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Species abundance and distribution patterns of some shellfishes in coastal waters of Ondo State, South West, Nigeria

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ABSTRACT
The abundance and distribution of some shellfishes of the coastal waters bordering Ayetoro, Bijimi, Asumogha and Idiogba of Ondo States, Nigeria was studied between September and December, 2011. Specimens were collected monthly with the assistance of artisanal fishermen. The population structure and distribution patterns were determined using Margalef's diversity index, Sorensen's index, and Number of Occurrence Index (NOI). *Nematopalaemon hastatus, Farfantepenaeus notialis, Parapenaeopsis atlantica* and *Portunus validus* occurred at the four sampling stations throughout the sampling period. *Macrobrachium macrobrachion* was not caught in December while *Callinectes marginata* and *Ocypode africana* were caught once during the sampling period. In September, *N. hastatus* was dominant in the four locations with 83.05%, 76.47%, 72.50% and 71.67%, in Ayetoro, Idiogba, Asumogha and Bijimi respectively. In Asumogha in October, *N. hastatus* had 71.93%, *F. notialis*17.54%, *P. atlantica* 7.89%. while *P. validus* had 2.64% NOI. 207 specimens were captured from Idiogba in November and *N. hastatus* had 86.96% NOI. The diversity index (*d*) ranged from 0.38 at Idiogba to 0.91 at Asumogha in December and September respectively, while Sorensen's similarity (*Cs*) values ranged from 0.38 to 0.5. The study revealed that there was a generally high similarity among the shellfish communities in the four sampling stations.

Keywords: Shellfishes, Species Abundance, Distribution Patterns, Coastal Waters.

1. Introduction
Ondo State is located in South Western Nigeria and has coastal areas estimated to be about 60,000 hectares which have rich biodiversity that contains a diverse assemblage of fish, shellfish (shrimps, crabs, lobster, gastropods and cephalopoda), reptiles and other living organisms [1]. Shellfish harvested by the artisanal fishermen include white shrimps (*Nematopalaemon hastatus),* brackish river prawn (*Macrobrachium macrobrachion*), Africa river prawn (*Macrobrachium vollenhovenii*), West Africa freshwater crab (Brachyodontes Niger), Tiger prawn (*Farfantepenaeus monodon*) and pink shrimps (*Farfantepenaeus notialis)* [1].

The two largest species of *Macrobrachium* in Nigeria waters are *M. vollenhovenii* and *M. macrobrachion* both of which are found in fresh and brackish waters. They are universally accepted as food organisms and support a substantial number of local fisheries [3]. Oyekanmi [4] reported that *Macrobrachium species* accounted for up to 60% of the prawn landings from Lagos Lagoon and that *M. vollenhovenii* are usually absent from clear water rivers which are generally acidic, extremely transparent, lack of mollusc's fauna and show little seasonal change in level.

Shellfishes have been found out to be of very great commercial importance in Nigeria territorial waters and the exploitation has been on the increase due to increasing population and increase in demand for protein sources by man [5]. Nwosu [6] reported that there has been a significant reduction of the natural stock of shrimps in Nigerian coastal waters (probably due to environmental degradation which is detrimental to the abundance and life cycle of the shrimp species) while Deekae and Abowei [7] stated that the unfriendly fishing methods of local fishers who use poisons and chemicals are affecting the shrimp catch.

Extensive researches have been carried out in the coastal waters of Ondo State: Akegbejo-Samson[8] on the ecology of the fisheries resources of coastal wetlands of Ondo State and its management implications; Asaolu [9] on the chemical pollution studies of coastal waters of Ondo State; Adeparusi *et al.* [10] on smoke-curing of fish by artisanal fisher folks in Ilaje, Ondo

State, Nigeria; Adebowale *et al.* [11] impacts of natural and anthropogenic multiple sources of pollution on the environmental conditions of Ondo State coastal water; Abdus-Salam *et al.* [12] on physicochemical assessment of water quality of oil producing areas of Ilaje, Ondo State; Bayode *et al.* [13] on the environmental implications of oil exploration and exploitation in the coastal region of Ondo State, Nigeria; Ajibare [14] on the economically important shellfishes in four coastal towns of Ilaje local government area of Ondo State; however, the species abundance and diversity of shellfishes in Ondo State are yet to be investigated. Hence, this study is expected to provide information on the species abundance and distribution patterns of shellfishes needed for efficient and effective management, utilization, and conservation in coastal waters of Ondo State.

2. Materials and Methods

2.1 Description of Study Area

The study was carried out in Ilaje Local Government Area (ILGA) (Figure 1) in the coastal area of Ondo State between September, 2011 and December 2011. ILGA is at the extreme southern part of Ondo state. ILGA shares boundaries with Okitipupa Local Government Area in the North; the Atlantic Ocean in the South; Ijebu Waterside Local Government Area (Ogun State) in the West and Delta state in the East. It is comprised of several fishing communities located within the river tributaries discharging into the Atlantic and those along the coastline [10]. The coastal areas of Ondo State consist of over five hundred settlements spreading over 3,000 km^2.

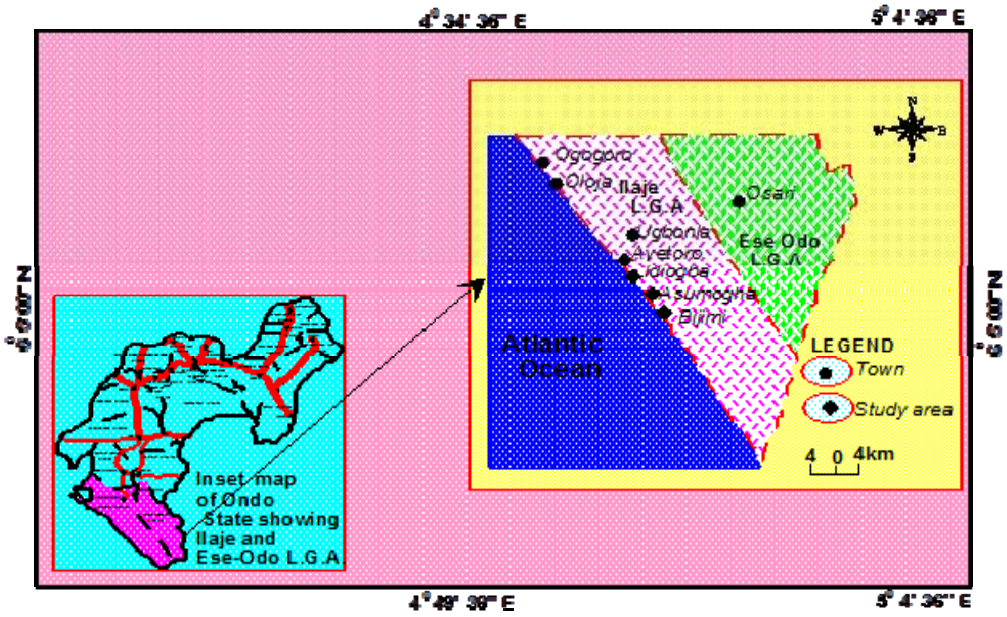

Fig 1: Coastal waters of Ondo State

ILGA has the longest coastline in Nigeria (about 78km) with long history in fishing dating back to the pre-colonial days [10, 13]. The study area falls within Latitudes 6.00° and 6° 30^1 north and Longitudes 4° 45^1 and 5° 45^1 east of the Greenwich Meridian. The area is positioned within the equatorial evergreen swamp forest. There are over 80 fishing communities along the coastline and are the major fish producers in Ondo State [8]. A few of them (Ayetoro, Bijimi, Idiogba, and Asumogha) were purposely selected for this study based on extensive fishing activities in the towns and accessibility.

2.2 Catching of Shrimps

Artisanal fishermen mainly exploit the fishery. The shrimps were collected on monthly basis between the months of September and December 2011, with the assistance of artisanal fishermen. The Shrimpers used boats with sizes ranging from 5 to 12m long. The boats were powered by small outboard engines and manned by an average of two men per boat, to which the shrimping nets are attached. The specimens were immediately preserved in iced packed cooler and transferred to the Fisheries and Aquaculture Laboratory, Federal University of Technology, Akure where they were frozen at -4 ^{o}C before they were used for the research work.

2.3 Species Identification

The specimens were sorted into different groups and identified to specific level using the FAO Species Identification Sheets, (Volume VI) [15]

2.4 Data Analysis

The data were analysed using the Margalef's diversity index, Sorensen's index, and the Number of Occurrence Index (NOI).

Margalef's diversity index: Margalef's diversity index is calculated by using the formula:

$$d = \frac{S-1}{log_e N} \quad [16]$$

Where d = Margalef's diversity index
S = number of species
N = number of individuals

Sorensen's similarity index: This is the degree of similarity between the fish communities in the different locations. It is

expressed as:

$$C_s = \frac{2j}{a+b}$$ [17]

Where *Cs* is Sorensen's index,

j is the number of species common to a given pair of locations,

a and *b* are the number of species occurring in either of the two locations.

Number of Occurrence Index (NOI): this is the total number of individual of each species in a catch, expressed as a percentage of the total number of individual of all species in the catch.

$$NOI = \frac{C}{D} \times 100$$

Where,
C = number of individual of each species in the catch,

D = total number of individual of all species in the catch.

3. Results and Discussion

Species Abundance

Figure 2 shows the Number of Occurrence Index (NOI) of species in all the sampling stations. The result showed that during the period of study, *N. hastatus* was dominant in the four sampled locations with 83.05%, 76.47%, 72.50% and 71.67%, (in Ayetoro, Idiogba, Asumogha and Bijimi, respectively) in September. The NOI of Asumogha in the month of October showed that *N. hastatus* had 71.93%, *F. notialis* had 17.54%, *P. atlantica* 7.89% and *P. validus* 2.64%. A total of 207 specimens were captured from Idiogba in November out of which *N. hastatus* had 86.96%, *F. notialis* had 8.70%, *P. atlantica* 3.86% and no *M. macrobrachion* were captured while the NOI of the species caught in December indicates that *N. hastatus* had 84.34% of the total catch in Bijimi, *F. notialis* 6.96%, *P. atlantica* had 7.83%, while *P. validus* had the minimum of 0.87%. The study showed that the shellfish catches were largely composed of the following species in decreasing order of abundance: *N. hastatus, F. notialis, P. atlantica* and *M. macrobrachion*.

The abundance recorded was in line with the work of Ofor[18] and Zabbey [19] which stated that *N. hastatus* dominate artisanal catches from coastal waters and in estuaries, together with *F. notialis, P. kerathurus* and *P. atlantica* as the major representatives in small-scale catches. According to Marioghae [20] *N. hastatus* (which he called the "tiny shrimp" in distinction from penaeid shrimps) makes up three-quarters of the catch of filter traps or nets, while, Marioghae[21] made estimates of catches which give a figure of about 35kg of *N. hastatus* per fisherman per day and the catch is sun-dried or smoked, and marketed over much of inland Nigeria as "crayfish", which is ground and used as a condiment in cooking.

The result recorded between October and November, 2011 was similar to the result of Enin *et al.* [22] who studied *N. hastatus* fishery in the outer estuarine region of Cross River, Nigeria and reported that catch rates rose to a major peak between March and June (end of dry season and early rainy season). The authors also reported a secondary peak in October/November (transitional period between rainy and dry season). Also, Nwosu and Holzlohner [23] studied lunar and seasonal variations in the catches of *Macrobrachium* fishery and reported two maxima in May – July and November - December.

Powel [24] reported that *P. atlantica* is caught in appreciable quantities in the river mouth fisheries alongside *P. notialis* and *N. hastatus*, but is of secondary importance to each of the species and its greatest importance is in the coastal trawl fisheries while *F. notialis* is the dominant species in the commercial offshore trawl fisheries where they are heavily harvested with handnets and are of primary importance at the artisanal level.

P. validus, O. africana and *C. marginata* occurred in very low numbers during the sampling period and this was referred to as 'bycatch' by Zabbey [19] who stated that the composition of 'bycatch' observed during shrimping ranged from jellyfishes to finfish and occasionally gastropod molluscs. Bycatch may be defined as anything the fisherman does not intend to catch and may include the turtles, fish, crabs, sharks, weed and seabed debris [25].

The occurrence of the shellfishes in the sampled stations is shown in Table 1. The table shows that *N. hastatus*, *F. notialis*, and *P. atlantica* were caught in all locations throughout the sampling period, while *P. validus* was caught in both Bijimi and Asumogha but was not caught in both Ayetoro and Idiogba in October and December respectively. *M. macrobrachion* was caught between September and November in Bijimi, between September and October in Ayetoro and Idiogba in October, but was not caught in Asumogha. Also, *C. marginata* was caught in Asumogha in both September and December, while *O. africana* was only caught in Asumogha in November. These results showed that *N. hastatus*, *F. notialis*, and *P. atlantica* were captured throughout the sampling period and in all locations, while *P. validus* was captured throughout the sampling period in both Bijimi and Asumogha and was not captured once in both Ayetoro and Idiogba in September and December respectively. *C. marginata* and *O. africana* were only captured in September and November respectively.

The result reveals that species diversity is a useful parameter for the comparison of communities under the influence of biotic disturbances or to know the state of succession and stability in the community as the diversity index (*d*) ranged from 0.38 at Idiogba to 0.91 at Asumogha in December and September respectively (Table 2), this indicates little difference in the species diversity of the shellfish communities, while Sorensen's similarity (*Cs*) values ranged from 0.38 to 0.5 (Table 3) suggesting a generally high similarity among the shellfish communities in the study area. The closeness of the diversity indices is reflected in the communities being very similar and this is buttressed by the similarity index values.

Balloch *et al.* [26] found the diversity index to be a suitable indicator of water quality, Hughes [27] also concluded that this index was useful for community structure, but could not stand alone for assessing environmental quality while Costa and Fransozo [28] reported that the important factors that affect distribution and abundance of shrimps in the tropical region are water quality (temperature, salinity), nourishment and substrates. Thus, this finding could be as a result of the prevailing highly similar environmental conditions as reported

by Ekta [29].

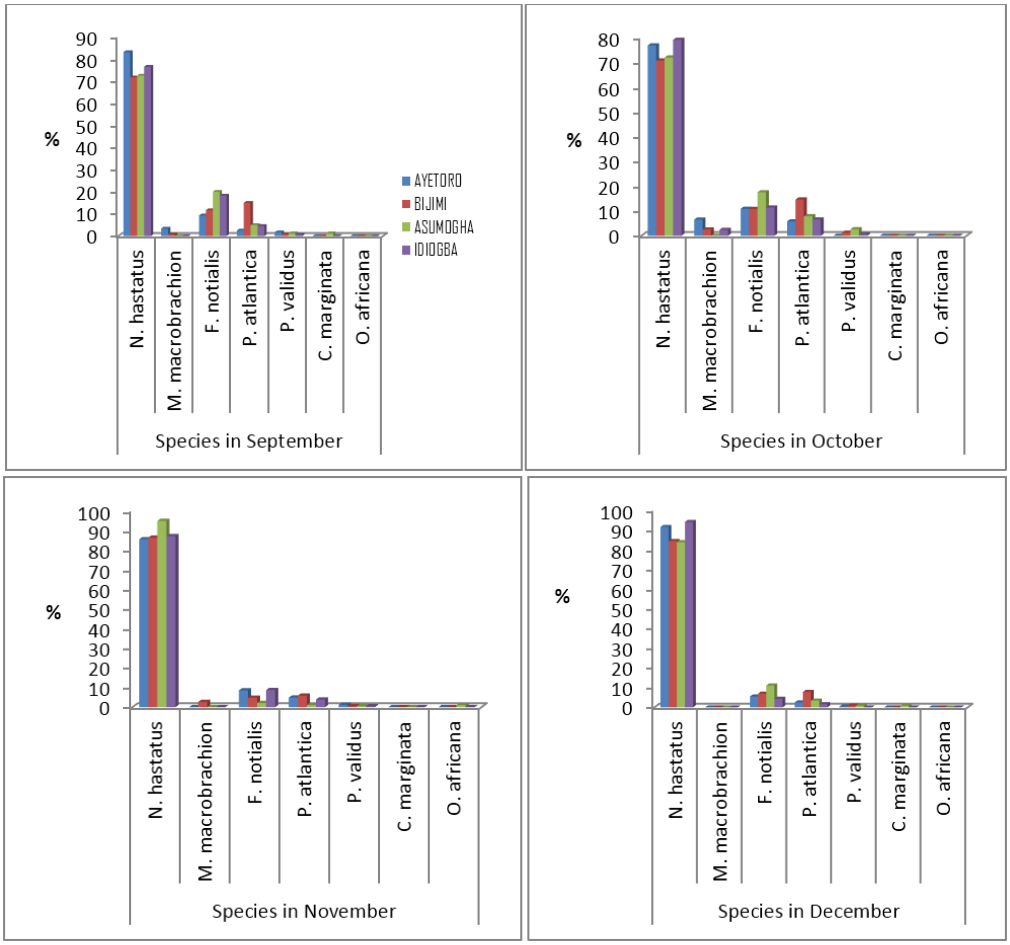

Fig 2: Relative abundance of Shellfishes in coastal waters of Ondo State, between September and December, 2011.

Table 1: Occurrence of Shellfishes in coastal waters of Ondo State, between September and December, 2011.

Months	Species	AYETORO	BIJIMI	ASUMOGHA	IDIOGBA
September	*N. hastatus*	+	+	+	+
	M. macrobrachion	+	+	-	-
	F. notialis	+	+	+	+
	P. atlantica	+	+	+	+
	P. validus	+	+	+	+
	C. marginata	-	-	+	-
	O. africana	-	-	-	-
October	*N. hastatus*	+	+	+	+
	M. macrobrachion	+	+	-	+
	F. notialis	+	+	+	+
	P. atlantica	+	+	+	+
	P. validus	-	+	+	+
	C. marginata	-	-	-	-
	O. africana	-	-	-	-
November	*N. hastatus*	+	+	+	+
	M. macrobrachion	-	+	-	-
	F. notialis	+	+	+	+
	P. atlantica	+	+	+	+
	P. validus	+	+	+	+
	C. marginata	-	-	-	-
	O. africana	-	-	+	-
December	*N. hastatus*	+	+	+	+
	M. macrobrachion	-	-	-	-
	F. notialis	+	+	+	+
	P. atlantica	+	+	+	+
	P. validus	+	+	+	-
	C. marginata	-	-	+	-
	O. africana	-	-	-	-
+ indicates present; - indicates absent					

Table 2: Margalef's diversity index of Shellfishes in coastal waters of Ondo State, between September and December, 2011

MONTH	AYETORO	BIJIMI	ASUMOGHA	IDIOGBA
SEPTEMBER	0.84	0.84	0.91	0.60
OCTOBER	0.61	0.79	0.63	0.78
NOVEMBER	0.59	0.76	0.76	0.56
DECEMBER	0.57	0.63	0.84	0.38

Some important factors governing the abundance and distribution of aquatic communities includes, water quality, immediate substrates for occupation and food availability [30] and any ecological imbalance arising from any severe alterations of these factors may affect the environment. Also, Kennish [31] noted that anthropogenic activities could lead to the periodic or permanent elimination of estuarine dependent fish species from individual estuarine systems. Therefore, the relatively low composition and diversity may be as a result of stress imposed by land based pollutants, as well as substrate instability possibly arising from frequent anthropogenic activities in the area. Similar observations were made by Ajao and Fagade [32] on the western industrialised parts of Lagos Lagoon, which received a complex mixture of domestic and industrial wastes.

Table 3: Sorensen's similarity index for the pairs of fish communities.

MONTH	STATION	AYETORO	BIJIMI	ASUMOGHA	IDIOGBA
SEPTEMBER	AYETORO	0			
	BIJIMI	0.50	0		
	ASUMOGHA	0.40	0.40	0	
	IDIOGBA	0.44	0.44	0.44	0
OCTOBER	AYETORO	0			
	BIJIMI	0.44	0		
	ASUMOGHA	0.38	0.44	0	
	IDIOGBA	0.44	0.50	0.44	0
NOVEMBER	AYETORO	0			
	BIJIMI	0.44	0		
	ASUMOGHA	0.44	0.40	0	
	IDIOGBA	0.50	0.44	0.44	0
DECEMBER	AYETORO	0			
	BIJIMI	0.50	0		
	ASUMOGHA	0.44	0.44	0	
	IDIOGBA	0.43	0.43	0.38	0

4. Conclusion

It could be concluded that *N. hastatus* (which makes up about three-quarters of the total catch of artisanal fishermen in the study area), followed by F. *notialis* and *P. atlantica* were very abundant in small-scale catches in the coastal waters of Ondo state and were widely distributed while the distribution of *M. macrobrachion, O. africana* and *C. marginata* was limited in the study area. Also, there was a generally high similarity among the shellfish communities in the four sampling stations. However, the relatively low composition and diversity calls for further research on the condition of the ecosystem especially in terms of pollution status. There is hence an urgent and serious need for the monitoring and control of pollution in coastal area of developing nations to further analyse its sustainability of biodiversity.

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