Length-weight relationship and condition factor of *Periopthalmus papilio* (Bloch & Schneider, 1801) obtained from a tidal creek in the Bonny Estuary, Nigeria

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The aim of this study was to evaluate the length-weight relationship and condition of mudskipper (*Periophthalmus papilio*) obtained in a tidal creek in the Niger Delta. Total of 120 samples were collected in twelve months with length and weight measurements carefully taken in the laboratory. The difference in weight per unit length (b) obtained from regression equations ranged from 1.95-3.5 while the condition factor (K) ranged from 1.12-1.45. Monthly values of 'b' and K compared well with overall 'b' value (2.551) and K-value (1.25) with implication of sample homogeneity. The 'b' values showed both positive and negative allometric growth pattern while K values indicated mudskipper samples were in good condition. All the fish examined for each month showed a linear relationship between weight and length of mudskipper however, variation in weight for each month was observed and was significantly different (P<0.01) between the months of study. The observed differences in 'b' and K values may have environmental and dietary implications with respect to time. The study concluded that the weight of mudskipper per unit length varied across periods and all fish samples had K values that indicated good condition suggesting favourable ecological condition in the study area. Caution should however, be applied, as mudskippers could bioaccumulate and biomagnify pollutants in aquatic environments while in good condition without physical signs of distress.

Key Words: *Length-weight; Condition factor; Mudskipper biology; Niger delta*

Mudskippers belong to the family Gobidae, subfamily Oxudercinae and tribe Periophthalmini (1). They can move with their pectoral fins on land and are amphibious fish (2,3). This makes them major dwellers of the intertidal habitat, particularly on stretches of mudflats at low tide and on roots/bodies of aquatic plants during high tide; they also make holes/burrows into mud as part of their main habitats (4). Some gobiid (*Periophthalmodon schlosseri* Pallas, 1770) actively transports ammonia against a concentration gradient and breath air through its skin (5,6).

Length-weight relationship is important for good exploitation and management of fish species population (7). It is also useful for evaluating the relative well-being of the fish population. Length-weight relationships let fisheries experts to convert growth in-length equations to growth-in-weight in stock assessment models, estimate biomass from length frequency distributions, compare life history and morphological aspects of populations inhabiting different regions and calculate fish condition (8-12). The regression coefficient or slope value (b) got from length-weight relationship provides useful information for estimating fish growth pattern (13). Fish can reach either isometric growth, negative allometric growth or positive allometric growth. Isometric growth has to do with approximately proportionate change of body parts as an organism grows. Negative allometric growth implies the fish becomes more slender as it increase in weight while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length (14). Condition factor is an indication of the general well-being of fish (15,16). It is based on the hypothesis that heavier fish of a given length are in better condition than less weightier fish (17-19). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (20). It is strongly influenced by both biotic and a biotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (7,8,21,22).Condition can vary both within and between fish populations and it is therefore critical to identify environmental predictors of this variation to optimize fishery production (23). In the Niger Delta area, mudskipper has high economic and ecological value. Azuabie creek with inputs of domestic and industrial wastes has mudflats and mangroves housing mudskippers. This study seeks to examine the length-weight relationship and condition factor of mudskipper (*Periophthalmus papilio*) obtained from a tidal creek (Azuabie) in the Bonny estuary as a useful biological factor in the management and exploitation of the fish.

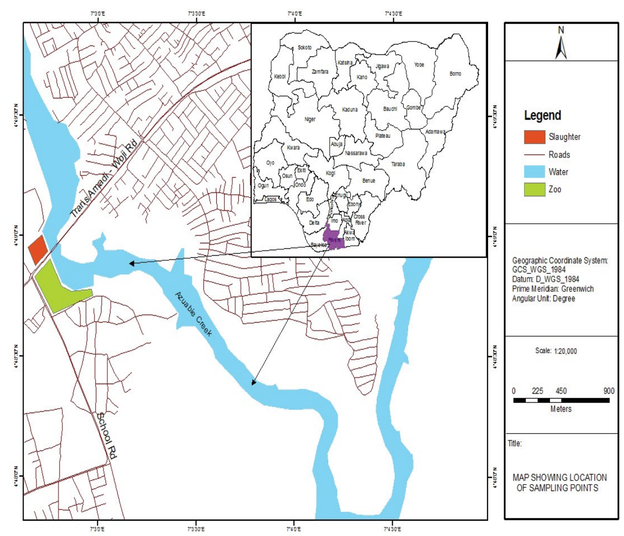

Figure 1) *Study site where fish samples were collected (© IOSR 2017)*

MATERIALS AND METHODS

Study area

The study area is Azuabie creek which is located on the eastern part of Port Harcourt, Nigeria (Figure 1). The creek had rich fishery resource but is now prone to impacts of anthropogenic activities capable of affecting aquatic resources in the area.

Collection of fish samples

Ten (10) mudskipper (*Periophthalmus papilio*) samples were collected by hand

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from mudflats on a monthly basis for twelve months (January-December, 2015). Samples were put in labeled plastic containers with ice packs and transported to the laboratory for analysis immediately. Total of 120 samples were collected during the study.

Laboratory analysis

Excess water from mudskipper body was wiped using filter paper before weighing to ensure accuracy (24). Total length and weight of fish samples were measured to the nearest 0.1 cm and 0.1 g, respectively. Weight and length of samples were determined with an electronic weighing balance (model-P1203) and metre rule, respectively.

Length-weight relationship and condition factor

The Length-Weight relationship was determined using the equation: W=aLb (25)

Where, W=Fish weight (g), L=Fish length (cm), a=intercept (rate of change of weight with length), b=slope (weight at unit length). Log-transforming the equation (log a+b log L=Log weight+b Log Length) was done to determine 'a' and 'b'. If "b"=3 then growth is isometric, if not the growth is allometric (>3=positive allometry, <3=negative allometry).

The condition factor of the fish was evaluated from the mean weight and length of the ten replicate specimens using the equation:

K=W/aLb

Where, K=condition factor

W=Observed fish weight (g)

aLb=Expected fish weight (g)

The exponent 'b' value that is equal to 3 was not used to calculate the 'K' value. Bolger and Connolly (26) argued that it is not a real depiction of the length-weight relationship for greater majority of fish species, therefore the 'b' value was obtained from the estimated length-weight relationship equation (W=aLb) as suggested by Lima-Junior et al. (27). The length-weight relationship and condition factor were determined irrespective of fish age and sex.

Statistical analysis

The length and weight of fish was subjected to analysis of variance (ANOVA-General linear Model) to ascertain significance difference across periods. The condition factor and growth coefficient was also tested across study period for significant difference. Tukey test was used for post hoc analysis to determine where actual significant difference occurred. The statistical software package Minitab 16 was used for the analysis.

RESULTS

Length-weight relationship

The linear regression for pooled 120 mudskipper samples (overall LWR) is presented in Figure 2 while the results of the regression of fish weight on length for each month (January-December) is given in Figure 3 and the temporal trends in condition factor (monthly averages) and equation parameter ('b') is given in Figure 4. Pooled data of 120 fish samples observed gave a 'b' value of 2.55 indicating negative allometric growth pattern for mudskipper in the study area while the R2 value (0.897) of the regression equation also suggested strong length-weight relationship. The slope 'b' value which is the weight at unit length of the fish varied from 1.95-3.5 showing both negative and positive allometric growth for mudskipper fish in the study area. All the fish examined for each month showed a linear relationship between weight and length of mudskipper however, variation in weight for each month was observed. The length of the fish over the period of study did not show significant difference (p>0.05) but the variation of weight on unit length was significantly different (P<0.01) between the months of study therefore, Null hypothesis (H0) was here rejected. The significant difference occurred thus: May<November=February=October=December=April=September=January=March=June=August<July with no particular seasonal trend. The condition factor of the mudskipper fish also varied minimally across the months of study. The values ranged from 1.12-1.45 during the months of November and August respectively (Figure 3). These values showed that the mudskipper fish from the study area were in good condition. Analysis of variance did not show significant variation (p>0.05) for condition factor across the months of study.

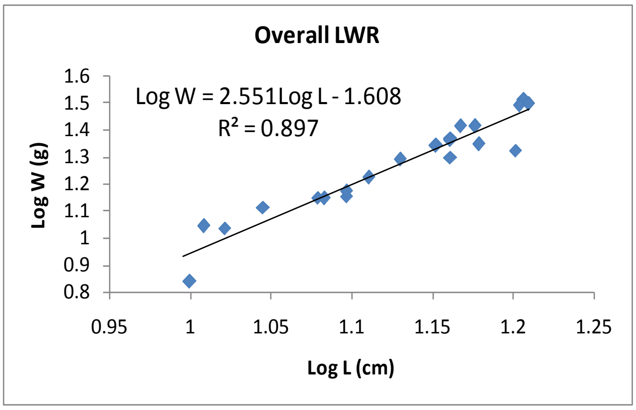

Figure 2) *Length-weight relationship graph for pooled 120 fish samples*

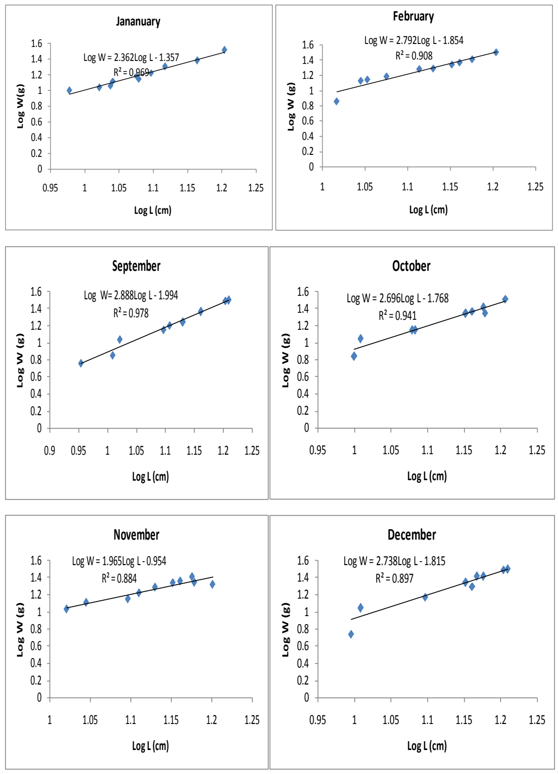

Figure 3) *Regression of fish weight on length for each month*

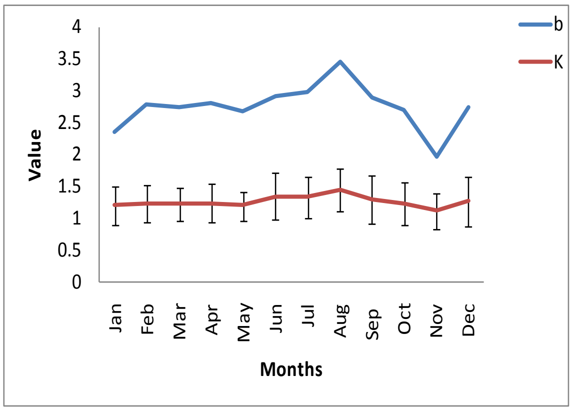

Figure 4) *Temporal variation of change in weight per unit length (b) and monthly average condition factor (K) of mudskipper samples from the study area.*

DISCUSSION

The overall correlation coefficient (R2) in Figure 2 suggest strong length weight relationship with 'b' value of 2.55 which also indicated negative allometric growth for generally mudskipper found in the study area. This was also corroborated by the monthly averages Figure 3 with b<3 except for month of August (b>3) and shows near homogeneity of samples. The scatter diagram Figure 3 gives a relationship to which the 'b' is the slope and the regression equation for each month has a value of correlation coefficient (R2). The regression of weight of the mudskipper fish on length showed that unit length produced least weight of the fish in the month of November while highest weight per unit length of the fish was noticed in the month of August. This also corresponds to the least negative allometric and most positive allometric growth periods observed. This may have both environmental and dietary implications in the biology of the organism with respect to seasons. August is one of the peak months of rainy season in the study area while November is a dry season month suggesting the influence of season on the weight and condition factor of the fish in the study area. The least 'b' value (1.95) obtained in this study was lower than the range (2-4) of 'b' values encountered in fishes (17). Attributed the variation in 'b' values to sizes and length range of samples used while attributed it to sexual dimorphism) and traced it to water quality and availability of food for fish growth in addition to periodic influence observed in this study (28-30). Had recorded 'b' value range of 2.458-3.473 in a study of length-weight relationships of 52 species in lagoons of West Africa while reported 'b' value range of 2.173-3.472 in 36 species from tropical reservoirs (31). These values are in consonance with the 'b' values obtained in this study. Observed variations in the 'b' values also suggest the cube law may not apply to specimens observed in this study (32).

Generally, all mudskipper samples examined had good condition with pooled K-value for 120 samples as 1.25. This was also obvious compared to the monthly average condition factor Figure 4 with no value below one (1). The monthly average values of the condition factor (K) in this study varied across study period. It gradually rose in January and reached its peak in August before reaching the ebb in November. Interestingly, condition factor of the mudskipper fish examined showed the same trend with the 'b' value implying a positive relationship between the weight and the condition of the fish. The condition factor (K) of a fish reflects physical and biological circumstances and fluctuations by interaction among feeding conditions, parasitic infections and physiological factors (33). It also indicates the changes in food reserves and therefore an indicator of the general fish condition (34). The condition factor (1.12-1.45) of the mudskipper fish obtained from Azuabie creek suggests that the fish were in good condition and compared favourably with the range (0.53–2.07) reported by in fresh and marine water fish (35). The condition factor of the current study also accords with the findings (0.648 ± 0.13-2.194 ± 0.153) of and those (0.76–2.96) of in other length-weight relationship studies (14,36).

CONCLUSION

In conclusion, mudskipper fish obtained from Azuabie creek in the Niger Delta showed both negative and positive allometric growth pattern. The change in weight per unit length (b) and the condition factor varied across the months of study with a significant difference in 'b' values across the period of study. All the mudskipper fish examined had K values that depicted good condition generally and monthly, regardless of negative and positive allometry, suggesting favourable ecological condition for the mudskipper fish in the study area. This should however, be used with caution as mudskippers could bioaccumulate and biomagnify pollutants in the aquatic environment without signs of physical distress.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest and that this research was solely sponsored by the authors (self-funded).

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