Diversity and Spatial Distribution of Crabs in the Intertidal mudflat of Cross River Estuary Mangrove Swamp, Southeastern, Nigeria.

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Abstract: An investigation on Diversity and Spatial distribution of crabs in the intertidal mudflat of Cross River Estuary mangrove swamp, southeastern, Nigeria was carried out at three different stations (Inua abasi, Jamestown and Oron) between January and July, 2015. From the study it is revealed that the crab species were wide spread and abundant in the mangrove swamp. Five species of crab were identify during the study which include; *Pachygrapsus gracilis*, *Uca tangeri*, *Sersama species* and *Callinectes amnicola*. Crabs abundance was generally high at low tide and mid tide levels, and less at high tide levels, which explain the feeding and burrowing habits of the different crab species. *Pachygrapsus gracilis* were present in high numerical abundance during the study period with low numerical abundance recorded for *Callinectes amnicola* which was attributed to variation in salinity and temperature of the mangrove swamp during the study period. There was significant variation ($P<0.05$) in distribution of crab species in the three stations of Cross River Estuary mangrove Swamp but no significant variation ($P>0.05$) in physicochemical parameters in the three stations of Cross River Estuary mangrove Swamp was observed except for salinity which show significant variation ($P<0.05$) in the three stations. Abundance in terms of number and biomass was observed during the wet season and rise to the peak in the month of June and July. Based on the result of findings, salinity and temperature were identified as the major factor regulating the population and distribution of Mangal crab in the Cross River Estuary.

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1. Introduction

Mangroves are widely distributed in the tropical and subtropical world where they form a unique and dynamic ecosystem at the fresh-saline water interface. In almost every part of the world coastal lives are invariably linked to the mangrove ecosystem. Most of the coastal population engages in fishing or fisheries-related occupations which largely subsist on mangrove resources. Generally, mangrove forest has a worldwide distribution confined to the tropics and sub-tropics of the world with about 55 species, of which 7 of the species are represented in West Africa (Wilcox 1985) and two genera (Rhizophora and Aviecennia) being commonest in Nigeria (Moses, 1985). Mangroves are halophytic in nature, existing only in extreme habitats characterized by changes in water level and salinity.

The importance of mangrove both ecologically and economically has been highlighted by Tomlinson (1986), Moses (1985) Ibianga (1985) and Willocks (1985). The mangrove vegetation is a valued ecological component because of its high productivity and because its prop-breathing roots-provide shelter for a wide variety of fish and other aquatic species with significant socio-economic and ecological values. In connection with the world-wide increasing temperature and the consequent melting ice in the Antarctic and a rise in water level, the role of mangroves as dams against wave erosion becomes imperative (Sieghard, 1997). Mangroves are known to provide a nursery for the Larval of many commercially important fish and shellfish species. Larval, post-Larval and juvenile stages of shrimp such as penaeus and macrobrachium, mullets, tilapia, snappers, shinynose, sciaenids and clupeids utilize the mangrove environment as breeding grounds. Other organisms such as crabs, bivalve molluses (Oysters and mussels), Gastropod Molluse (periwinkle) and some fish, particularly, the mudskipper pericophthalmus are rather permanent members of the community.

Crabs makes up the largest and the most diverse group of decapods with more than 4,500 species (Castro and Huber, 2005). Crabs makes up 20% of all marine crustaceans caught and farmed worldwide, with about 1.5 million tones being consumed annually.

Crabs are important detritivores, reducing the particle size of leaf litter and organic debris, presenting a source of nutrition to filter feeding fauna and enabling microbial activity (Hill and O'Keefe, 1992). Crabs utilized energy from diverse trophic levels and

contribute to energy and resource recycling within the River ecosystem (Hill and O'Keefe, 1992).

The importance of shellfish as a source of readily accessible protein and an economic renewable resource for coastal dwellers makes it the single most important exploited species in the mangroves. In Africa and Nigeria Crabs are highly valued seafood and of economic importance to both rural and urban dwellers. They most commonly encountered species of crabs are Uca tangeri, Callinectes amnicola, Pachygrapsus gracilis and Sersama species (Ewa-oboho, 1993, 2009; Warner, 1969; Berry, 1972; Odum, 1972; Jones, 1984).

Temperature and salinity strongly affects the distribution of mangrove crabs especially during the larval stage as reported by (Paula *et. al*., 2003; Jones, 1984). Salinity is one of the factors accounting for estuarine stress, as osmoregulatory capability develops throughout the larval stages (Charmantier *et. al*., 2002). Most newly hatched stages are regarded as been more sensitive to low salinity (Charmantier *et. al*., 2002).

Until recently, studies on the benthic fauna of intertidal mudflats in tropical regions have been exceptionally rare in spite of the fact that such studies would provide indications of the value of mudflats as potential feeding habitats for water birds, benthic organism and marine and estuarine fish (Erftemeijer, *et. al*., 1988; Silvius, *et. al*., 1987). Recent studies have however been carried out for instance in Hong Kong, China and Taiwan - often in connection with feasibility studies on the use of mangroves for waste water treatment (HKUST, 1993).The present study is aimed at complementing existing information on the distribution and diversity of crabs in the Cross River Estuary mangrove swamp.

2.0 Materials and methods

2.1 Study Area

The Cross River estuary is the largest estuary along the Gulf of Guinea. It has an area of about 1500km2. The estuarine coastal plain is characterized by mangroves, river tributaries and creeks. *Rhizophora racmosa and Avicenia Africana* are the main mangrove species. The mangroves of the estuary serve as spawning and feeding grounds for shrimps, crabs, clams, periwinkles and fish. The study lies geographically between latitude 4º45'N and longitude 7º06'E, located in Cross river system, south eastern Nigeria. The study was carried out on an extensive mudflat at low tides with many shallow water drainage creeks. It is a major intertidal area along the coast of Nigeria. At high tides the creeks are flooded, allowing access to the mangrove vegetation. At low tides the intertidal area are exposed. Thus, the extent of exposure of the benthos can be extremely variable.

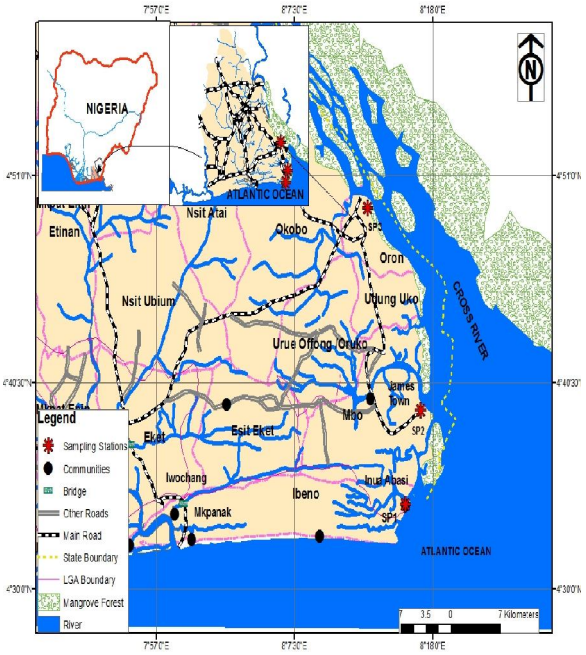

Fig 1: Map of the Study Area

2.2 Sampling Locations

Three sampling sites were selected for the study namely; Inua Abasi, Jamestown and Oron.

2.3 Collection of Water Samples for Physico-chemical Analysis

Surface water samples were collected from three different Stations (oron, Jamestown and Inua Abasi) of Cross River Estuary, twice monthly for six month (January - July, 2015). Water samples were collected in a one (1) litre capacity of plastic rubber for physico-chemical analysis. All the sampling bottles were thoroughly washed and sun dried after which the sampling bottles were labeled with dates and collection stations before use for collection of water samples. Collected water samples were stored in a cool box containing ice blocks and transported to the laboratory. Physico-chemical parameters, such as temperature, pH as well as dissolved oxygen were measured *in situ* during sampling using test kits.

Water samples for salinity was collected using sample bottles and transported to Ministry of Science and Technology laboratory, Uyo. In the laboratory salinity was determine based on the principles and procedures outlined in standard methods for the examination of physico-chemical parameters in water (APHA, 1998).

2.4 Collection of Crabs Samples

The services of an engine boat was employed which took us to three sampling stations along the Cross River Estuary. The three stations were established at approximately 500m apart. Each station was divided into quadrats and crab samples were taken

on the mud flat using $0.25m^2$ quadrat placed alternatively along transect mapped out on a site of 20 m^2 x 20 m^2 area on the swamp floor. The quadrat was randomly thrown and burrows with the quadrat sampler were counted and crabs samples were captured by hand.

2.5 Identification of Crabs Samples

In the laboratory, initially all faunal groups were sorted, preserved (5-10% formalin), and identified up to the lowest taxonomic level. The crabs were identified with the help of identification keys provided by Tirmizi and Siddiqui (1981); Eisenberg (1981); Tirmizi and Zehra (1982); Oliver (1984) and Bianchi (1985).

2.6 Data Analysis

Numerical abundance and percentage relative abundance of crabs species obtained from Cross River Estuary mangrove swamp were empirically analyzed using the formula:

$\% R_a = {}^{n}/_{N} \times 100$ (Ali *et al.*, 2003).

Where: $\%_{Ra}$ = relative abundance

n = number of individuals

N = total number of all individuals.

One-way analysis of variance (ANOVA) powered by (SPSS, version 20.0) was used to test for significant spatial variation in the distribution pattern of Crabs in the Cross River Estuary mangrove swamp using data collected from the three stations.

3.0 Results

3.1 Physicochemical Parameters of the Cross River Estuary Mangrove Swamp, Nigeria.

During the study period (January – July), mean surface water temperature ranged between 28.6 and 30.9^0C; mean pH value ranged between 6.4 to 7.3; mean range value of 5.4 to 6.4mg/l was recorded for Dissolved oxygen and mean salinity value was observed to range between 16.0 to 21.2‰. (Table 1). There was no significant variation ($P>0.05$) in physicochemical parameters in the three stations of Cross River Estuary mangrove Swamp, except for salinity which show significant variation ($P<0.05$) in the three stations.

3.2 Numerical Abundance of Crabs Species

The total number of crabs species obtained during the studies was 2551; *Pachygrapsus gracilis* dominated the three stations with the highest numerical abundance of 900 which constituted about 35.28% of the total crab fauna. *Uca tangeri* was 812 with percentage relative abundance of 31.83%, *Sersama species* was 602 which represent 23.60% and *Callinectes amnicola* was 237 which constituted about 9.29% of the total crab fauna caught (Table 2, Table 3 and Fig. 2). There was significant variation ($P<0.05$) in distribution of crab species in the three stations of Cross River Estuary mangrove Swamp.

3.3 Vertical and Horizontal Distribution of Crabs

Crab abundance was generally high at low and mid tide levels. *Pachygrapsus gracilis* and *Uca tangeri* dominated vertically which was attributed to their ability to withstand fluctuation in salinity while *Sersama species* and *Callinectes amnicola* could not contend with fluctuation in salinity. However, population decreases towards the land and also at high tide.

Table 1: Mean Physicochemical Parameters Measured in the Sampling Stations during the Study Period (Jan – July, 2015).

Stations	Temperature (^{0}C)	pH	Dissolved Oxygen (mg/l)	Salinity (‰)
Inua abasi	**28.6 ± 0.01**	**6.8 ± 0.001**	**5.8 ± 0.02**	**21.2 ± 0.04**
Jamestown	**30.9 ± 0.02**	**7.3 ± 0.002**	**6.4 ± 0.01**	**19.3 ± 0.06**
Oron	**30.7 ± 0.01**	**6.4 ± 0.001**	**5.4 ± 0.00**	**16.0 ± 0.02**

Table 2: Frequency of occurrence of Crab Species at the different Stations during the Study period (Jan – July, 2015).

Species	Stations	Months							Total
Pachygrapsus gracilis		January	February	March	April	May	June	July	
	Station 1	25	31	45	58	61	62	68	350
	Station 2	22	22	34	48	59	53	62	300
	Station 3	18	16	30	37	42	53	54	250
Sersama species	Station 1	15	18	36	38	51	53	59	270
	Station 2	10	13	20	28	30	36	43	180
	Station 3	10	12	20	22	24	32	32	152
Uca tangeri	Station 1	25	30	48	55	60	64	68	350
	Station 2	16	20	30	32	47	53	54	252
	Station 3	15	18	25	30	32	42	48	210
Callinectes amnicola	Station 1	5	5	8	15	22	24	26	105
	Station 2	4	7	8	12	14	17	20	82
	Station 3	2	2	5	7	8	13	13	50

Table 3: Summary of the Distribution of the Major Crabs Species in the Cross River Estuary Mangrove Swamp, Nigeria during the Study Period (January – July, 2015).

S/N	Crabs Species	**Numerical Abundance (n)**	**(%n)**
1.	*Pachygrapsus gracilis*	**900**	**35.28**
2.	Sersama species	**602**	**23.60**
3.	Uca tangeri	**812**	**31.83**
4.	Callinectes amnicola	**237**	**9.29**
	Total abundance (N)	**2551**	**100.0**

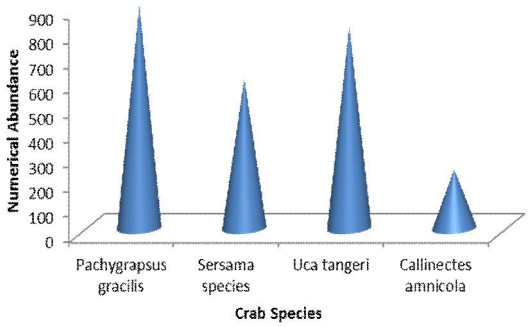

Fig. 2: Variation in Numerical Abundance of the Major Crabs Species in the Cross River Estuary Mangrove Swamp Nigeria, during the Study Period (January – July).

4.0 Discussion

The study of mangal crabs in the Cross River Estuary mangrove swamp showed monthly fluctuation and abundance both in number and biomass of individuals. The highest number of crabs caught was recorded in June and July while the lowest number was recorded in January and February (Table 1). *Pachygrapsus gracilis* and *Uca tangeri* is the most common crab fauna that dominates the Cross River mangrove swamp. Most of the crabs found here are permanent residents while others like *Callinectes amnicola* are temporal resident (Warner, 1969; Jone, 1984), as observed in the present study.

Crabs generally remain near their burrow and quickly return to them in times of danger. Studies have shown that for burrowing crabs to escape the problem of overheating, they tend to forage close to their burrows providing the possibility for retreat into and cooling off. Retreat increases with environmental temperature, a phenomenon which was observed during the study period. Ngaraj (1993) had earlier suggested increase in environmental temperature as a prime stimulus for crab burrow retreat. However, regular retreat is necessary to replace water losses and this is indispensable for feeding besides evaporative heat loss (Smith and Miller, 1972). Burrowing behavior also influence habitat selection in crabs. Most of the crab species construct burrows; but the function and behavior associated with burrows differ (Ewa-oboho, 1993).

Salinity and temperature was the two main physicochemical parameters observed to affect the distribution and abundance of crab species during the study. Crab population was observed to increase during the rainy season and fall during the dry season. Salinity was suggested to be responsible for the observed fluctuation rather than seasonal difference. High values for salinity were recorded during the dry season compared to low values recorded during rainy season, which is an indication that salinity plays a major role in the distribution of crab species in the mangrove swamp of the Cross River Estuary. Salinity and temperature vary considerably in the mangrove habitat and the tolerance of the various crabs is dependent on the species and physiological states of the animals. (Kinne, 1967; Warner, 1969; Jones, 1984; Ewa-oboho, 1993). Barnes (1969) proposed that spatial distribution within an Estuary is determined by these parameters.

Crab population densities were higher at low and mid-tide level and larger crabs were found at high intertidal levels. Similar observations were reported earlier by previous researchers (Ombu, 1987; Ewa-oboho, 1993, 2009). Smaller crabs were found around the edges of the mid and low tide especially *Pachygrapsus gracilis*, a phenomenon probably due to predation (Chilton, 1984; Ewa-oboho, 1993; Klaasens and Ens, 1972).

5.0 Conclusion

Studies conducted on the Diversity and Spatial Distribution of Crabs in the Intertidal mudflat of Cross River Estuary Mangrove Swamp, Southeastern, Nigeria using three sampling stations. Five species of crab were identify during the study which include; *Pachygrapsus gracilis*, *Uca tangeri*, *Sersama species* and *Callinectes amnicola*. Crabs abundance was generally high at low tide and mid tide levels, and less at high tide levels, which explain the feeding and burrowing habits of the different crab species. *Pachygrapsus gracilis* were present in high numerical abundance during the study period with low numerical abundance recorded for *Callinectes amnicola* which was attributed to variation in salinity and temperature of the mangrove swamp during the study. Salinity and temperature were identified as the major factor regulating the population and distribution of Mangal crab in the Cross River Estuary. There was significant variation ($P<0.05$) in distribution of crab species in the three stations of Cross River Estuary mangrove Swamp but no significant variation ($P>0.05$) in

physicochemical parameters in the three stations of Cross River Estuary mangrove Swamp was observed except for salinity which show significant variation ($P<0.05$) in the three stations.

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