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M Moslen
Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria

CA Miebaka
Institute of pollution studies, Rivers State University, Port Harcourt, Nigeria

Correspondence
M Moslen
Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria

Condition factor and length-weight relationship of two estuarine shell fish (*Callinectes* Sp and *Penaeus* sp) from the Niger Delta, Nigeria

M Moslen and CA Miebaka

Abstract
Study aim was to assess length-weight relationship-LWR and condition factor of crabs (*Callinectes* sp) and shrimps (*Penaeus* sp) from upper the bonny estuary. Seven samples of each specimen were collected monthly between January-December 2015 making total of 168 samples. Samples were immediately moved in coolers to the laboratory for length-weight measurements and further evaluations. Regression coefficient (b-value) ranged from 0.215-2.96 indicating negative allometry for all crabs and 0.67-3.13 indicating negative and positive allometric growth for shrimps. Coefficient of determination (R^2) showed both weak and strong LWR while condition factor (CF) values were 1.03-1.32 for shrimps and 1.01-2.09 for crabs. The condition of the crabs were generally better compared to the shrimps with significant difference ($p<0.05$) between the two variables. In conclusion crabs and shrimps exhibited negative/positive allometry and good condition but observed weak relationships indicated by R^2 values may suggest presence/introduction of environmental stress factors and perturbations in the study area.

Keywords: length-weight, condition factor, crabs, shrimps, Niger Delta

1. Introduction

Length-weight relationship (LWR) and its equation parameters ‘a’ and ‘b’ are very significant with respect to biology of fish and practical assessment of stocks of aquatic species [1, 2, 3]. recommended that LWR may be useful in the following: converting length of individual fish to weight, estimation of the mean weight of fish of a given length, converting growth equation for length into growth equation for weight, and comparisons of morphology between populations of the same species or between species. In addition [4, 5] had earlier stated that LWR is also important in studies of gonad development, rate of feeding, metamorphosis, maturity and well being of the fish population. The condition factor or index is an evaluation of the general well being of fish and crustaceans [6, 7]. This is on the premise that heavier individuals of a given length are in healthier condition than less weightier individuals [8]. Condition factor decreases with increase in length [9, 10, 11] and also influences the reproductive cycle in fish. Length-weight is more suitable not only for fish assessment but also crustaceans [12]. According to [12] most frequently used measures of assessment in the study of crustaceans are body weight, total length and carapace length. Relationship between weight and carapace length can be used to evaluate biomass, condition factor, standing stock, analysis of ontogenetic changes and several other aspects of crustacean population dynamics [13, 14] reported on the edibility of the crabs while [15] reported on the abundance of *Callinectes amnicola* all year round especially in shallow shaded sub-tidal waters where it is caught in large quantities and [16] reported on the length weight and condition factor of *Callinectes amnicola*. The edible crab has very high commercial and economic value and serves as rich nutrition in the diet of the people of the Niger Delta. Prawns and shrimps have also been reported to have high export potential hence are target species in shell fisheries in the Nigerian coastal region [17] 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 [18]. In spite of its economic importance and potentials, very little documented works are available on length-weight relationship and condition factor of shrimps in West Africa [19]. The study of growth pattern and condition index (wellbeing) with respect to the biology of blue swimming crab (*Callinectes amnicola)* and shrimps (*Penaeus* sp) obtained from Azuabie creek had received little or no attention. This study therefore, aim to assess the length weight relationship and condition index of crab (*Callinectes amnicola*) and shrimps (*Penaeus* sp) obtained from this estuarine creek to compliment the biology of such crustaceans from the study area.

2. Materials and Methods

2.1 Study site

The study was carried out in Azuabie creek in the upper reaches of the Bonny estuary, Niger Delta, Nigeria (Fig. 1). The creek is brackish in nature but receives fresh water input upstream, which is more during the rainy season. The creek is habitat for crabs and shrimps but over exploitation and anthropogenic activities have affected abundance as confirmed by local fishermen and catch.

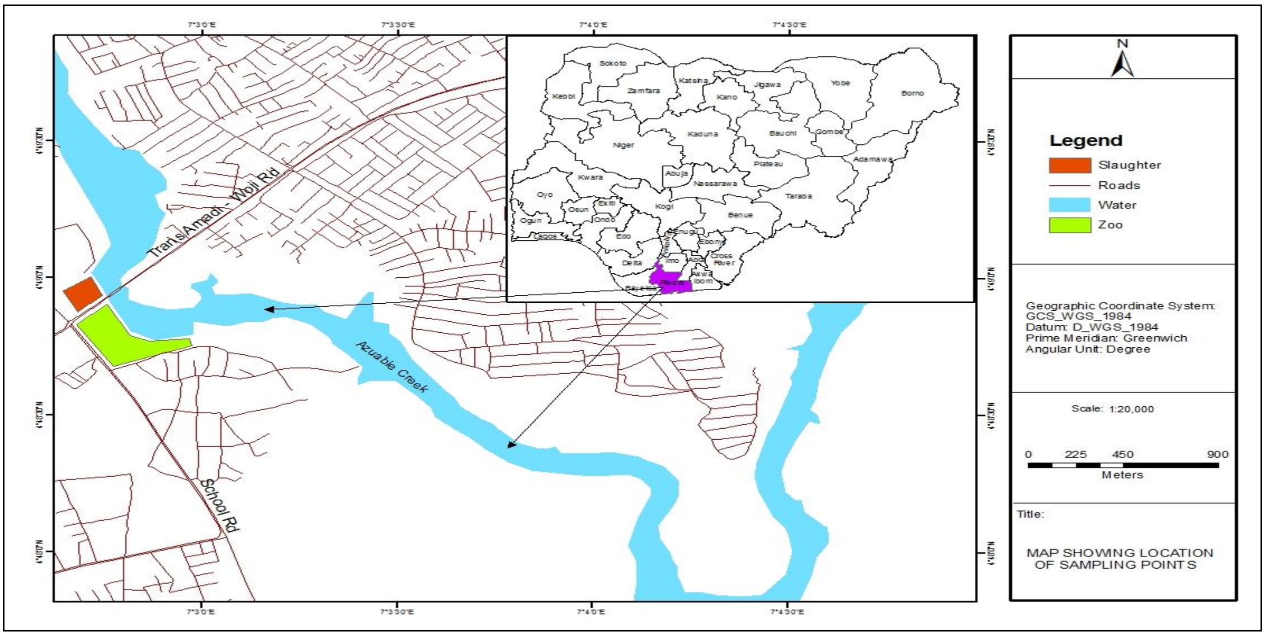

Fig 1: Map of Study site where fish samples were collected (© IOSR 2017)

2.2 Sample collection

Five samples each of crab (*Callinectes amnicola*) and shrimp (*Penaeus* sp) were obtained directly from fishermen on a monthly basis for twelve month (January - December 2015). Samples were put in labeled plastic containers with ice chests and transported to the laboratory for immediate analysis. Eighty four (84) samples were collected for each specimen (crab and shrimp) making a total of 168 samples during the study.

2.3 Laboratory analysis

Excess water from crab and shrimp samples was removed using filter paper before weighing to ensure accuracy [20]. For shrimp total length, measurement was taken from the tip of the rostrum to the end of the telson while carapace length, end to end was taken for each crab. Total length and weight of fish samples were measured to the nearest 0.1 cm and 0.1 g respectively. Length of samples was measured with a calibrated metre rule while weight was done with an electronic weighing balance (model- P1203).

2.4 Length –weight relationship and condition factor

The Length-Weight relationship was evaluated using the equation $W= aL^b$ [3]. Where W= crab/shrimp weight (g), L= crab (carapace) / shrimp (rostrum - telson) length (cm), a = intercept (rate of change of weight with length), b = slope (weight at unit length). The values of ‘a’ and ‘b’ were got from the Log-transformed equation (log a + b log L = Log weight + b Log Length) using the linear regression output. If “b” = 3 then growth is isometric, if not the growth is allometric (>3 = positive allometry, <3 = negative allometry).
The condition factor of crab and shrimp samples were estimated from the mean weight and length of the replicate specimens using the equation, $K = W/ aL^b$
Where K = condition factor
W = Observed crab/shrimp weight (g)
aL^b = Expected crab/shrimp weight (g)

The exponent ‘b’ = 3 was not used to assess the ‘K’ value because [5] had argued that it is not a real representation of the length-weight relationship for greater majority of fish species, hence the ‘b’ value was obtained from the estimated length-weight relationship equation ($W = a L^b$) as suggested by [21]. The age and sex of crab/shrimp samples were irrespective of the assessment of the length-weight relationship and condition factor evaluation.

3. Results

3.1 Length-Weight Relationship

The scatter diagram for the regression of weight against length for crabs and shrimps on a temporal basis are presented in Fig. 2 and 3 respectively. For the crabs, ‘b’ value (regression coefficient) ranged from 0.215 in July to 2.96 in June indicating negative allometry while those of the shrimps also showed variation ranging from 0.67 in August to 3.13 in December indicating both negative and positive allometric growth. The coefficient of determination R^2 ranged from 0.052-July to 0.998-June for crabs and 0.048-February to 0.994-March for shrimps. Analysis of variance of log L and Log W transformed data did not show significant difference (p>0.05) between the months of study for the two organisms examined hence, null hypothesis was accepted. Comparison of allometric growth rates (b-values) of crabs and shrimps using t-Test also did not vary significantly (p>0.05

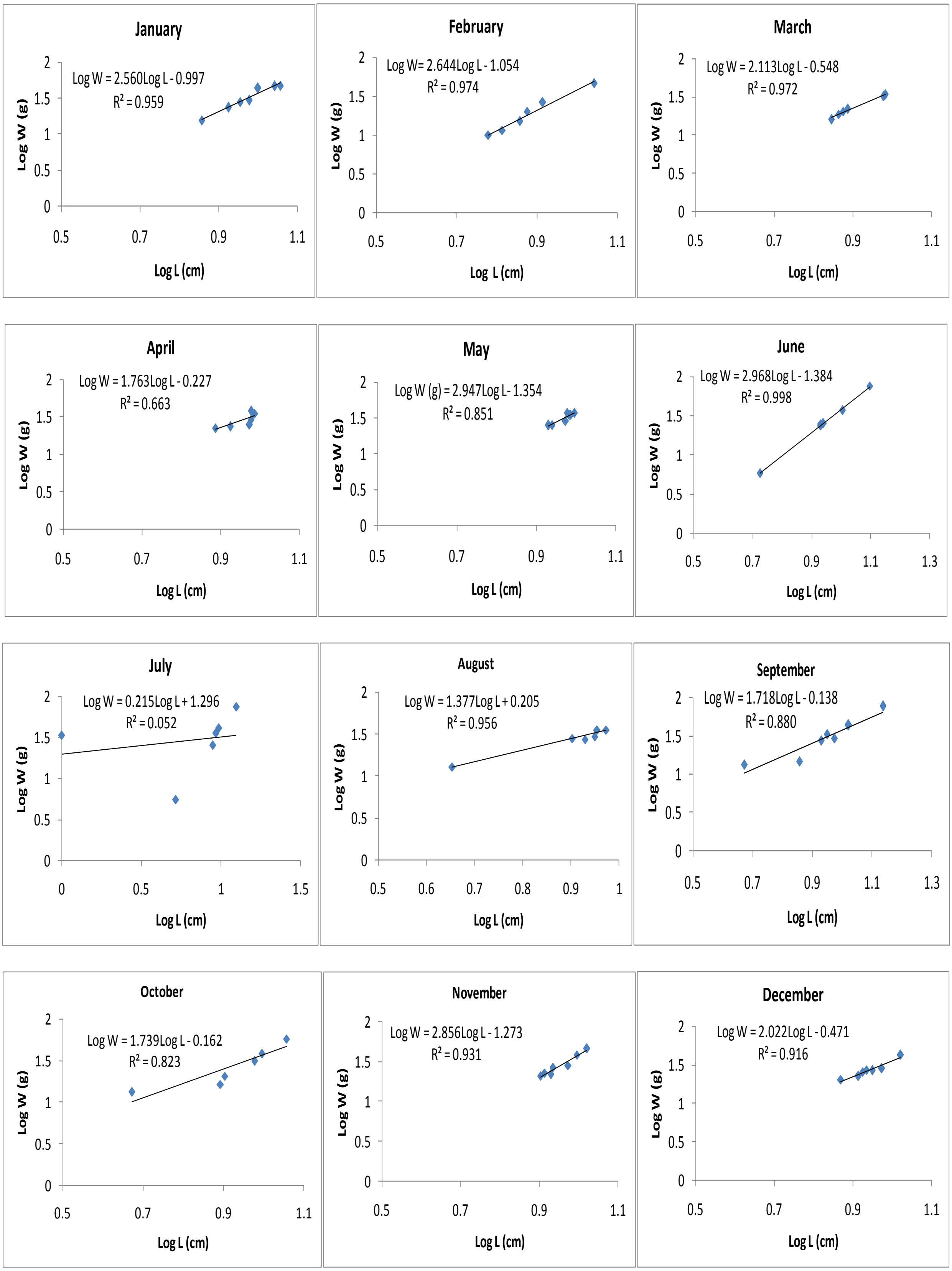

Fig 2: Regression of crab weight on length for each month

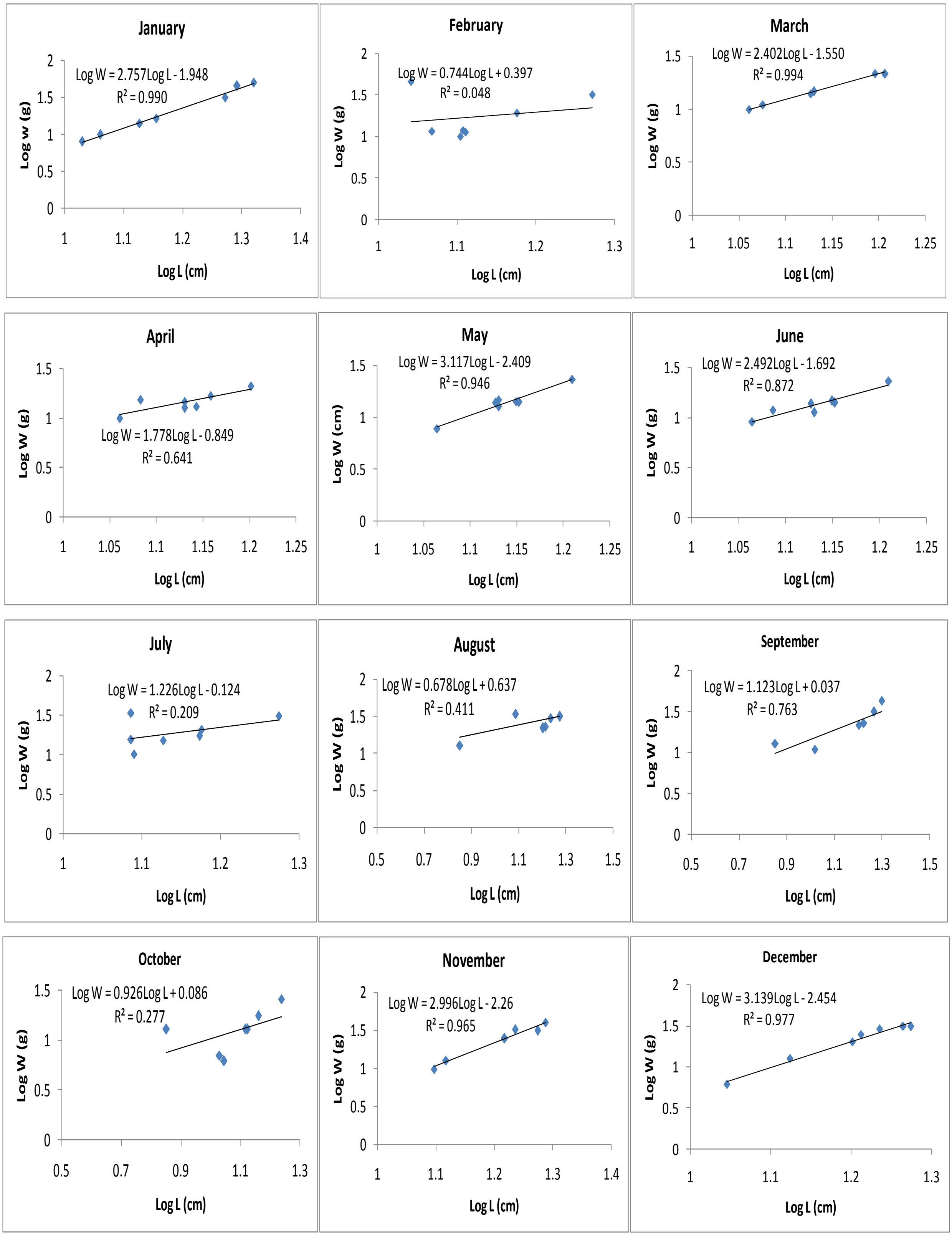

Fig 3: Regression of shrimp weight on length for each month

3.2 Condition Factor

There were temporal variations in the condition factors of both the crabs and the shrimps examined (Fig. 4). The condition factor of *Penaeus* sp ranged from 1.03 in August to 1.32 in January while those of *Callinectes* sp ranged from 1.01 in November to 2.09 in October (Fig.4). Comparison using t-Test showed that the condition factor of the shrimps differed significantly ($p<0.05$) from that of the crabs. The condition of the crabs were generally better compared to those of the shrimps.

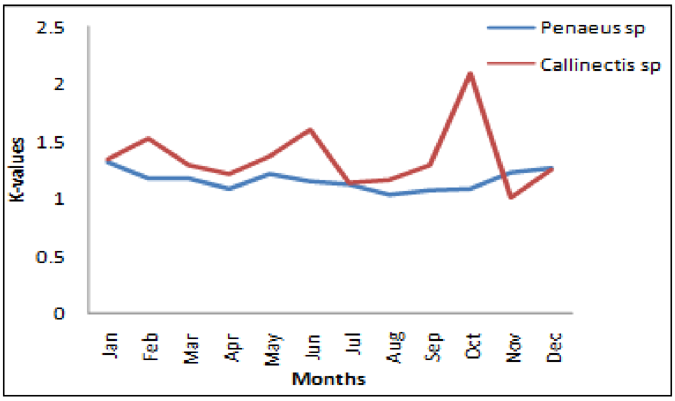

Fig 4: Temporal variation in the condition factors of crabs and shrimps in the study area.

4. Discussion
4.1 Length-Weight Relationship
The regression of crabs and shrimps weight against length showed linear relationship for each month of study. This normally means increase in length was followed by an increase in weight. However, coefficient of determination (R^2) indicated both weak and strong relationship between length and weight at a particular point in time for both crabs and shrimps. But the weight at unit length (b-value) for both crabs and shrimps was different for each month but not significantly ($p<0.05$). The variation in 'b' values have been attributed to sizes and length range of samples used [22], sexual dimorphism [23], water quality and availability of food for fish growth [24]. Also, variation observed in the weight and length of crabs and shrimps was not significantly different ($p>0.05$) between months of study. The slope (b-values) derived from the regression equation parameter indicated that all the crabs (*Callinectes* sp) examined had negative allometric growth pattern which indicated that the crabs obtained from Azuabie creek became more slender as weight increased. On the other hand, the weight at unit length (b-value) of the shrimps had both positive and negative allometric growth conditions. This implied that some of the shrimps became relatively stouter and deep bodied as they increased in length particularly in the month of May and December while others became more slender even with increase in weight as noticed for the remaining period of the study [8]. Reported that the range of b-values encountered in fishes is between 2 -4 but b-values obtained in this study were within and below this range. Our view is that types of organisms, biological and environmental factors could account for the differences observed. The range of b-values obtained in the current study accords with the values reported by another researcher [25]. Base on the current study, with regards to the b-values obtained, the cube law of [26] may not apply to specimens observed in this study. In a study of the length weight relationship of the west African fiddler crabs [27], reported b-value of 1.64 which accords with the findings of this work but [28] reported b>3 (positive allometry) for *Callinectes pallidus* in Lagos area [29]. reported b-values of 2.35 for the Decapod, *Barytelphusa gurini*, while [16] had reported 2.35 - 2.54 for *Callinectes amnicola* in previous studies [30]. had also reported negative allometric growth for *Callinectes amnicola* regardless of sex or size using carapace width but with carapace length, the crab exhibited isometric growth for male (b=3) and positive allometric growth (b>3) for female and combined sex, this also compares favourably with the findings of this study. The b-values of shrimps recorded in the current study compares favourably with the reports (b= 1.01 - 3.26) of [31] for different shrimps, also b<3 & b>3 observed by [32] for *Macrobrachium macrobrachion* and 2.245 - 2.793 reported by [33] for *Penaeus monodon*.

4.2 Condition factor
The condition factor was calculated in other to assess the wellbeing of the crabs and shrimps from the study area. Values obtained showed that both crabs and shrimps were in good condition but the crabs were better with generally higher CF values compared to the shrimps. No particular seasonal trend was observed but the best condition factor for crab (2.09 - October) and shrimp (1.32 - January) were noticed during the dry season. The condition factor variation between the shrimps and the crabs was significantly different ($p<0.05$) which could be due to differences in organisms used, feeding behaviour, biological factors and responses to environmental perturbations. The condition factor obtained in this study compares with the range of those (0.53 – 2.07) obtained by [34] in a study fresh and marine water fish [35]. Reported condition of 0.648 ± 0.13 - 2.194 ± 0.153 while [36] recorded condition factors of 0.76 – 2.96 which is all in tandem with values observed in the current study. The condition factor of crabs in this study is at variance with that (9.61) reported by [27] for fiddler crabs, 0.000214 reported by [29] for the crab *Barytelphusa gurini* and 21.48 - 104.95 observed by [37] for *Callinectes amnicola* got from the Cross River estuary. The condition factor of the shrimps in this study was compared to those of other researchers within and outside the Niger Delta area [38]. reported CF values of 0.5914 - 0.6909 for *Penaeus monodon* [39], reported CF values of 0.7973±0.125 - 1.4076±0.4583 for different life stages of Macrobrachium, [40] found CF values of 0.89± 0.03 - 1.90± 0.33 for *Macrobrachium nipponense* and [41] observed CF values of 0.27 - 0.59 in a study of LWR of Giant Tiger Shrimp, *Penaeus monodon*. The CF values of shrimps in this study compared fovourably with the outcome of other researchers.

5. Conclusion
The length weight relationship for all crabs examined showed negative allometry with all regression coefficients (b<3) but the b-values for shrimps were b<3 and b>3 meaning both negative and positive allometric growth pattern was exhibited by the shrimps. Few months of sampling had results indicating weak relationships but other months had coefficient of determination showing strong relationships between length and weight for both crab and shrimp samples examined. The assessment of the condition factor for the samples indicated well being and good condition of both crab and shrimp samples. The study concluded that crabs and shrimps samples from Azuabie creek exhibited good conditions but observed weak relationship as seen in the coefficient of determination (R^2) could suggest introduction or presence of environmental stress factors capable of affecting aquatic life.

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