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DIVERSITY AND DISTRIBUTION OF MANGROVE CRABS IN THREE INTERTIDAL AREAS OF BALOCHISTAN, PAKISTAN

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ABSTRACT: The mangrove crab diversity and densities were studied by transect analyses from three coastal sites (Bhaira, Dam and Miani) of Balochistan. Among all the macrofauna inhabiting in the mangrove swamps, some brachyuran crab species are among the most important taxa with regard to species diversity and distribution The brachyuran crabs were collected from the low tide level to high tide level. Diversity and distribution of crabs were significantly different between the sites and among tidal levels. A total of 14 species of brachyuran crabs was recorded belongs to the family Ocypodidae, Macrophthalmidae, Dotillidae, Camptandriidae, Grapsidae and Xanthidae. The 11 species were from the Bhaira mangroves, while 10 species were recorded in Miani mangroves. The abundance of crabs varied between the tide levels among three habitats.

KEYWORDS: Brachyuran crabs, Density, Diversity, Bhaira, Grapsidae, Ocypodidae.

INTRODUCTION

Mangrove is the habitat of very rich faunal assemblage and taxonomic diversity. The significance of mangroves and mangrove associates (fauna and flora), as an ecological group, is well known (Azariah and Govinda Samy 1998, Alongi 2002, Saravana Kumar 2007, Priyadarshani 2008, Saher and Qureshi 2012). In mangrove swamp the brachyuran crabs are among the most important taxa with regard to species diversity and total biomass and is a valuable asset to the mangrove ecosystem (Jones 1984, Macintosh 1984, Ashton et al. 2003). They make up as much as 80% of the macrofaunal biomass in mangroves and densities reach as much as 80–90 m^{-2}(Macintosh 1984,1988). Crabs play many important roles in the mangrove system as these crabs aerate the sediment through burrowing (Micheliet al. 1991), modify topography and grain size distribution (Warren and Underwood 1986), trap energy within the mangrove forest (Robertson and Daniel 1989, Lee 1998, Ashton 2002), create microhabitat for other fauna (Bright and Hogue 1972, Gillikin et al. 2001), contribute to secondary production (Lee 1998), and increase the amount of nutrients (Kristensen et al. 2008) and decrease the sulfide concentration in the sediment (Smith et al. 1991). Due to the significant role burrowing crabs play in the mangrove ecosystem, Smith et al. (1991) considered them as key stone species.

There are few reported investigations of crab's diversity and distribution present from the Karachi coast (Hashmi, 1971, Siddiqui and Ahmed, 1991, Saher and Qureshi 2011 and 2012) , but no information available from the Balochistan coast This study represents the first description of the composition and diversity of Some brachyuran crab associated with vegetation and substrates in the Sonmiani, Balochistan mangroves.

MATERIALS & METHODS

Study site

***Sonmiani*:** The Sonmiani Bay (locally called as Miani Hor) lagoon is situated some 90 km away from Karachi along the coast of Balochistan coast. It is located at approximately 25°26'N At Sonmiani Bay, three fishing villages, Damb, Miani and Bhaira are situated . At Miani fishing village the natural mangrove, *Avicennia marina* was sparse and patchy with stunted growth. The site consists of a very gently sloping intertidal area with mangroves at the seaward end (Sonmiani Bay), the width of the intertidal zone was about 2.0 km.

***Bhaira*:** Bhaira (25°29'N 66°33'E) is one of the fishing village of Sonmiani Bay (Miani Hor). Bhaira village is 6 km from the Dam with no road connection between Damb and Bhaira, therefore, the site was visited during low tides and visited through the exposed area. At this site the mangrove stand appears to be natural, healthy with dense patches and pneumatophores. The site consists of a sloping intertidal area with a dense stand of mangroves at the seaward end (Sonmiani Bay),the width of the intertidal zone was about 0.5 to 1.0 km. The site was visited during low tides.

Sampling and methodology: The sampling sites visited twice during November, 2002.. At each site two transects (50 meters) were set up in the mangrove area from the low tide mark to the high tide mark during low tide periods. On each transect, a 0.5m quadrate frame ($0.25m^2$) was placed (10 meters apart) at 5 different tidal levels. The quadrate was excavated down to the depth of 30 cm (as most of the crabs do not construct burrows deeper than 30 cm),the excavated sediments were sieved on 1 mm mesh size seive. The crabs present in each quadrat were bagged in labeled polythene bags and kept in ice box that was brought back to the laboratory. Crabs were sorted, identified up to the species level, measured and sexed and the proportion of each species in the samples was calculated.

To identify the relationship of crabs with the habitat, sediment samples taken by PVC cores (inner diameter (ID) 5.6 cm, up to 30 cm deep) from each tidal level of each site to analyze the sediment properties. In the laboratory the sediment properties (percent porosity, percent organic matter content and grain size) were analyzed by following Saher and Qureshi (2011). Briefly, for organic content 2–5 g of dry sediment sample was placed in a pre-weighed crucible, covered with a lid and ignited at 450°C for 3 hrs. Grain size was analyzed by dry sieving methodology following Folk (1974).

The diversity of brachyuran crabs was calculated following the Shannon–Wiener index (Shannon and Weaver, 1949), species richness was calculated by Margalef index (d) using the formula

$d = (S–1)/\log N$, where S is the number of species and N the total number of crabs.

The evenness (J) was computed using the following formula of Pielou 1977. Dominance was calculated as:

$Di=(ni/N)*100$

Where *Di* is the mean dominance index for species *i*, *ni*, the number of individuals belonging to species *i*, *N*, the total number of individuals belonging to all the species (Bellan-Santini 1969, Soyer 1970).

RESULTS & DISCUSSION

RESULTS

Physical parameters: Spatial variations were observed in all physical parameters. The estimated percent organic matter contents were high at Bhaira (14.73±3.59) as compared to the Dam and Miani. The percent porosity (79.03±27.71) and the density of crab (77.2 ±73.6m^2) were high at Miani and then Bhaira and Dam (Table 1). The grain size analyses revealed fine sand at all three study areas (Table 1). The maximum granulometric Mean (φ) was (2.54±0.135) at Dam (Table 1).

Table 1. Descriptive statistics for the sediment properties and density of crab collected from three station of Sonmiani.

Factor	N	Miani		N	Dam		N	Bhaira	
		Mean ±SD	Min-Max		Mean ±SD	Min-Max		Mean ±SD	Min-Max
Porosity (%)	10	79.03±27.71	41.20-129.19	6	17.88±0.77	16.94-18.96	8	61.47±13.46	51.89-85.36
Percent Organics (%)	10	3.75±1.15	2.24-4.99	6	1.66±0.344	1.24-2.01	8	14.73±3.59	12.87-23.54
Mean (φ)	5	2.15±0.35	1.677-2.587	3	2.54±0.135	2.410-2.680	4	2.441±0.414	1.920-2.933
Density m^2	10	77.2 ±73.6	12 - 228	6	54.0 ±16.15	36 - 84	8	43 ±13.48	20-64

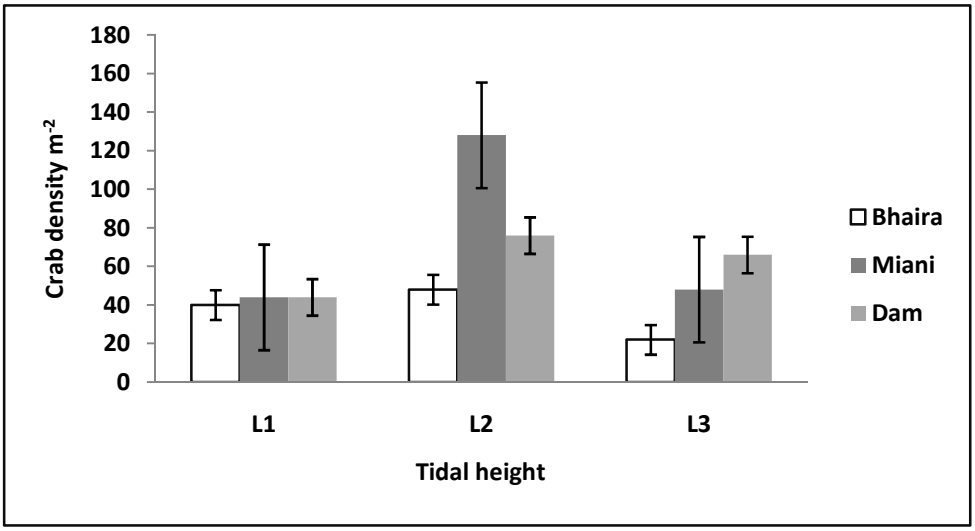

Fig.1. The zonal density m^2 distribution of crabs at three mangrove study sites of Balochistan. (L1 (low tide level), L2 (mid tide level) and L3 (high tide level).

Zonal Distribution of Crabs: The density distribution of crab's species varied between the sites as well as among the tidal height (Fig. 1). High crab density (m^2) was estimated at a mid tide level, than high tide and low tide levels (Figure 1).The highest density (128 m^2) was observed at L2 in Miani and lowest density (22 m^2) was observed at L1 in Bhaira.A very few species were observed at low tide level in soft sediments. The Grapsid species were found at Bhaira and Dam were associated with the sparse mangrove vegetation. There was a marked zonal distribution of crab species observed from low tide level to high tide level as well as between biotopes (Table 2).

Table 2. The mean size distribution of Brachyuran crabs collected from the three sites (Miani, Bhaira and Dam)of Sonmiani.

S.No	CRAB SPECIES	FAMILY	MEAN SIZE (mm) CRAB (MALE			MEAN SIZE (mm) CRAB (FEMALE)		
			MIANI	DAM	BHAIRA	MIANI	DAM	BHAIRA
1	*Dotilla blandfordi*	Dotillidae	-	-	7.17±1.44 (5.50-8.0)	-	7.25 ±0.06 (6.5-8.0)	-
2	*Eurycarcinus orientalis*	Xanthidae	-	14.00	10.00	-	-	-
3	*Ilyograpsus paludicola*	Macro-pthalmidae	-	-	9.0±1.41 (8.0-10)	-	-	-
4	*Ilyoplex frater*	Ocypodidae	8.5±0.8 (7.0-10)	6.78±1.7 (4.5-10)	8.5±0.00 (8.5-8.5)	8.4±1.28 (5.5-11)	7.2±2.2 (4.0-9.0)	7.7±1.4 (6.0-9.5)
5	*Macropthalmus boscii*	Macro-pthalmidae	-	13.0±1.4 (11 -15)	10.5±0.70 (10 - 11)	-	13.5 ±2.6 (11-16)	8.54±3.5 (4.0-13.0)
6	*M. pectinipes*	Macro-pthalmidae	10.0±1.4 (9-11)	12.0±5.6 (8-16)	19.00	10.7±0.7 (10-11.5)	12.6±2.7 (9.5-17.0)	-
7	*Opusia indica*	Campt-andriidae	8.2±1.8 (5.5-16.0)	-		7.4±1.3 (4.0-10.0)	-	
8	*Parasesarma plicatum*	Sesarmidae	-	-	17.0	-	-	17.0
9	*Scopimera crabicauda*	Dotillidae	-	6.7±0.35 (6.5-7.0)		-	7.0±0.0 (7.0-7.0)	
10	*Uca (Paraleptuca)iranica*	Ocypodoidae	11.2±4.1 (4-17)	11.3±2.6 (6.5-17)	12.3±1.7 (9-16)	6.0±3.0 (4.0-12.0)	9.3±2.2 (4.0-13.0)	10.4±2.6 (5.5-13.5)
11	*U.(Paraleptuca) sindensis*	Ocypodoidae	10.0±0.00 (10 - 10)	-	8.3±3.1 (3.5-16.5)	9.0±1.7 (7.0-10.0)	-	6.2±1.5 (5.0-8.0)
12	*U. (Tubuca)urvillei*	Ocypodoidae	-	-	17.9±2.07 (16-21)	-	-	-
13	*Metaplax indicus*	Varunidae	-	-	-	-	17.00	-
14	*Nasima dotilliformes*	Campt-andriidae			18.5±2.5 (13.5-22.1)			

Crabs Density and Distribution: A total of 14 brachyuran crab species belonging to three super families Ocypodoidea, Grapsoidea and Xanthoidea were recorded from the study sites. This included two grapsoid species, 11 Ocypodoid species and only one Xanthoid species. From the Bhaira the 11 species were recorded includingtwo species of family Dotillidae, one species *Eurycarcinus orientalis*, of family Xanthidae, three species *Ilyograpsus paludicola*, *Macropthalmus boscii* and *M. pectinipes* of family Macrop-thalmidae, and four species belong to the family Ocypodidae, one species *Opusia indica* of family Camptandriidae and one species of family Sesarmidae (*Parasesarma plicatum*) were found from Bhaira (Table. 2). The 8 species of five familes (Dotillidae Xanthidae. Macropthalmidae, Ocypodidae and Grapsidae) were identified from Dam, 5 species of

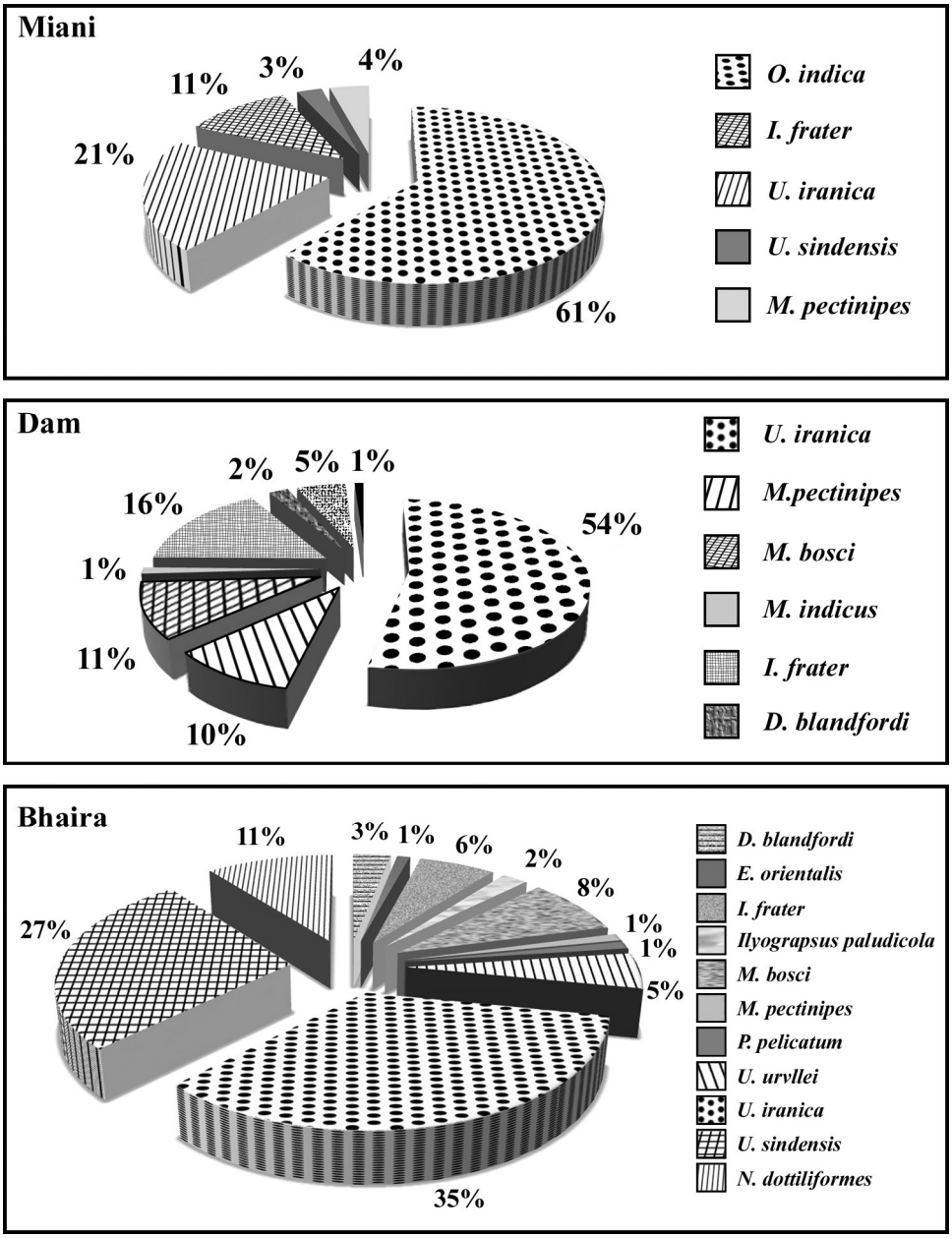

Fig. 2. Percent species composition of Crabs at three study sites.

Ocypodoideafrom Miani, three species of family Ocypodidae, one species (*O.indica*) of family Camptandriidae and one species *M. pectinipes* of family Macropthalmidae were found in Miani mangrove areas while there were no species of Dotillidae, Xanthidae and Grapsidaefound in Miani.(Table.2). The *O. indica* was found only at Miani while

Scopimera crabricauda is the species which was found only at Dam and *Uca (Tubuca) urvillei* was only found at Bhaira.A total of 450 individuals were recorded of which more than 80% were Ocypodoid crabs. The *O. indica* and *Ilyoplex frater* made up 61% and 21% of all sampled crabs at Miani and *U. iranica* and *I.frater* made up 54% and 16% of all sampled crab species at Dam (Fig. 2) whereas, *U. iranica* and *U. sindensis* made up 35% and 27% of all sampled crabs at Bhaira respectively, while each of the species accounted for less than 15 % (Fig 2). Species density rankings varied at three study sites. Diversity and Equitability were high at Bhaira (H'= 2.464, J'=0.741) as compared to Dam (H'= 2.041, J'=0.680) and Miani (H'=1.588, J'= 0.684) (Fig. 3).

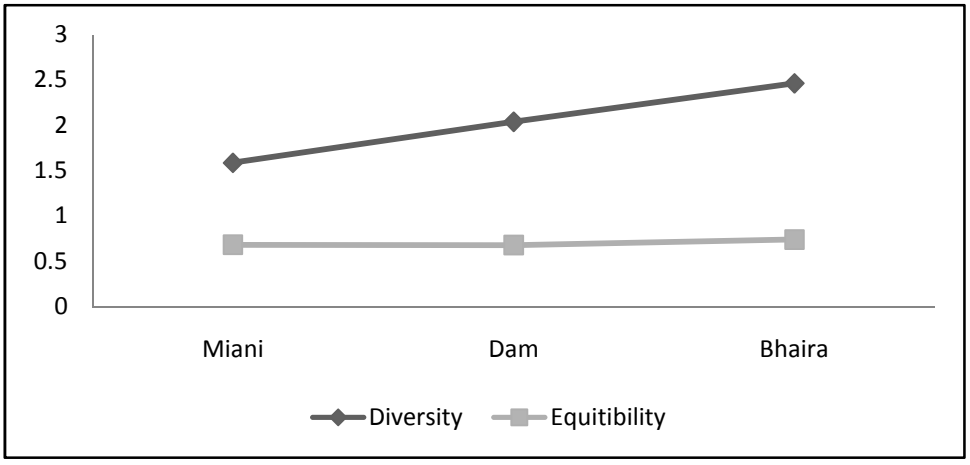

Fig. 3.The estimated diversity and equatibility of crabs specie at three study sites.

DISCUSSION: The results presented here are the first analysis exclusively of the Brachyuran crab's assemblages from the three mangrove areas, Miani, Dam and Bhaira of Balochistan coast. In the present study a total of 450 individuals of 14 species were collected in the area of investigation, of which more than 80% were Ocypodoid crabs. During the present study significant spatial differences and clear habitat stratification was observed in the distribution of species at different biotope and tidal level. Among brachyuran crabs, the Ocypodoid crabs belong to four families, Ocypodidae, Dotillidae, Camptandriidae and Macrophthalmidae and Grapsoid crabs (*Sesarminae, Metaplax spp.*) are dominated in the study areas. The representative of family Xanthoidea (*E. orientalis*) also confirmed its presence in the study area. Hartnoll (1975) also observed clear habitat stratification and vertical zonation of crab species in the mangrove ecosystem.

This study clearly demonstrates the importance of vegetation and substratum characteristics in controlling the diversity, distribution and abundance of crabs and this have interesting implication on the inter specific dynamics of crabs population at three sites. The sediment provides two fundamental resources, i.e., space and food, required by organisms which characterize these biotope complexes. It provides the space and sediment texture for building burrows (Lee 1999), and the food source for predominant deposit and detritus feeders. In present study, the percent porosity (Table 1) was high

(79.03±27.71) at Miani, and lowest (17.88±0.77) calculated at Dam. The maximum percent organic matter content was estimated at Bhaira (14.73±3.59) as compare to Miani (3.75±1.15) and Dam (1.66±0.344). The high crab density was estimated at Miani (77.2±73.6) as compare to Dam (54.0 ±16.15) and Bhaira (43 ±13.48). The faunal composition of the same sediment type between sites was found to be different, indicated that the sediment properties like porosity and organic content also play an important role in the species density distribution. The retained water content in the sediments provides a suitable condition for these burrowing crabs. The availability and abundance of benthic larvae/adults may form an important factor than sediment characteristics in determining benthic settlement. Many larvae of benthic marine organism's exhibit substrate preference upon their settlement (Butman and Grassle 1992, Grassle et. al. 1992, Sundberg and Kennedy 1993, Saher and Qureshi 2011).

The distribution patterns are mainly related to physico-chemical characteristics of the environment (Frusher et al. 1994), or to the presence of specific tree species or tree diversity, remains to be determined (Lee 1997, Dahdouh-Guebas et al. 2002). Presence of mangrove vegetation also provides the habitat structure and food for mangrove crabs and determines the habitat structure of these crabs. The presence of Grapsid species at Bhaira provide the evidences to confirm the relationship between the grapsid crabs and the mangrove vegetation as they have been reported as one of the most abundant group of fauna inhabiting mangrove forests (Golley et al. 1962, Jones 1984, Smith et al. 1991, Fratini et al. 2000).

The crab density was high at mid tide level at all sites as compared to high tide level and mid tide level. Miani showed the high crab density (128 m^2) at mid level than Dam (72m^2) and Bhaira (48m^2). At low tide level the crab density was same at three sites (Figure 3). Close observations suggest that each species has a distinct position in the transect. In the present study H' values from 1.588 - 2.464 were observed. The highest diversity (H'= 2.464) was found at Bhaira, and the lowest diversity (H'= 1.588) was observed at Miani. The similar mode was observed between Equitability values (Fig 3). This difference is mainly due to the presence of one Grapsid and two Ocypodid species and the higher relative frequency of *U. iranica* at Bhaira.The distribution of species appears to be controlled by the physical factors, physiological adaptations or competition with each other for space and food. Also the area for settling selected by the megalopa stages will form an important criterion in the distribution of adult crabs, although these crabs can move considerable distances (Teal 1958). Other flora and fauna in relation to food availability (Ashton 2002, Kristensen and Alongi 2006), their reproductive and life history strategies in relation to tree composition and environmental factors (Lee and Kwok 2002, Koch et al,. 2005, Moser et al. 2005, Qureshi and Saher 2012) play an important role in the density and diversity of the crab species. Further detailed study heplful to reavel the status, life history and population dynamics of species present in valuable habitat of mangrove and their relationship with environment.

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