Published September, 2017

EFFECTS OF SEASONS ON THE LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF TWO BRACKISH WATER SHRIMPS IN ONDO STATE, NIGERIA

Ajibare[1*], A. O., Olawusi-Peters[2], O. O. and Bello-Olusoji[2], O. A.

ABSTRACT

[1]Department of Biological Sciences, Wesley University Ondo, Nigeria. [2]Department of Fisheries and Aquaculture Technology, Federal University of Technology Akure, Nigeria, [*]Corresponding Author: mrajifem@yahoo.com

The Length-Weight Relationship (LWR) and Condition Factor (K) of Nematopalaemon hastatus and Farfantepenaeus notialis in the coastal waters of Ondo State, Nigeria were investigated from April, 2014 to March, 2016. The mean length of examined shrimps ranged from 4.90±0.99cm to 5.31±0.76cm and 9.29±1.20cm to 9.71±1.36cm (wet-season) while it ranged from 4.87±1.03cm to 5.29±0.50cm and 9.29±1.43cm to 9.57±0.99cm (dry-season) in N. hastatus and F. notialis respectively while the mean weight of N. hastatus and F. notialis ranged from 0.58±0.21g to 0.65±0.18g and 4.10±1.24g to 4.75±1.20g (wet-season) and 0.56±0.20g to 0.64±0.18g and 4.19±1.14g to 4.97±1.16g (dry-season) respectively The length-weight relationship of N. hastatus had regression coefficient ranging between 1.43 and 1.77 in the wet-season and from 1.33 to 1.66 in the dry-season while the corresponding 'b' obtained for F. notialis was from 1.84 to 2.54 and 1.53 to 1.99 in the wet and dry-season respectively. The minimum (0.42) and maximum (0.53) condition factor of N. hastatus were recorded in wet and dry-season respectively while the 'K' value of F. notialis ranged between 0.47 and 0.57 in wet-season and from 0.48 to 0.57 in the dry-season. The b coefficients indicated that growth were allometric in individual species while the K values indicated that the shrimps were in good and healthy conditions. The values recorded in both seasons were not statistically different (P>0.05) from each other in both species. Consequently, close monitoring of pollution of the study area is recommended since the result shows that the health of the examined shrimps is not being influenced by seasons.

Keywords: *Seasonal dynamics, Length-Weight Relationship, Condition Factor, Shrimps, Ondo Coastal Water.*

INTRODUCTION

The coastal area of Ondo State, Nigeria which is well known for sea foods is located between the Lagos coast with very high population density and industrial activities and the Delta coast where there is high volume of ongoing crude oil exploration. The area has increasing domestic and commercial activities while the major means of transportation in the area is motorboat with lightly heavy traffic of goods and persons. These make contamination of the area most likely and its pollution may have national and global health and ecological effects (Adebowale *et al.*, 2008). The sewage and other domestic wastes from settlements around the coast are major sources of pollution in coasts (Kress *et al.*, 2004). Agricultural practices which have been reported to be major sources of pollution in the environment (Keller *et al.*, 2002; Murray, *et al.*, 2004) can be a marked source of pollution in this coast. The most sought after shrimp in the Nigerian shore is *F. notialis* (Penaeidae) and *Nematopalaemon hastatus* (Palaemonidae) which are exploited in the shallow areas by the artisan fishermen (USAID, 2002). Zabbey (2007) stated that *Nematopalaemon hastatus* and *Farfantepenaeus notialis* dominate artisanal catches from coastal waters and estuaries while Olawusi-Peters and Ajibare (2014) reported that they make up about three-quarter of the total catch of artisanal fishermen in the coastal waters and estuaries where it is used as condiment in cooking due to the unique flavour imparted to food and the protein content of almost 70% dry matter it contains.

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. While condition factor has been used as an index of growth and feeding intensity (Fagade, 1979), one of the most commonly used analyses of fisheries data is Length-Weight Relationship (Mendes *et al.*, 2004). Weatherly and Rogers (1978) as quoted by Olawusi-Peters *et al.* (2014) posited that condition factor of different populations of same species is indicative of food supply and timing and duration of breeding. Condition Factor (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. Although various studies have been carried out regarding shrimps, there is dearth and paucity of information on Length-Weight Relationships and condition factor (K) of shrimps from this part of the country. Olawusi-Peters *et al.* (2014) obtained low condition factor for shrimps in the coastal area of Ondo State, Nigeria and attributed it to pollution and/or anthropogenic activities that occur in the area and called for further study to analyze the sustainability of biodiversity. It is on this basis that this study was embarked on with the aim of providing useful information on the Length-Weight Relationship (LWR) and condition factor (K) of shrimps in

coastal waters bordering Ayetoro, Idiogba, Asumogha and Bijimi of Ondo State, Nigeria and ensuring the safety of this ecosystem.

MATERIALS AND METHODS

Study area

The study was carried out in the coastal area of Ondo State (Ilaje Local Government Area) between April, 2014 and March, 2016. The study area is at the extreme southern part of Ondo State. Ilaje LGA has the longest coastline in Nigeria (about 78km) with long history in fishing dating back to the pre-colonial days (Olawusi-Peters *et al.* 2015a). The area is positioned within the equatorial evergreen swamp forest with two major seasons; the dry season and the wet season. The environment experiences consistently high temperatures (about 32°C) all year round (Bayode *et al.*, 2011; Olawusi-Peters *et al.* 2015a). For the study, Ayetoro (06°06'N 04°46'E), Idiogba (06°05'N 04°47'E), Bijimi (06°04'N 04°49'E), and Asumogha (06°04'N 04°39'E) were purposely selected based on earlier information for extensive shrimp fishing activities in the towns, accessibility and possible anthropogenic inputs from activities of oil exploration, transportation, farming practice, domestic and cottage industrial discharges into rivers and streams which finally emptied into Atlantic Ocean in the southern part. This area is noted for sea foods which are consumed within and outside the state (Olawusi-Peters *et al.* 2015a).

Collection and identification of shrimps

Specimens were collected monthly from April, 2014 to March, 2016 with the assistance of artisanal fishermen after which the specimens were immediately preserved in ice and transferred to the laboratory where they were frozen at -4ºC before being used for the research work. The shrimps were then sorted and identified to species level using the FAO Species Identification Sheets, (Volume VI) (FAO, 1981), Powell (1980, 1982) and Holthius (1980).

Determination of length and weight

After thawing the shrimps, the weight of each shrimp sample was measured with top loading sensitive weighing balance (Model BL100001) to the nearest 0.01g while the total length (from the tip of the rostrum to the extremity of the telson) was measured using graduated measuring board to the nearest 0.01 cm.

Determination of length-weight relationship (b)

The relationship between the length (L) and weight (W) of prawns was expressed by the equation:

$W = aL^b$ (Pauly, 1983) ……eq 1

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.

Determination of condition factor

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

$K = \frac{100W}{L^3}$ ……eq 2

Where K = Condition factor, W = Weight of shrimps (g), L = Length of shrimps (cm)

The mean lengths and weights of each species were used for data analysis, the format accepted by FISAT (Gayanilo and Pauly, 1997).

RESULTS

Length and weight of shrimps

The mean seasonal length and weight of examined shrimps is presented in Fig. 1. The figure shows that the total length of *N. hastatus* ranged from 4.90±0.99cm (Idiogba) to 5.31±0.76cm (Bijimi) in the wet season while it ranged from 4.87±1.03cm (Idiogba) to 5.29±0.50cm (Bijimi) in the dry season. The figure further shows that the mean total length of *F. notialis* ranged from 9.29±1.20cm (Asumogha) to 9.71±1.36cm (Ayetoro) in the wet season and between 9.29±1.43cm (Idiogba) and 9.57±0.99cm (Bijimi) and in the dry season and there was no significant difference (P>0.05) between the length and weight recorded in the wet and dry seasons across the four stations for both species. The total weight of *N. hastatus* shows that the mean total weight in the wet season ranged from 0.58±0.21g at Ayetoro to 0.65±0.18g at Bijimi while the mean total weight ranged from 0.56±0.20g (Ayetoro) to 0.64±0.18g (Bijimi) in the dry season while the mean total weight of *F. notialis* in the wet season ranged from 4.10±1.24g (Idiogba) to 4.75±1.20g (Bijimi) and from 4.19±1.14g (Ayetoro) to 4.97±1.16g (Bijimi) in the dry season and the values recorded in both seasons were not statistically different (P>0.05) from each other in both species.

Length and weight frequency distributions of shrimps

The length frequency distribution of *N. hastatus* in this study is presented in Table 1. The Table shows that the length range of 4.0-5.9cm had the highest percentage frequency (from 64.7% in Ayetoro (dry season) to 80.0% in

Bijimi (wet season) in all the sampling stations and in both seasons. Moreover, Table 2 which presents the length frequency distribution of *F. notialis* reveals that the length range of 8.5-10.4cm had the highest percentage

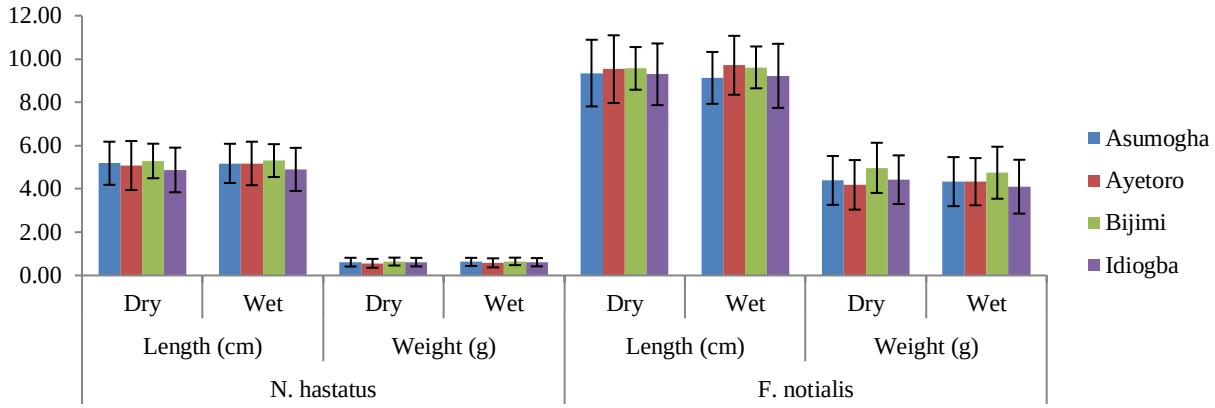

Fig. 1: Length (cm) and Weight (g) of examined shrimps

Table 1: Length frequency distribution of examined *N. hastatus*

	Asumogha (%)		Ayetoro (%)		Idiogba (%)		Bijimi (%)	
Range	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
< 2.0cm	0	0	0.2	0.8	1.2	1.7	0	0.2
2.0-3.9cm	11.8	14.9	13.3	16.2	17.2	18.7	5.4	7
4.0-5.9cm	72.8	66.5	65.1	64.7	72.1	69.5	80	81
6.0-6.9cm	15.4	18.6	21.4	17.5	9.6	10.1	14.6	11.8
≥7.0cm	0	0	0	0.7	0	0	0	0

Table 2: Length frequency distribution of examined *F. notialis*

	Asumogha (%)		Ayetoro (%)		Idiogba (%)		Bijimi (%)	
Range	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
4.5-6.4cm	0	4.2	0	4.6	4.3	7	0	0.3
6.5-8.4cm	0	46.0	20.7	16.7	22.9	17.8	10	10
8.5-10.4cm	70.9	49.7	47.5	48.9	52.9	54.3	71	71.6
10.5-11.4cm	20.5	0	20.2	18.8	13.8	15.4	15.9	13.8
>11.4cm	8.6	0	11.6	11	5.9	5.4	3.1	4.3

frequency (from 47.5% in Ayetoro (wet season) to 71.6% in Bijimi (dry season) in all the sampling stations and in the wet and dry seasons.

The weight frequency distribution of *N. hastatus* in this study is presented in Table 3. The Table shows that the weight of *N. hastatus* varied between 0.01g and 0.99g in both seasons while Idiogba in the wet season (0.3%) and Bijimi (0.7%) in the wet and (0.2%) in the dry season had shrimps that fell in the range of ≥1.00g. Also, the weight frequency distribution of *F. notialis* varied between 2.0g and 5.99g in Asumogha, Ayetoro and Idiogba in both seasons while Bijimi had shrimps that weighed between 6.0g and 7.9g in both wet (3.2%) and dry (5.7%) seasons as presented in Table 4.

Length-weight relationship (b) of shrimps

The length-Weight relationship of the examined shrimps is presented in Table 5. The exponential (b) values obtained for *N. hastatus* in the wet season ranged between 1.43 (a= -2.78, R^2 = 0.89) and 1.77 (a= -3.49, R^2 = 0.87) in Idiogba and Ayetoro respectively while the corresponding 'b' obtained for *F. notialis* was 1.84 (a= - 2.73, R^2 = 0.85) and 2.54 (a= -4.22, R^2 = 0.81) at Ayetoro and Bijimi respectively. The Table further shows that the b obtained for *N. hastatus* in the dry season ranged from 1.33 (a= -2.62, R^2 = 0.80 at Idiogba) and 1.66 (a= -3.23, R^2 = 0.80 at Bijimi) while the values obtained for *F. notialis* in the dry season was 1.53 (a= - 1.97, R^2 = 0.64) and 1.99 (a= -2.92, R^2 = 0.73) at Asumogha and Bijimi respectively

Condition factor (K) of shrimps

The condition factor of the examined shrimps is also presented in Table 5 which shows that the minimum 'K' value (0.42) recorded for *N. hastatus* in the wet season was for the 608 shrimps caught at Ayetoro and the maximum was 0.52 for 584 shrimps captured at Idiogba while the 'K' value of *F. notialis* ranged between 0.47

(n= 352) and 0.57 (n= 361) in Ayetoro and Asumogha respectively. Also, the K obtained for *N. hastatus* in the dry season ranged from 0.43 (n= 604 at Ayetoro; n= 551 at Bijimi) and 0.53 (n= 662 at Idiogba) while the values of *F. notialis* in the dry season ranged between 0.48 (n= 346) and 0.57 (n= 348) at Ayetoro and Bijimi respectively.

Table 3: Weight Frequency Distribution of examined *N. hastatus*

	Asumogha (%)		Ayetoro (%)		Idiogba (%)		Bijimi (%)	
Range	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
0.01-0.39g	11.9	16	20.9	23.4	15.6	16.1	8.2	10
0.40-0.59g	32.4	28.7	27.5	32.1	30.3	29.2	31.9	33.3
0.60-0.79g	31.7	32.9	35.7	28.9	33	32.6	39.4	34.1
0.80-0.99g	23.9	22.3	15.9	15.6	20.7	22.1	19.8	22.5
≥1.00g	0	0	0	0	0.3	0	0.7	0.2

Table 4: Weight frequency distribution of examined *F. notialis*

	Asumogha (%)		Ayetoro (%)		Idiogba (%)		Bijimi (%)	
Range	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
<2g	0	10.1	3.3	8.6	8.4	8.6	2	1.4
2.0-3.9g	5.3	56.7	32.7	36.3	37.9	27.5	27	23.2
4-4.99g	34.6	30.2	35.5	28.3	25.9	25.4	25.9	26.7
5-5.99g	60.1	3.1	28.5	26.9	27.8	38.4	42	42.9
6.0-7.9g	0	0	0	0	0	0	3.2	5.7

DISCUSSION

This study showed that shrimps of various size range exist in the coastal waters of Ondo State. *N. hastatus* with the size range of 4.0-5.9cm were the most abundant, followed by 6.0-6.9cm and 2.0-3.9cm in both seasons while *F. notialis* in the size range of 8.5-10.4cm were the most abundant, followed by 6.5-8.4cm and 10.5-11.4cm in both seasons. The consistency recorded throughout the study reflects a steady environment which in turn gives the shrimps steady condition in terms of length and weight frequency distributions even in both dry and wet seasons.

However, the sizes and weight of shrimps encountered throughout the study were smaller than those reported for the Lagos lagoon by Adetayo and Kusemiju (1994) and Lawal-Are and Owolabi (2012) as well as Olawusi-Peters *et al.* (2014) in the study area; it can therefore be suggested that the study area may be acting as a nursery ground for fish assemblages as a similar situation was recorded for fish biota by Emmanuel and Kusemiju (2005) in Agboyi creek. According to Olurin and Aderibigbe (2006) differences in length and weight resulted from differences in sex and developmental stages of the fish. Kunda *et al.* (2008) and Olawusi-Peters *et al.* (2014) were of the view that the fluctuations obtained in certain length groups might be due to variation in sample size, sex, gonad condition and fullness of gut or even environmental conditions as reported by Ajibare (2014).

The 'b' values obtained for individual species in this study was allometric as b values were less than 3 and are within the range obtained by Enin *et al. (*1991) for Cross River estuary. Waribugo (2005) reported that the growth pattern of *N. hastatus* and *Palaemon maculates* in River Nun Estuary, Bayelsa State, Nigeria were allometric while *M. macrobrachion* were reported by Deekae and Abowei (2010) in Luubara creek (Nigeria) to have allometric growth pattern. The values of 'b' for both species were also similar to the results obtained by Olawusi-Peters *et al. (*2014) on the same species in the coastal waters of Ondo State. This also agrees with the results of Yakubu and Ansa, (2007) on *F. notialis* and *F. Monodon* in Buguma and Nurul Amin *et al.* (2009) on *Acetes Indicus* and *Acetes intermeduis* in the coastal waters of Malacca Peninsular, Malaysia. Okayi *et al.* (2012) also reported higher values for some shrimp and prawn species in the lower Benue and Niger River. Bassey and Ricardo, (2003) noted that the observation of absolute isometric growth (b=3) in nature is occasional and deviation from isometric growth is often observed in most aquatic organisms which changes shape as they grow.

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 Deekae and Abowei (2010). Olurin and Aderibigbe (2006) as reported by Olawusi-Peters *et al. (*2014) 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,

Table 5: Length-weight relationship of examined *N. hastatus* and *F. notialis* of the coastal waters of Ondo State

Species	Season	Ayetoro					Asumogha					Bijimi					Idiogba				
		n	a	b	R^2	K	n	a	b	R^2	K	n	a	b	R^2	K	n	a	b	R^2	K
N. hastatus	Dry	604	-2.94	1.43	0.81	0.43	623	-3.00	1.51	0.73	0.44	551	-3.23	1.66	0.80	0.43	662	-2.62	1.33	0.80	0.53
	Wet	608	-3.49	1.77	0.87	0.42	611	-3.04	1.55	0.80	0.45	595	-3.05	1.56	0.72	0.44	584	-2.78	1.43	0.89	0.52
F. notialis	Dry	346	-2.26	1.63	0.87	0.48	358	-1.97	1.53	0.64	0.54	348	-2.92	1.99	0.73	0.57	361	-2.04	1.57	0.73	0.55
	Wet	352	-2.73	1.84	0.85	0.47	361	-2.80	1.92	0.70	0.57	352	-4.22	2.54	0.81	0.53	370	-3.13	2.03	0.91	0.52

a=Constant (intercept); b=The Length exponent (slope); n= number of individuals; K= Condition Factor; R^2 = Regression Coefficient

maturity, season and environmental conditions (e.g. pollution). Thus the species studied were observed to be in good condition, as the values were generally higher than one.

The condition factor obtained in this study falls within the range observed by previous researches. Ekelemu and Zelibe (2006) were of the opinion that fishes with allometric growth patterns often have K factor values of less than 1. This view supports the result of this study. Olawusi-Peters *et al.* (2014) stated that reduced or low condition factor indicates either a period of unfavourable ecological conditions or a period which the species might have undergone stress from low food availability and/or reproductive processes. Olawusi-Peters *et al.* (2015b) further stated that when an organism undergoes starvation or has become spent, its condition factor reduces even when every other ecological factor is optimum while Enin and Enidiok (2002) suggested that low mean condition factor may indicate the state of growth and food availability. The non-seasonality in the length and weight as well as condition factor of shrimps is in contrary to the findings of Abowei (2010) who stated that the values of the condition factor vary according to seasons and are influenced by environmental conditions such as water quality, availability of food, predation, competition etc. Hence, the non-seasonality, non-significant variations across the study 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 Ikomi and Sikoki, (2001) for fish in the River Jamieson, Nigeria.

CONCLUSION

Based on the findings of this research, it is concluded that the two sampled species indicated allometric growth patterns and were in relatively good conditions. The consistency in the length and weight distributions, 'b' and 'K' values over the study period shows that the health of the shrimps/organisms in the study area is not being influenced by seasons but by other environmental conditions. Hence, the low K value obtained may be attributed to pollution status or anthropogenic activities that occur in the study area. It is therefore recommended that government should help in public enlightenment campaign to raise the level of awareness and reorienting the attitude of large and small scale industries as well as individuals with respect to environmental pollution problems which may result from discharge of untreated wastes/effluents into the natural water bodies.

REFERENCES

Abowei, J. F. N. 2010. The Condition Factor, Length–Weight Relationship and Abundance of *Ilisha africana* (Block, 1795) from Nkoro River Niger Delta, Nigeria. *Advance Journal of Food Science and Technology*. 2(1):6-11.

Adebowale, K. O., Agunbiade, F. O. and Olu-Owolabi, B. I. 2008. Impacts of Natural and Anthropogenic Multiple Sources of Pollution on the Environmental Conditions of Ondo State Coastal Water, Nigeria. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, (EJEAFChe) 2797-2811.

Adetayo, J. A. and Kusemiju, K. 1994. Some aspects of the biology of pink shrimp, *Penaeus notialis* in the Lagos Lagoon, Nigeria. *Journal of Science Research and Development*. 1(1):80-84.

Ajibare, A. O. 2014. Assessments of Physico-Chemical Parameters of Waters in Ilaje Local Government Area of Ondo State, Nigeria. International Journal of Fisheries and Aquatic Studies. 1(5):84-92.

Bassey, E. A. and Ricardo, P. K. 2003. Seasonality in growth of *Aphyosemion gradnerei* (Bolenger) in Mfangmfang pond in Uyo, Nigeria. *The Zoologist* 2:68-75.

Bayode, O. J., Adewunmi, E. A. and Odunwole, S. 2011. Environmental implications of oil exploration and exploitation in the coastal region of Ondo State, Nigeria: A regional planning appraisal. *Journal of Geography and Regional Planning* 4(3):110-121.

Deekae, S. N. and Abowei, J. F. N. 2010. *Macrobrachium macrobrachion* (Herklots, 1851) Length-Weight Relationship and Fulton's Condition Factor in Luubara Creek, Ogoni Land, Niger Delta, Nigeria. *International Journal of Animal and Veterinary Advances* 2(4):155-162.

Ekelemu, J. K. and Zelibe, S. A. A. 2006. Growth Patterns and Condition Factors of Four Dominant Fish Species in Ona Lake, Southern Nigeria. *Journal of Fisheries International* 1 (2-4):157-162.

Emmanuel, B. E. and Kusemiju, K. 2005. Variations in castnet catch in a tropical brackish water pond. *Journal of Science Technology and Environmental.* 5 (1&2) 6-14.

Enin, U. I., Lowenberg, U. and Kunzel, T. 1991. The *Nematopaleamon hastatus* (Estuarine prawn) Fishery in the Outer Estuarine Region of The Cross River, Nigeria. *Archiv fur Fischereiwissenschaft*, 41:67-88.

Enin, U. I. and Enidiok, S. E. 2002. Length-weight relationship, condition factor and feeding habits of *Cynoglossus senegalensis* (Kaup, 1850) (Pleurnectiformes, Cynoglossidae) in the Cross River Estuary, Nigeria. *Afr. J. Fish. Aquacult.* 3:31-42.

Fagade, S. O. 1979. Observations on the biology of species of Tilapia from Lagos Lagoon. Bull. De.1' F.A.N., 41(A3):60-72

Gayanilo, F. C. and Pauly, D. 1997. FAO ICLARM stock assessment tools (FISAT. References Manual, FAO Computerized Information Series (Fisheries) (8). 262pp.

Holthus, L. B. 1980. FAO Species Catalogue. Shrimps and prawns of the world. An annotated catalogue of Species of Interest of Fisheries. *FAO Fisheries Synopsis* 125(1):261.

Ikomi, R. B. and Sikoki, F. D. 2001. Studies on the distribution, abundance, growth pattern and dietary habits of *Brycinus mires* (Rupell, 1832). Osteichthyes: Characidae, in the River Jamieson, Nigeria. *Acta Ichthyol. Piscat*, 31(1):27-44.

Keller, A., Abbaspour, K. C. and Schulin, R. 2002. Assessment of Uncertainty and Risk in Modeling Regional Heavy-Metal Accumulation in Agricultural Soils. *Journal of Environmental Quality*; 31:175–187.

Kress, N., Herut, B. and Galil, B. S. 2004. Sewage sludge impact on the sediment quality and benthic assemblage off the Mediterranean coast of Israel – a long term study. *Marine Environmental Research*; 57:213–233.

Kunda, M., Dewan, S., Uddin, M. J. Karim, M. Kabir, S. and Uddin, M. S. 2008. Length-Weight Relationship, Condition Factor and Relative Condition Factor of *Macrobrachium rosenbergii* in Rice Fields. *Asian Fisheries Science.* 21:451-456.

Lawal-Are A. O. and Owolabi, A. T. 2012. Comparative Biology of the Prawns *Macrobrachium macrobrachion* (Herklots) and *Macrobrachium vollenhovenii* (Herklots) from two interconnecting fresh/brackish water lagoons in South-West Nigeria. *J Marine Sci Res Dev*. 2:1-8.

Mendes, B., Fonseca, P. and Campos, A. 2004. Weight - length relationships for 46 fish species of the Portuguese west coast. J. of Applied Icht., 20: 355- 361

Murray, K. S., Rogers, D. T. and Kaufman M. M. 2004. Heavy Metals in an Urban Watershed in Southeastern Michigan. Journal of Environmental Quality; 33:163–172.

Nurul-Amin, S. M., Arshad, A, Siraj S. S. and Bujang J. S. 2009. Population structure, growth and length weight relationship of sergestid shrimp (Acetes spp) from the coastal waters of Malacca, Pennisular Malaysia. *Sains Malaysaina* 38(2):159- 169.

Okayi, R. G. Ataguba, G. A. and Mbata, F. U. 2012. Stock assessment of shrimps and prawn species of the lower Benue and Niger River, Nigeria. *Journal of Agricultural Research and Development*. 2(4):092-095.

Olawusi-Peters, O. O. and Ajibare, A. O. 2014. Species richness, diversity and abundance of some Decapod Crustaceans In coastal waters of Ondo State, South West, Nigeria. *Int J. of Fauna and Biological Studies*. 1(5):44-51.

Olawusi-Peters, O. O., Ajibare, A. O. and Bello-Olusoji, O. A. 2014. Length-weight Relationship and Condition Factor of Shrimps in Coastal Waters of Ondo state, South West, Nigeria. *International Journal of Fisheries and Aquatic Studies*. 1(3):137-142.

Olawusi-Peters, O. O., Ajibare, A. O. and Ajetunmobi, O. A. 2015a. Gillnet Fishing in Igbokoda Coastline Area of Ondo State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*. 11(1):13-18.

Olawusi-Peters O. O., Ajibare A. O. and Olowoyeye, I. M. 2015b. Gut content analysis and condition factor of *Ethmalosa fimbriata* (Bowdish 1825), from Badagry Lagoon, Nigeria. Proceedings of the 8th Annual Conference of the School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Federal University of Technology, Akure. pp.185-190.

Olurin, K. B. and Aderibigbe, O. A. 2006. Length-Weight Relationship and Condition Factor of Pond Reared Juvenile *Oreochromis niloticus. World Journal of Zoology*; 1 (2) 82-85.

Powell, C. B. 1980. Key to shrimps and prawns (Crustracea: Decapoda, Natantia) of the Niger Delta Basin Development Authority Area. Consultancy Report, University of Port Harcourt.

Powell, C. B. 1982. Fresh and Brackish Water Shrimps of Economic Importance in the Niger Delta. In proceedings of the 2nd Annual conference of the Fisheries Society of Nigeria, Calabar, 24-27-January 1982, 254-285pp.

Waribugo, S. A. 2005. Aspects of the biology and fisheries of some palaemonid shrimps in River Nun Estuary, Bayelsa State, Nigeria. M.Sc. Thesis, Rivers State University of Science and Technology, Port Harcourt, 60 pp.

Weatherly, A. H. and Rogers, C. 1978. Some Aspects of Age and Growth. In: Ecology of Fresh Water Production: S.D. Gerking, (Ed.). Blackwell Scientific Publications, Oxford. pp: 63-64.

Yakubu, A. S. and Ansa, E. A. 2007. Length-weight relationships of the pink shrimp *Penaeus monodon* and giant tiger shrimp, *P. monodon* of Buguma Creek in the Niger Delta Nigeria. *The Zool.*, 5: 47-53.

Zabbey, N. 2007. Small scale shrimp fisheries in Nigeria Centre for Environment, Human Rights and Development, Eleme, Rivers State. Technical Report, CEHRD /TESH/CONSERV/01/2007, pp: 64.