PRELIMINARY STUDY ON THE COMPOSITION AND ABUNDANCE OF SHELLFISH (DECAPODA: CRUSTACEA) IN UTA EWA ESTUARY, IKOT ABASI LOCAL GOVERNMENT AREA, AKWA IBOM STATE, NIGERIA

AKPAN, Akaninyene Udoh, EGWALI, Edwin Chuks, ESENOWO, Imeh Kokoette and AKPABIO, Eno Kinsley

Department of Animal and Environmental Biology, University of Uyo, Akwa Ibom State, Nigeria.

Corresponding Author: Akpan, A. U. Department of Animal and Environmental Biology, University of Uyo, Akwa Ibom State, Nigeria. **Email:** unik_sea@yahoo.com **Phone:** +234 8038981129

Received: *September 23, 2018* ***Revised:*** *February 19, 2019* ***Accepted:*** *February 27, 2019*

ABSTRACT

The study, Preliminary Study on the Composition and Abundance of Shellfish: Decapoda: Crustacea, in Uta Ewa Estuary was carried out between January and May 2012. The physico-chemical parameters of the water were measured in situ using standard methods according to APHA, AWWA and WEF (1998). Shellfish specimens were sampled monthly. Air- and water-temperature ranged from 27.9 – 31.6 °c and 28.2 – 28.9 °c respectively, while DO, pH and salinity were between 3.28 – 4.09 mg/L, 6.40 – 7.7 ppm and 0.00 – 12.9 ppm respectively. The mean values of the physico-chemical parameters measured were not significant at r = 0.456. Pandalus sp. was the most abundant in station 1 accounting for 50.29 %, followed by Nematopalaemon hastatus which accounted for 29.21 % , while in station 2, N. hastatus was the most abundant, accounting for 39.78 %, followed by Pandalus sp. accounting for 31.40 % of the relative abundance. Panopeus africanus was the least collected shellfish species, it accounted for 0.14 % in station 1 and 0.45 % for station 2. Station 2 had shellfish Shannon diversity of 1.54 while station 1 had 1.31. The physico-chemical parameters showed significant relationship with the abundance of the shellfish species (p<0.05). The results of air- and water-temperature and pH were within limits of stipulated minimum values of the National Environmental Standards and Regulations Enforcement Agencies (NESREA) for aquatic life. Uta Ewa estuary is rich with a wide variety of shellfish species of ecological and economical importance; hence the coastal area should be monitored and protected from pollution.

Keywords: Shellfish, Decapoda, Uta Ewa estuary, Composition, Abundance

INTRODUCTION

Shellfishes of the Decapoda: Crustacea are of great commercial importance in Nigeria territorial waters and the exploitation has been on the increase due to demand for protein sources for human consumption as well as source of income for coastal towns and villages of the Nigeria Delta environment (Bankole, 2007; Adebayo-Tayo and Ogunjobi, 2008; Okayi *et al.,* 2013). Nigeria's shrimp fisheries, both industrial and artisanal, are a major source of both direct and indirect employment (Okayi *et al.,* 2013).

Decapod shellfish comprise crabs, prawns and shrimps. Thus several shellfish species from the three groups: crabs (*Cardiosoma armatum, Callinectes amnicola, Goniopsis pelii* and *Ocypode africana*), prawns (*Macrobrachium* sp., *Nematopalaemon hastatus*) and shrimps (*Parapanaeopsis* sp. and *Pandalus* sp.), have been reported in coastal brackish water bodies of Nigeria (Marioghae, 1982; Powell, 1982; Shaw *et al.,* 1988; Enin, 1998; Chindah *et al.,* 2000; Lawal-Are and Kusemiju,

2000; Okayi *et al.,* 2013; Olawusi-Peters and Ajibare, 2014; Onadeko *et al.,* 2015 among many others).

Uta Ewa estuary is known for its high productivity and rich biodiversity, including a wide variety of finfish and shellfish species (Akpan, 2013; Akpan and Etim, 2015; Esenowo *et al.*, 2016). This research was directed to the preliminary study of the shellfish species composition and abundance in the coastal area and to complement existing information on Decapoda of Uta Ewa estuary and other estuaries in Nigeria.

MATERIALS AND METHODS

Study Area: Uta Ewa estuary is located within Latitude 4°32′ to 4°52′N and Longitude 7°25′ to 7°45′E (Figure 1).

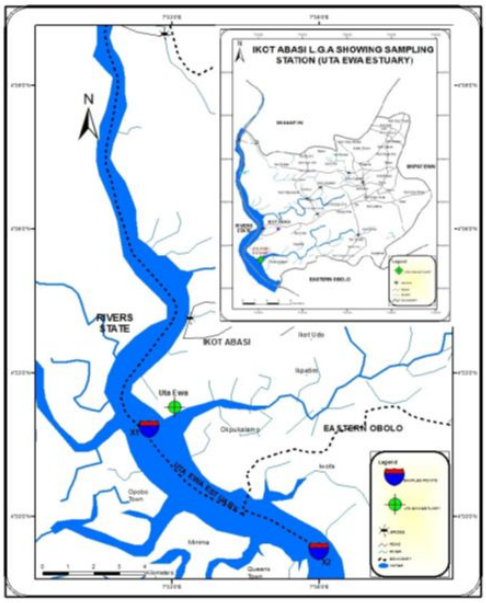

Figure 1: Map of the study area showing Uta Ewa Beach and the sampling stations

The estuary lies on the western bank of Enong creek about 12 km from the mouth of Imo River. Characteristically, the area is typical of an estuarine tidal water zone with freshwater input from Imo River and with extensive mangrove swamps and intertidal mud flats. The estuary is bounded by thick mangrove forest dominated by *Rhizophora* species and interspersed by Nipa palm (*Nypa fruticans*). The main occupation of the people is fishing, while other activities include trading on fishes (both fresh and smoked), fuel wood cutting and water transportation are also carried out (Esenowo *et al.,* 2016). Two sampling stations with unique ecological characteristics and human activities were established along the length of the estuary. The sampling stations were about two kilometres apart from each other.

Station 1: Is located upstream of the Uta Ewa estuary with human settlement and local market on the left flank of the shoreline. Vegetation is sparse with mainly mangrove *Rhizophora* sp. and Nipa palm (*Nypa fruticans*). The station is very shallow and the bottom when exposed at low tide is made of fine sand. Human activities included logging of the mangrove, sand dredging, washing of boats, canoes and fishing nets and swimming.

Station 2: Is about two kilometers away from station 1, downstream of the estuary with no human settlement. On the shorelines are thick vegetation of mangrove *Rhizophora* sp. and Nipa palm. The station is deep and at low tide, the greater part of the bottom mud flat is exposed. Human activities in this station are minimal, with mainly fishing activity on the high.

Physico-Chemical Parameters: The following physical and chemical parameters were determined: air temperature, water temperature, pH, dissolved oxygen (DO), depth, transparency and salinity. Air and water temperature, transparency, salinity and depth were determined *in situ*, Dissolved oxygen was determined in the laboratory. Surface water samples were collected in 2 litre glass bottles containers after they were rinsed with distilled water from each sampling stations.

Air and water temperatures were taken using a centigrade mercury-in-glass thermometer. Air temperature was measured by holding the thermometer in the air for 3 minutes. Water temperature was measured by inserting the thermometer to a depth of 10 cm into water for 3 minutes. Reading was taken three times and mean value recorded. The results were expressed as degree Celsius (°C).

Water sample from each station was carefully collected into 250 mL stoppered samplings bottle without air bubbles and immediately 1 ml $MnSO_4$ solution was added, followed by 1 ml alkali-iodide-azide reagent, and 2 ml Conc. H_2SO_4. In the laboratory, the DO concentration of the treated water sample was determined as reported by APHA, AWWA, WEF (1998). The result was expressed as mg/L. An Extech meter (Model ExStik EC400) was used to measure salinity. The meter was calibrated with 3.3 mol solution of potassium chloride. The glass electrode of the meter was inserted into the water sample after being rinsed with distilled water and measurement was taken after the reading had stabilized. The result for salinity was expressed as part per thousand (‰).

The pH was measured using electronic pH meter (Oakton waterproof Instruments pH tester 10). The pH meter was standardized using prepared buffer solution according to the manufacturer's instruction. Water sample was put into a beaker after it was rinsed with distilled water. The glass electrode of the meter was inserted into the water sample and measurement was taken after the reading had stabilized.

For depth an improvised long pole was dipped into the river; the pole was marked and later measured out with a measuring tape. The result was expressed in metre. Transparency was measured using a Secchi disc measuring about 20 cm in diameter. The Secchi disc was lowered into the water and the suspended rope that was marked was later measured out. The result was expressed in metre.

Shellfish Sampling: The crab, prawn and shrimp species were collected on monthly basis between the months of January and May 2012. Crabs species were collected using square lift net at low tide. The prawns and shrimps were collected with the assistance of artisanal fishermen. The artisanal fishermen used boats with sizes ranging from 5 to 12 m in length. The boats were powered by small outboard engines and manned by an average of two men per boat, to which the harvesting nets were attached.

The shellfish specimens collected were preserved in an iced packed chest box in the field (Lawal-Are, 2009) and later transferred to the Entomology Laboratory of the Department of Zoology, University of Uyo, for sorting and identification according to identification keys provided in FAO (1981).

Data Analysis: Microsoft Excel 2007 was used for data analysis for the percentage abundance of the shellfish**,** mean and standard error of the physicochemical parameters of the study stations**,** while version 3 of PAST Software Design was used to determine the shellfish species diversity (Shannon Diversity index) and richness (Margalef) of the shellfish community composition in each sample stations. SPSS version 20.0 was used for correlation analysis on the relationship between the physiochemical parameters and shellfish abundance.

RESULTS

Physico-Chemical Parameters: The results on range, mean and standard error of the physico-chemical parameters measured are presented in Table 1. The lowest mean value for salinity of 2.98 ppt was recorded for Station 2, while the highest mean value for salinity (10.14 ppt) was recorded for Station 1. The mean values for the physico-chemical parameters measured were not significant in Stations 1 and 2 at $r = 0.456$ ($p \leq 0.05$).

Shellfish Composition and Abundance: The composition and abundance of the shellfish species encountered from the sampling stations in the study area are presented in Table 2. A total of 1583 individuals of the shellfish species were sampled in the sampling stations, with 688 sampled in Station 1 and 895 sampled in Station 2. The shellfish species comprised eight families. Five Families: Grapsidae, Gecarcinidae, Ocypodidae, Portunidae and Xanthidae made up the crabs, while one Family: Palaemonidae made up the prawns and two Families; Penaeidae and Pandalidae made up the shrimps.

Table 1: The range and mean of the physico-chemical parameters of the water sample from the Uta Ewa Estuary, Akwa Ibom State, Nigeria

Parameter	Station 1		Station 2	
	Range	Mean	Range	Mean
Air temperature (°C)	27.9 - 31.6	29.86 ± 1.55	28.6 - 30.3	29.56 ± 0.69
Water temperature (°C)	28.2 - 28.9	28.40 ± 0.29	28.1 - 28.9	28.36 ± 0.36
Dissolved Oxygen DO (mg/L)	3.28 - 4.09	3.71 ± 0.40	3.55 - 3.79	3.68 ± 0.10
Salinity (ppt)	7.5 - 12.9	10.14 ± 2.53	0.00 - 4.3	2.98 ± 2.05
pH	7.3 - 7.7	7.44 ± 0.19	6.40 - 7.0	6.74 ± 0.24
Depth (m)	2.5 - 11	5.48 ± 3.30	1.50 - 4.0	3.24 ± 1.12
Transparency (m)	0.45 - 0.83	0.66 ± 0.19	1.10 - 1.65	1.50 ± 0.23

Table 2: The composition and abundance of the shellfish encountered in sampled stations of Uta Ewa Estuary, Akwa Ibom State, Nigeria

Family		Shellfish species name	Common name	Station 1		Station 2	
				Ni	%	Ni	%
Crabs	**Grapsidae**	*Goniopsis pelii* (Herklots, 1851)	Purple mangrove crab	13	1.89	40	4.47
	Gecarcinidae	*Cardisoma armatum* (Herklots, 1851)	Land crab	-	-	5	0.56
	Ocypodidae	*Ocypode africana* de Man, 1881	Ghost crab	2	0.29	10	1.12
	Portunidae	*Callinectes amnicola* (Rochebrune, 1883)	Swimming crab	34	4.94	41	4.58
	Xanthidae	*Panopeus africanus* A. Milne-Edwards, 1867		1	0.14	4	0.45
				50		**100**	
Prawn	**Palaemonidae**	*Nematopalaemon hastatus* (Aurivillius, 1898)	Estuarine prawn	201	29.21	356	39.78
		Macrobrachium macrobrachion Herklots, 1851	Brackish river prawn	39	5.67	83	9.27
				240		**439**	
Shrimp	**Penaeidae**	*Parapenaeopsis* sp Balss, 1914	Guinea shrimp	52	7.56	75	8.40
	Pandalidae	*Pandalus* sp	Shrimp	346	50.29	281	31.40
				398		**356**	
Grand Total				**688**		**895**	

n_i = number of individual shell fish species; % = percentage

From the overall results on composition and abundance, shrimp species, *Pandalus* sp. (Figure 2) (50.29 %) accounted for the most abundant shellfish species in Station 1, followed by prawn species, *N. hastatus* (Figure 3) (29.21 %) and crab species *C. amnicola* (Figure 4) with 4.94 %. In Station 2, prawn species, *N. hastatus* (39.78 %) was the most abundant, followed by shrimp species, *Pandalus* sp. (31.40 %) and crab species *C. amnicola* (4.58 %). Crab species, *Panopeus africanus* (Figure 5), with percentages of 0.14 and 0.45, were the least encountered shellfish species in Station 1 and 2, respectively. The results of the shellfish species diversity (Shannon) and richness (Margalef) are presented in Table 3. A relatively high species diversity (1.54) and richness (1.18) were recorded for Station 2, while relatively low species diversity (1.31) and richness (1.07) were recorded for Station 1.

Figure 2: *Pandalus* sp. from Uta Ewa Estuary, Akwa Ibom State, Nigeria, Mag. 0.12 m

Figure 3: *Nematopalaemon hastatus* from Uta Ewa Estuary, Akwa Ibom State, Nigeria, Mag. 0.11 m

Figure 4: *Callinectes amnicola* from Uta Ewa Estuary, Akwa Ibom State, Nigeria, Mag. 0.17 m

Relationship between Physicochemical Parameters and Shellfish Abundance: The results on relationship between physicochemical parameters and shellfish abundance in stations 1 and 2 are presented in Tables 4 and 5.

Figure 5: *Panopeus africanus* from Uta Ewa Estuary, Akwa Ibom State, Nigeria, Mag. 0.15 m

Table 3: Ecological indices of the shellfish from Uta Ewa Estuary, Akwa Ibom State, Nigeria

Ecological Indices	Station 1	Station 2	Total
Diversity indices	688	895	1583
Shellfish species diversity (Shannon)	1.31	1.54	
Shellfish species richness (Margalef)	1.07	1.18	

From the result, water temperature had positive correlation relationship with *Parapenaeopsis* sp. and was significant ($r = 0.91$; $p<0.05$) (Table 4), and negatively correlated with *O. africana* ($r = -0.91$; $p<0.05$) and *Pandalus* sp. ($r = 0.96$, $p<0.05$) in station 2 (Table 5). Dissolved oxygen positively correlated with *G. pelli* ($r = 0.96$, $p<0.05$), *N. hastatus* ($r = 0.93$, $p< 0.05$) and *Pandalus* sp. ($r = 0.97$, $p<0.01$) in station 1 (Table 4). In station 2, DO positively correlated with *N. hastatus* ($r = 0.98$ and $p<0.05$) and negatively correlated with *C. amnicola* ($r = -0.97$ and $p<0.05$). pH had significant positive correlation relationships with *C. amnicola* ($r = 0.97$, $p<0.01$). Transparency did not show significant correlation ($p>0.05$) with the shellfish species abundance (Table 4).

DISCUSSION

Physico-Chemical Parameters: According to Costa and Fransozo (2004), the important factors that affect composition and abundance of shellfish species in the tropical region are water quality.

Table 4: Relationship between physico-chemical parameters and shellfish abundance in station 1 of Uta Ewa Estuary, Akwa Ibom State, Nigeria

Physico-chemical parameters	*Goniopsis pelii*	*Ocypode africana*	*Callinectes amnicola*	*Panopeus africanus*	*Nematopalaemon hastatus*	*Macrobrachium macrobrachion*	*Parapenaeopsis* sp.	*Pandalus* Sp.
Air temperature	-0.69	-0.98**	0.51	-0.75	-0.55	-0.32	0.99**	0.98*
Water temperature	-0.40	-0.65	0.78	-0.99**	-0.80	0.03	0.91*	0.96*
Dissolved oxygen	0.96*	0.61	0.53	0.20	0.93*	-0.49	-0.52	0.97**
Salinity	0.53	-0.08	0.96*	-0.50	0.95*	0.89*	0.18	0.91*
pH	0.43	-0.19	0.97**	-0.91*	0.98**	0.65	0.29	0.98**
Depth	0.40	-0.32	0.89*	-0.59	-0.72	0.76	0.62	0.42
Transparency	0.36	-0.17	0.45	-0.42	-0.32	0.70	0.13	0.40

** Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)*

Table 5: Relationship between physico-chemical parameters and shellfish abundance in station 2 of Uta Ewa Estuary, Akwa Ibom State, Nigeria

Physico-chemical parameters	*Goniopsis pelii*	*Cardiosoma armatum*	*Ocypode africana*	*Callinectes amnicola*	*Panopeus africanus*	*Nematopalaemon hastatus*	*Macrobrachium macrobrachion*	*Parapenaeopsis* sp.	*Pandalus* Sp.
Air temperature	-0.97*	-0.69	-0.94*	-0.66	-0.37	0.70	0.45	0.28	0.46
Water temperature	-0.61	-0.74	-0.91*	-0.59	-0.44	0.75	0.51	0.21	0.52
Dissolved oxygen	-0.72	0.32	-0.79	-0.97*	0.70	0.98*	-0.63	0.99**	0.94*
Salinity	0.29	0.99**	0.19	-0.21	0.56	-0.99**	-0.98*	0.55	-0.98*
pH	0.086	0.94*	-0.02	-0.42	-0.99**	-0.93*	-0.99	0.71	-0.99**
Depth	0.97*	0.20	0.99**	0.96*	-0.25	-0.21	0.16	-0.80	0.15
Transparency	-0.22	0.79	-0.31	-0.67	0.98*	-0.78	-0.96*	0.89	-0.95*

** Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)*

The physicochemical parameters of any water body are vital ecological factors, as they directly affect oxygen consumption, metabolism, growth, moulting, hormones and survival of crustaceans (Chen *et al.,* 1995; Medesani *et al*., 2001; Onadeko *et al.,* 2015). The dissolved oxygen (DO) values of 3.71 mg/L and 3.68 mg/L for Station 1 and Station 2 respectively, were slightly low compared to the National Environment Standards and Regulations Enforcement Agency (NESREA) limits of minimum value of 6.0 mg/Lfor surface water fisheries. According to Esenowo *et al.* (2017), this indicates that Uta Ewa brackish water estuary is a less oxidized aquatic ecosystem. However, pH and transparency were within recommended limits as stipulated by NESREA for aquatic life. Although salinity was low in Station 2, this could be attributed to the intrusion of freshwater into the brackish water during low tide (Esenowo *et al.,* 2016).

Shellfish Composition and Abundance: The results on the composition and abundance of the shellfish in the study area are indication that the water body is rich with diverse shellfish species. *G. pelii, C. armatum, O. africana, C. amnicola* and *Panopeus africanus* (Esenowo *et al.,* 2016) made up the crab group of the shellfish composition, while the prawn group was made up of *N. hastatus* and *Macrobrachium macrobranchion*, and shrimp group include *Parapanaeopsis* sp. and *Pandalus* sp. All the shellfish species were caught in both Stations 1 and 2 except *C. armatum* that was not caught in Station 1. Also, of these species reported in this research, *N. hastatus, M. macrobrachion, Parapanaeopsis, O. africana, and C. amnicola* have been reported by Ofor (2002), Zabbey (2007), Olawusi-Peters and Ajibare (2014) in other estuaries in Nigeria and are major catches for artisanal fishermen. According to Shaw *et al.* (1988) the shellfish species are accepted as food organisms and support a substantial number of local fisheries. Besides, the prawn, *N. hastatus,* is the major constituent and an essential food condiment in almost all local dishes of the area, including the South East, South-South and further north in Nigeria (Okayi *et al.,* 2013).

Pandalus sp. was the most abundant shellfish species encountered in Station 1. The station is characterized with few mangrove (*Rhizphora* species), *Nypa* palms and fine sandy bottom. These features may have been interplaying factors favouring the population of the shellfish species abundance (Esenowo *et al.,* 2016). In Station 2, *N. hastatus* was the most abundant. The features such as thick vegetation of mangrove (*Rhizophora* sp.), *Nipa* palm on the shorelines and muddy bottom may have favoured the population and survival of the species in the station (Onadeko *et al.,* 2015; Esenowo *et al.,* 2016). The results on the composition and abundance of shellfish in Uta Ewa estuary was contrary to the results from Marioghae (1982) in the Lagos Lagoon, Powell (1982) in the Niger Delta, Enin (1998) in the Cross River estuary and Olawusi-Peters and Ajibare (2014) in the coastal waters of Ondo State, who reported *Macrobrachium macrobrachion* as the most dominant shellfish species.

Comparatively, Station 2 has higher abundance of shellfish species than Station 1. The relatively low composition and diversity of shellfish species in Station 1 may be as a result of pressure from anthropogenic activities as well as physico-chemical parameters' instability. According to Kennish (2002), anthropogenic activities could lead to the periodic or permanent elimination of estuarine dependent shellfish species from the estuary. Nevertheless, the shellfish species encountered strive well in amphibious areas (Onadeko *et al.,* 2015), a characteristic feature of Station 2. However, the results on the diversity indices of the shellfish species in the study area indicated that there was relatively higher shellfish species diversity in Station 2 than in Station 1. Also, shellfish species richness was relatively higher in Station 2 than Station 1 (Esenowo *et al.,* 2016).

Relationship between Physicochemical Parameters and Shellfish Abundance: The correlation relationship between physico-chemical parameters and the shellfish species abundant results indicate that physico-chemical parameters such as depth and transparency were not major determining parameters for the

abundant of the shellfish species in station 1 and station 2, but air- and water-temperature, dissolved oxygen, salinity and pH were. The abundant of *Pandalus* sp. in station 1 and *N. hastatus* in station 2 is positively correlated to dissolved oxygen. The negative correlation result of dissolved oxygen with *C. amnicola* in station 2 show competition for oxygen demand among the shellfish species. The demand for oxygen among the shellfish species may be caused by high metabolic activities (Eyo and Ekwonye, 1995).

Conclusion: It could be concluded that Uta Ewa estuary is rich with wide variety of shellfish species of Decapoda (Crustacea). However, given the ecological and economical values of the shellfish species reported in this study, there is need for the monitoring and control of pollution in the coastal area for sustainability of this aquatic biodiversity.

ACKNOWLEDGMENTS

Our sincere gratitude goes to the artisanal fishermen who assisted in the collection of the shellfishes.

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