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Length-weight relationship and condition factor of shrimps in coastal waters of Ondo state, South West, Nigeria

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ABSTRACT
The Length-Weight Relationship (LWR) and condition factor (K) of *Nematopalaemon hastatus*, *Farfantepenaeus notialis, Parapenaeopsis atlantica and Macrobrachium macrobrachion* obtained from the coastal waters bordering Ayetoro, Bijimi, Asumogha and Idiogba of Ondo States, Nigeria between September and December, 2011 were studied. The length-weight relationship of the sampled shrimps had regression coefficient ranging between (b= 1.01) in *M. macrobrachion* caught in Bijimi in September to (b= 3.26) in P. atlantica caught in Bijimi in November. The b coefficients were not equal to 3 in the individual species, hence growth were allometric (b values were lesser/greater than 3). The highest condition factor (K = 0.57) and the lowest (K =0.48) in *N. hastatus* were recorded in December (at Ayetoro) and September (at Idiogba) respectively, while in *P. atlantica*, the lowest condition factor (K = 0.32) was recorded in September at Ayetoro, and the highest value (K = 0.52) was recorded in December at Bijimi. The months of September and October had the highest condition factor (K = 0.44) in *F. notialis* caught from Ayetoro location while the lowest K value of 0.31 was recorded in specimens caught at Idiogba in October. The range of K values which was from 0.46 (Bijimi in November) to 0.82 (Idiogba in October) in *M. macrobrachion* indicated that the shellfishes examined from four locations in Ondo State coastal area were in good and healthy conditions.

Keywords:*Nematopalaemon hastatus, Farfantepenaeus notialis, Parapenaeopsis atlantica, Macrobrachium macrobrachion.*

1. Introduction
Shrimps are highly priced seafood harvested from coastal tropical and warm-temperature waters throughout the world. Shrimps support commercially valuable fisheries in many areas of the world [1]. The most sought after shrimp in the Nigerian shore is *F. notialis*. Other shrimps of commercial importance include; *Parapenaeopsis atlantica* (Brown Shrimp) caught at depth of 9- 27 m, *P. longirostris* (Red Shrimp) caught at depth of 150 -200 m, *Penaeus kerathurus* (Stripe or Zebra shrimp), and the Palaemonidae, (*Nematopalaemon hastatus,* Estuarine prawn) which are exploited in the shallow areas by the artisan fishermen [2].
F. notialis juveniles are found in river mouths and mangrove creeks, inland areas with salinities of about 5 ppt [3]. Adults are found in marine coastal water where they are the dominant species in the commercial offshore trawl fisheries. Juveniles develop in brackish water within the Delta, where they are heavily harvested with handnets and are of primary importance at the artisanal level while *P. atlantica* inhabit areas with high-salinity, (over 25 ppt) within the river mouths, and coastal marine waters [3].

Due to the economic importance of shrimps worldwide, particularly in aquaculture, a great effort to understand the growth biology of shrimps has been made in recent years, although various studies have been carried out regarding shrimps, there is a dearth and paucity of information on Length-weight relationships of shellfishes from this part of the Country [4].

Despite its economic importance and future potentials very little documented works are available on length-weight relationship and condition factor of these shrimps in West Africa [5]. Aspects of the biology of the *Macrobrachium* species occurring in Nigeria have been documented by [6] on the ecology and distribution in Lagos Lagoon [3], on their occurrence in the Niger Delta area [7], and [8], on the salinity tolerance and sexual dimorphism in Asejire Lake [9], on the food of the larvae, [10] on the food and feeding habits in Epe Lagoon and [11] on the recruitment pattern in the Lagos-Lekki Lagoon system.

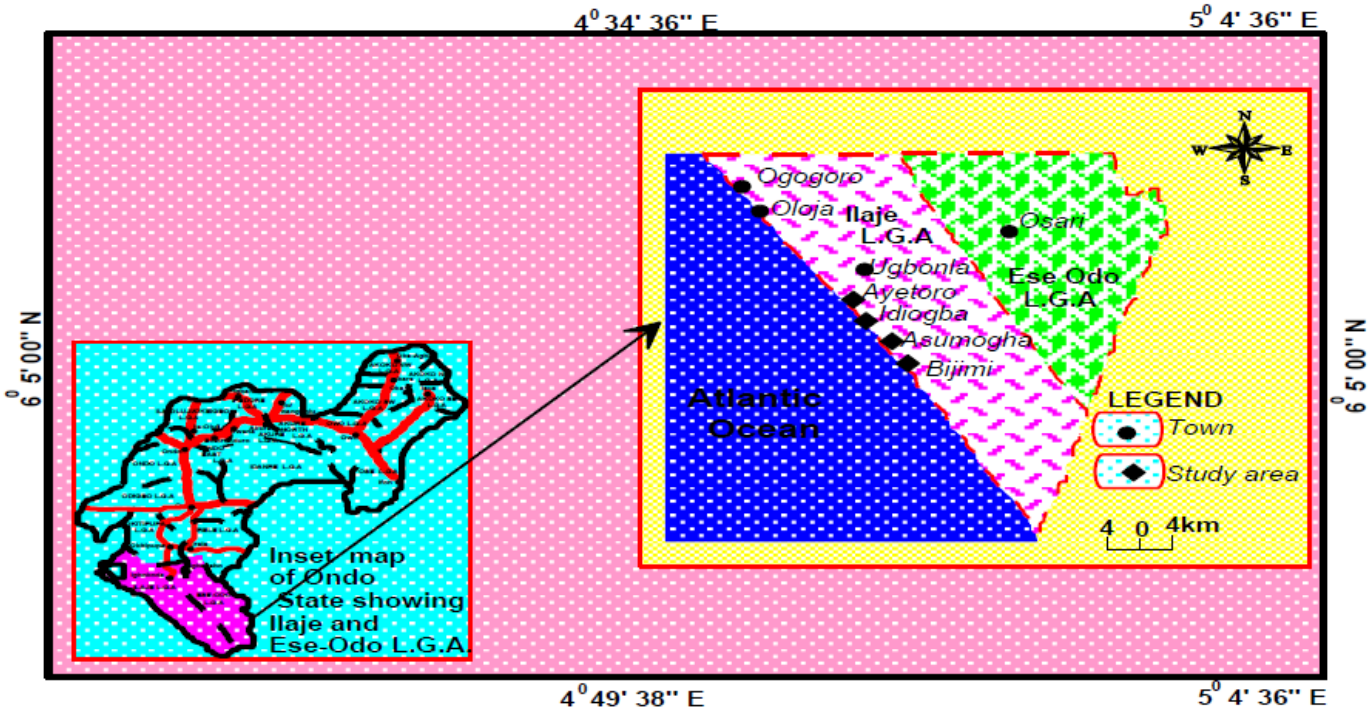
The present study is an attempt to support and enrich already existing knowledge on the growth pattern of shrimps. Thus, this study was embarked on aiming at providing useful information on the length-weight relationship (growth patterns) and condition factor (state of wellbeing) of shrimps caught in coastal waters bordering Ayetoro, Bijimi, Asumogha and Idiogba of Ondo State, Nigeria where such study was lacking. Hence, researchers will be able to make reasonable predictions on the shrimp species in the ecosystem for better management and sustainability of shrimp fishery.

2. Materials and Methods

2.1 Description of Study Area

The study was carried out in Ayetoro, Bijimi, Idiogba, and Asumogha located in Ilaje Local Government (Figure 1) in the coastal area of Ondo State between September, 2011 and December 2011. The study area is at the extreme southern part of Ondo state. Ilaje L.G.A. 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. The coastal areas of Ondo State consist of over five hundred settlements spreading over
3,000 km2. The area has over 180 km long shoreline thereby making it the longest coastline in
Nigeria [12].

The study area falls within Latitudes 6.00° and 6° 301 north and Longitudes 4° 451 and 5° 451 East of the Greenwich Meridian. The area is positioned within the equatorial evergreen swamp forest. Ondo State coastal areas are estimated to be about 60,000 hectares with a rich biodiversity which contains diverse assemblage of fish, shellfish (shrimps, crabs, lobster, gastropods and cephalopods, reptiles and other living organisms [13]. For the study, Ayetoro, Bijimi, Idiogba, and Asumogha were purposely selected based on extensive fishing activities in the towns and accessibility.



2.2 Catching of Shrimps

Artisanal Shrimpers (Fishermen) mainly exploit the fisheries. The Shrimpers use boats with sizes ranging from 5 to 12m long, to which push nets are attached. The boats are powered by small outboard engines ranging from 15 to 25 hp, and manned by an average of two men. From these boats, the shrimpers operate their shrimping nets.

2.3 Collection of Specimens

Shrimps were collected on monthly basis between the months of September and December 2011, with the assistance of artisanal fishermen after which the specimens were immediately preserved in iced packed cooler and immediately transferred to the Fisheries and Aquaculture Laboratory, Federal University of Technology, Akure where they were frozen at -4 ^{0}C before they were used for the research work. The specimens were sorted into different groups and identified to species level using [14].

2.4 Determination of Meristic Measures:

Measurements were taken for total length (from the tip of the rostrum to the extremity of the telson), rostral length (from the tip to the posterior margin of the orbit), carapace length (from the posterior margin of the carapace to the extremity of the telson), and body length (from the posterior margin of the orbit to the extremity of telson), using graduated measuring board to the nearest 0.01 cm. The weight was also measured after excess water had been removed from the shrimp with digital Sartorius top loading weighing balance (Model 1100) to the nearest 0.01g.

2.5 Length-Weight Relationship

The relationship between the total length (TL) and weight (W)

of shrimps was expressed by equation:

$$W = aL^b$$ [15]

Where
W=Weight of shrimps in (g) L=Total Length (TL) of shrimps in (cm) a=Constant (intercept)
b=The Length exponent (slope)

The "a" and "b" values were obtained from a linear regression of the length and weight of shrimps.
The values of "a" and "b" were given a logarithm transformation according to the following formula:

The Scatter diagrams were plotted to illustrate the relationship between the length and the weights of the shrimps using Minitab 14. The log of lengths and weights were obtained and plotted in order to establish the relationship between them.

2.6 Condition Factor:
The condition factor (k) of the shrimps was estimated from the relationship:

$$K = \frac{100W}{L^3}$$

Where K = Condition factor,
W = Weight of shrimps (g),
L = Total Length of shrimps (cm)
The mean total lengths and weights of each species in each location were used for data analysis, the format accepted by FISAT [16].

3. Results and Discussion

3.1 Length-Weight Relationship

The exponent "b" values for all the species ranged from 1.01 in *M. macrobrachion* caught in Bijimi in September to 3.26 in *P. atlantica* caught in Bijimi in November as in table 1. The b values were not equal to 3(except for *P. atlantica* captured at Ayetoro in September), Hence growth in the individual species was allometric (i.e. b values were less/greater than 3) showing that the rate of increase in body length is not proportional to the rate of increase in body weight.
The b values obtained for *N. hastatus* (1.20-1.62) and *M. macrobrachion* (1.01-1.99) indicate negative allometric growth pattern and is in line with *b* values (1.28-2.72) and (1.42-2.87) recorded for *N. hastatus* [17] and *M. macrobrachion* [5] respectively [6]. Similarly reported positive relationship between the carapace length and weight of *M. macrobrachion* in the Lagos Lagoon area, also when *M. macrobrachion* were considered by [18] in Luubara creek (Nigeria), the b value indicated allometric growth pattern. The slight variation in the values of b is understandable because length - weight relationship of a species could vary according to locality and season as stated by [18, 19].

Table 1: Length Weight Relationship (Growth Pattern) of species over the months and across the Locations.

Species	Month	Idiogba				Ayetoro				Bijimi				Asumogha			
		n	b	a	r^2	n	b	a	r^2	n	b	A	r^2	n	b	a	r^2
N. hastatus	September	117	1.41	-2.37	0.54	98	1.37	-2.25	0.73	86	1.36	-2.18	0.52	58	1.31	-2.04	0.54
	October	132	1.26	-1.99	0.51	106	1.54	-2.49	0.71	111	1.43	-2.31	0.73	82	1.62	-2.68	0.70
	November	180	1.24	-1.97	0.52	140	1.46	-2.45	0.73	162	1.59	-2.68	0.79	178	1.56	-2.57	0.69
	December	172	1.47	-2.48	0.94	182	1.43	-2.29	0.55	97	1.20	-1.85	0.94	98	1.54	-2.56	0.93
P. atlantica	September	7	3.02	-5.45	0.56	3	3.00	-5.73	0.78	18	3.08	-5.91	0.45	4	3.10	-5.62	0.86
	October	11	3.13	-5.82	0.89	8	3.13	-5.81	0.81	23	2.98	-5.58	0.86	9	3.17	-6.16	0.84
	November	8	3.02	-5.40	0.74	8	3.24	-5.95	0.84	11	3.26	-5.85	0.88	3	3.18	-5.93	0.87
	December	3	3.14	-5.91	0.91	5	3.21	-5.88	0.81	9	3.06	-5.52	0.75	4	3.20	-3.79	0.74
F. notialis	September	28	2.97	-5.62	0.87	11	2.96	-5.36	0.63	14	2.25	-3.95	0.78	16	2.32	-4.09	0.56
	October	19	3.13	-6.15	0.75	15	2.83	-5.06	0.67	17	2.84	-5.27	0.65	20	2.19	-3.84	0.62
	November	18	2.58	-4.78	0.87	14	2.25	-4.21	0.76	9	2.67	-4.94	0.86	4	2.84	-4.06	0.79
	December	8	2.06	-4.56	0.77	11	2.15	-4.19	0.68	8	2.04	-4.63	0.83	13	2.19	4.74	0.82
M. macrobrachion	September	0	-	-	-	4	1.39	-1.61	0.72	1	1.01	-1.54	0.68	0	-	-	-
	October	4	1.99	-2.88	0.79	9	1.30	-1.56	0.76	4	1.99	-1.63	0.73	0	-	-	-
	November	0	-	-	-	0	-	-	-	5	1.74	-1.56	0.70	0	-	-	-
	December	0	-	-	-	0	.	-	-	0	-	-	-	0	-	-	-

Also stated that the development of fish involves several stages, each of which has its own length-weight relationships and there may also be differences in the relationships due to sex, maturity, season and environmental conditions (e.g. pollution). Apart from *F. notialis* obtained in Idiogba in September which had a positive allometric growth (3.13), the species exhibited negative allometric growth pattern with values of b ranging between 2.04 and 2.97 and is similar with the results of [20] on *F. notialis* and *Penaeus monodon* who observed that both shrimp species showed allometric pattern of growth in Buguma Creek in the Niger Delta, Nigeria. Also the values of *b* for *P. atlantica* (2.98-3.26) show positive allometric or approximate isometric growth which falls within the range reported by [21], that *b* values may range from 2.5 to 3.5 suggesting that result of this study is valid. The differences in weight for all the sampled batches may be due to the individual condition factor as it relates to the well-being and degree of fatness [22, 23] also found similar results in pelagic fishes from Nkoro River, Niger Delta, Nigeria. This suggests that the condition of the coastal waters of Ondo State compares favourably to other coastal water or marine bodies in Nigeria, thus the species studied were observed to be in good growth condition, as the values were generally higher than one.

3.2 Condition Factor

The condition factor (K) which indicates the state of overall well-being of shrimps in this study is given in Table 2. The K-values show a fairly consistent but low values in all species irrespective of location ranging between 0.48 and 0.57 in *N. hastatus* collected in September at Idiogba and December at Ayetoro respectively while in *P. atlantica*, the lowest condition factor (K = 0.32) was recorded in specimens collected in September at Ayetoro, and the highest (K = 0.52) was recorded in specimens collected in December at Bijimi and this is in line with the report of [24] in the Orogodo River.

In the *F. notialis* specimens, the months of September and October had the highest condition factor (K = 0.44) both at Ayetoro while the lowest K value of 0.31 was recorded at Idiogba in October, this is within the range reported by [4] and [1] when comparing different size group of *F. notialis* in Lagos Lagoon, South West, Nigeria. In *M. macrobrachion* specimens, the range of k value (0.46; Bijimi in November to 0.82; Idiogba in October) was higher than the range reported by [18] for *M. macrobrachion* in Luubara creek, Ogoni land, Niger Delta, Nigeria while the k values were lower than the range (2.12 - 7.98) reported by [5] in both *M. macrobrachion* and *M. vollenhovenii* from two interconnecting fresh/brackish water lagoons in south-west Nigeria. The mean condition factor by site (0.34 - 0.82) obtained in this study varied slightly with the results from [25] and [26] who observed differences in the condition factor of the different sexes of *Callinectes amnicola* in Badagry Lagoon, Lagos Lagoon and its adjacent creek [27] posited that condition factor of different populations of same species is indicative of food supply and timing and duration of breeding. K also gives information when comparing two populations living in certain feeding density, climate, and other conditions; when determining the period of gonad maturation; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source [28]. From the above assertions we could assume that the four species in this work may be in their reproductive period as the K values were low, this is supported by [29] who confirmed that low K values during the more developed gonad stages might mean resource transfer to the gonads during the reproductive period.

Table 2: Condition Factors (K) of species over the months and across the Locations

Species	Month	Idiogba	Ayetoro	Bijimi	Asumogha
		K	K	K	K
N. hastatus	September	0.48	0.53	0.53	0.56
	October	0.54	0.57	0.56	0.52
	November	0.54	0.49	0.51	0.54
	December	0.49	0.57	0.56	0.51
	Mean	0.51	0.54	0.54	0.53
P. atlantica	September	0.46	0.32	0.36	0.34
	October	0.42	0.43	0.40	0.33
	November	0.38	0.38	0.40	0.45
	December	0.49	0.46	0.52	0.39
	Mean	0.44	0.40	0.42	0.38
F. notialis	September	0.35	0.44	0.35	0.35
	October	0.31	0.44	0.37	0.33
	November	0.38	0.32	0.43	0.35
	December	0.33	0.35	0.35	0.39
	Mean	0.34	0.39	0.37	0.36
M. macrobrachion	September	-	0.64	0.68	-
	October	0.82	0.69	0.71	-
	November	-	-	0.46	-
	December	-	-	-	-
	Mean	0.82	0.67	0.59	-

However, [30] showed that values of the condition factor vary according to seasons and are influenced by environmental conditions. The same may be occurring in the environment under study since the floodplain is influenced by many biotic and abiotic factors, which favour the equilibrium of all the species in the ecosystem. Pollution was also seen to affect the condition factors of fishes in lake Mariut, Egypt [31] while [32] documented that pollution reduced the condition factor of fishes in Shanawan drainage canal in Egypt. The non-seasonality and non-significant variations between locations may be related to food regime of the species utilizing food resources and accumulating a large quantity of flesh as was also observed by [33] for fish in their study.

4. Conclusion

In conclusion, the composition of all sampling stations gave better over-view of LWR for each shrimp species and that the four sampled shrimp species indicated allometric growth patterns and were in good and healthy conditions. The low K value obtained may be attributed to pollution status or anthropogenic activities that occur in it. Therefore a call for study of pollution status or anthropogenic activities to further analyse its sustainability of biodiversity is inevitable.

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