal region). Grapsid crabs are the dominant species among the crab taxa. The mangroves distribution, substrate suitability and tidal inundations were found to be the possible factors which influence zonation and distribution of crabs in the Pichavaram mangrove.

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