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Length-weight relationship of mudskipper, *Periophthalmus barbarus* (Bloch and Schneider 1801), from Buguma creek, Rivers State

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Abstract
The length-weight relationship and condition factor of Mudskipper (*Periophthalmus barbarus*) from Buguma Creek, Rivers State, Nigeria, was carried out. Sampling was done fortnightly for a period of three months (March-May, 2018). The length-weight regression statistics was done using Microsoft Excel Analysis Tool. The result obtained indicated that the physico-chemical parameters were within the range favourable for the growth of fish, except in dissolved oxygen. The length-weight relationship showed negative allometric growth, with b= 2.01. Moreover, *P.barbarus* had a low condition factor which ranged between 0.89-1.41 in both male and female fish, which is an indication of the retarded growth of the species in this environment.

Keywords: mudskipper, length-weight, condition factor, fish, rivers state

1. Introduction
Gobiidae is one of the largest fish families, with more than 230 genera and 1600 species discovered and described (Ahmed *et al*., 2011) [2]. The primary habitat for goby is marine environment, yet there are some species fully adapted to freshwater environment (Chukwu and Deekae, 2010) [8]. This species is highly adaptive to various types of habitats. They live in the intertidal habitat of the mudflats and in mangrove ecosystem. These fishes are uniquely adapted to a completely amphibious lifestyle (Gracia *et al*., 2008) [10]. They are quiet active when out of water feeding and interacting with one another and defending their territories. They have a range of peculiar behavioural and physiological adaptations to an amphibious lifestyle. These include anatomical and behavioural adaptations that allow them to move effectively on land as well as in the water (Pauly and Gayanilo, 1997) [23].
The length-weight relationship (LWR) has become one of the most important standard analyses or assessment in fishery biology studies. It shows population dynamics, growth pattern and condition of a species (King, 1995) [12]. LWR data can be used to estimate unknown weight for a given length in yield assessment, estimate biomass and determine fish condition (Deekae *et al*., 2010) [9]. It can also be applied to determine the deviation of expected weight from accepted weight-length standard for a certain fish species. This acts as an indication of robustness, feeding state, maturity and breeding of a species population (Ndimele *et al*., 2010) [21]. Condition factors calculated using LWR data functions as an indicator that shows if the population is experiencing slow growth rate due to environment factor such as disease and high population density (Offem *et al*., 2008) [22]. It is a known fact that growth in fish is in length in addition to weight (Abowei, 2009; Le Cren, 1951) [1, 19]. However, Sarkar *et al*. (2013) [27] depict growth in teleost fish as the adjustment in total weight or length of fish under a specific interval of time, while Pepple and Of or, (2011) [26] as well as Schnieder *et al*. (2000) [28] reviewed growth as a function of increase in fish size. The study of growth patterns in fish has been based majorly on length – weight relationships or association between sizes and body length as a result of their relevance in age and growth investigations.
Periophthalmus barbarus commonly called mudskipper is of the gobiidae family. *P. barbarus* are uniquely adapted toa completely amphibious lifestyle and live in the intertidal habitat of the mudflats and in the mangrove ecosystem. *P. babarus*is is of great economic value to the people of Buguma City, Rivers State, Nigeria (Akinrotimi *et al*. 2009; Akinrotimi *et al*. 2013) [4, 6]. The species constitutes part of the local delicacy hence, the exploitation and good market value (Akinrotimi *et al*. 2015) [5]. Buguma creek, is suffering frompollution due to the activities of illegal refineries that is predominant in the area (Akinrotimi, 2011) [3]. The establishment of the length-weight relationship and condition factor therefore will give vital information on the wellbeing of this fish in this creek and also be of great importance to future researchers that may be interested this fish. The aim of this study is to evaluate length weight relationship of *P.barbarus* from Buguma creek, Rivers State.

2. Materials and Methods
2.1 Study Area
The Buguma Creek is located Southeast of the Niger Delta between longitude 6° 47'E and 6° 59'E, and latitude 4° 31'N and 4° 59'N in Asari-Toru Local Government Area of Rivers State. The Buguma Creek system consists of the main creek channel and associated interconnecting creeks, which interconnect and surround Buguma and Ido communities (Figure1).

2.2 Collection of Samples and Fish Sampling
Samples of *P. papilio* were collected from artisanal catches landed by mudskipper fishers at Buguma city landing site. Samples of *P. papilio* were taken fortnightly, beginning from

March to May, 2018.

2.3 Length and Weight measurements
Two hundred (200) fish samples were measured and weighed at each sampling. Weights were recorded to the nearest gram and length to the nearest centimeter. The total length (measured from the tip of the anterior most part of the snout to the tip of the caudal fin) was taken using a measuring board, and the weight of the fish were taken using a sensitive weighing balance (Sartorious model H987, Hannah Products, Portugal)to the nearest decimal place.

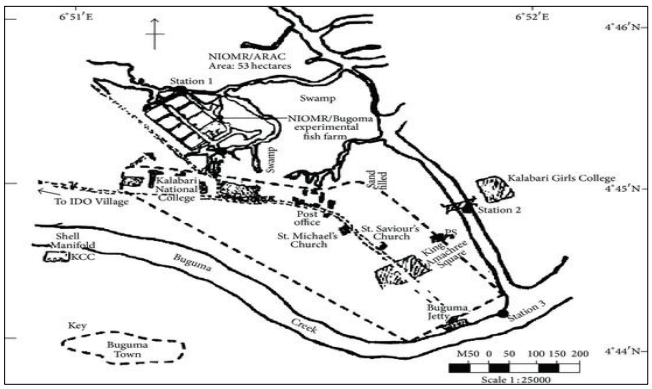

Fig 1: Map of Rivers State Showing Buguma Creek, Sampling Site

2.4 Identification of sex
Male and Female of *P. Papilio* were identified as described by King [15]. Each specimen was sexed by means of genital papilla. The urogential papilla in the males is more pointed whereas the females have more of a square shape to it and is more tapered

2.5 Evaluation of Physico-chemical Parameters
During the study, the following water quality parameters (temperature, hydrogen ion concentration (pH), dissolved oxygen (DO), and salinity of the creek were monitored monthly in situ apart from the dissolved oxygen concentration. Water temperature measurement was taken with mercury in glass thermometer (°C);hydrogen ion concentration (pH) was measured with pH meter (Model HI 9812, Hannah Products, Portugal); salinity was measured with a hand held Refractometer (Model RE 6783, Atago Products, Portugal).Water samples for dissolved oxygen concentration were collected and analysed in the laboratory by Winkler method (APHA, 1998) [7].

2.6 Data Analysis
2.6.1 Length Weight Relationship
The length-weight relationship was determined using the linear regression equation by Pauly [24]. Linear regression was incorporated into FISAT (FAO-ICLARM Stock Assessment Tool).

$Log_{10}W=a+bLog_{10}L$

Where:
W= total wet weight of fish (g),
L=Total length (TL) of fish (cm),
a=constant (intercept),
b= the length exponent (slope),
$Log_{10}W= Y$
$Log_{10}L= X.$

2.6.2 The Fulton Condition Factor (k)
The condition factor of fish was calculated using the formula according to Hile [11].

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

Where
K = Fulton condition factor
W= wet weight (g) of the fish
L = total length (cm) of the fish

3. Results
3.1 Physico- Chemical Parameters of Water in Buguma Creek
The result of the physico-chemical analysis of water from Buguma, creeks in the sampling months are presented in Table 1. The results revealed that the values of dissolved oxygen and salinity were significantly ($p<0.05$) higher in March than other months. While other parameters recorded in this study were within the same range.

3.2 Variations in Length and Weight of *P.barbarus*
Range of monthly variations in total length and weight of sampled *P.barbarus*from Buguma creek varied between months.A total of 630 fish specimen of*P.barbarus*were measured for total length and weight from March to May 2018. (Table 2).The values of individual fish length and weight in female fish were consistently higher than those of males in all the sampling months (Figure 2).

3.3 Length-Weight Relationship
Length-weight relationship of male and female*P.barbarus* from Buguma creek reflected negative allometric growth type (Table 3). The length-weight relationships of *P.barbarus* from Buguma creek presented in Table 3 indicate that the 95% confidence interval value of the exponent 'b' in the relationship was 1.90 for the male fish and 2.03 for the female. Analysis of both the males and females separately and combined showed that all the species exhibited negative allometric growth pattern. Their 'b' values were less than 3. There was strong correlation between the length and the weight of the species.

3.4 Condition Factor (K)
The mean condition factors (K) in both sexes of *P.barbarus*and the monthly condition factor for each sex are presented in Table 3. There were differences in the condition factors for the males and females as well as combined sexes in this study. As shown in the table, the condition factor for the male fish ranged from 0.85 and 1.01 while that of females ranged from 0.99 to 1.81. The mean monthly condition ranged between 0.89-1.41 in all the months of study (Table 4).

Table 1: Physico-chemical Parameters of Water in Buguma, Creek during the Sampling Months (Mean ± SD)

Parameters	Sampling Months		
	March	April	May
Temperature (^{O}C)	30.12 ± 2.56 ^{a}	29.97 ± 1.98 ^{a}	29.99 ± 2.08 ^{a}
Dissolved Oxygen (mg/L)	5.89 ± 0.99 ^{b}	4.54 ± 0.88 ^{a}	4.22 ± 0.98 ^{a}
pH	6.42 ± 1.23 ^{a}	6.33 ± 1.27 ^{a}	6.52 ± 1.04 ^{a}
Salinity (‰)	14.88 ± 2.98 ^{c}	10.08 ± 1.04 ^{a}	10.01 ± 1.05 ^{b}

Means in the same roll with different superscripts are significantly different ($p<0.05$)

Table 2: Range of total length and weight of sampled *P.barbarus* from Buguma creek.

Month	Total length(cm)	Weight(g)	Population size(n)
March	5.00 - 12.00	1.20 - 17.50	200
April	5.50 - 12.50	2.00 - 15.20	200
May	5.50 - 14.40	1.10 – 17.30	230

Table 3: Regression statistics for length-weight relationship parameters of male and female *P. barbarus* from Buguma creek

Sex	a	b	r	r^2	Growth type
Male	-0.39	1.9	0.94	0.88	Negative Allometric
Female	-0.54	2.03	0.94	0.89	Negative Allometric

a = correlation constant b = regression coefficient or length exponent, r = correlation coefficient, r^2= square of correlation coefficient.

Table 4: Monthly condition factor of male and female *P. barbarus* from Buguma creek.

Sampling month	Male	Female	Mean
March	0.85	1.05	0.95
April	0.79	0.99	0.89
May	1.01	1.81	1.41

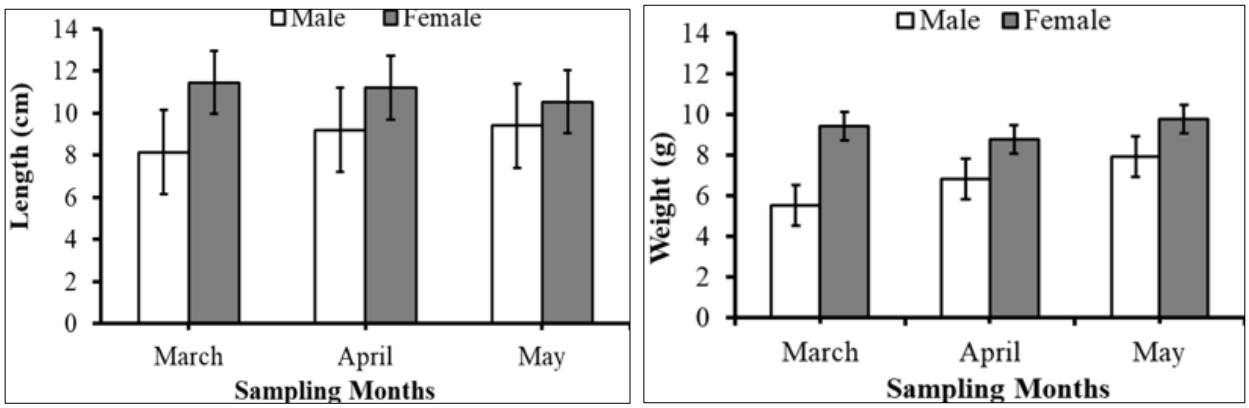

Fig 2: Variations in Length (cm) and weight (g) of Male and Female *P. papillio* from Buguma Creek

4. Discussion

4.1 Length/Weight Relationship

The differences in weight as observed in this study could be due to individual condition factor which is the wellbeing and degree of fatness of an (Pauly, 1983; Pauly, 1984) [24, 25]. It could be linked with season and environmental conditions. The ¨b¨ value in the females was higher than that of the males. This agrees with the report of Chukwu and Deekae [8] in the same species sampled in Elechi creek, Niger Delta. This indicated negative allometric growth which is agrees with the observation of the present study. The ¨b¨ values of this study revealed that the *P. Barbarus* exhibited negative allometric growth. According to Kulbicki *et al.* [17], when the ¨b¨ value is less than 3, the fish has a negative allometric growth but when it is greater than 3, it has a positive allometric growth and when it is equal to 3, the fish has isometric growth. The result indicates that the fish exhibited a negative allometric growth pattern which means that the length and body weight of the fish did not grow in the same proportion, i.e. the fish grew faster in weight than in length.

The values of "b" obtained in this study is supported by studies of King (2007) [14] that reported "b" value of 1.03 for combined sexes of *P,barbarus*from Cross River estuary, but differs from that of Koutrakis and Isikliras, (2003) [16] in some species of mudskipper sampled from Greece estuary. Such differences in "b" values can be ascribed to one or a combination of factors including differences in the number of specimens examined, area and season effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Mir *et al*., 2012) [20].

4.2 Condition Factor

The condition factors obtained were relatively lower when compared to the values documented by Kumolu- Johnson and Ndimele [18] for *P. barbarus* in Ologe lagoon, Lagos State. The present lower K values might be attributed to lack of food and poor environmental conditions. According to (Deekae *et al.*2010) [9] several factors affect the condition factor of fishes. They range from feeding, spawning, food nutrient composition and fat accumulation. The variations of condition factor (K) in fish according to King (1997) [13] may be due to food abundance, adaptation to the environment and gonadal development. It could also be attributed to a combination of the difference in the number of species, size of species, geographical location and season (Viveen *et al.*, 1986) [29].Length weight relationship is influenced by many factors related to population, variability, sampling and estimation method. Sampling related factor includes sample size, length distribution in the sample, and type of length measurement while nutritional conditions account for intrinsic biological variability (Pepple and Offor, 2011) [26].

The overall mean condition factor obtained in this study varied slightly with results from other studies in Niger Delta. This difference may be as a result of changes that might have occurred over time such as seasonal change, degradation caused by oil explorative activities in the area. Some other causes like loss of aquatic vegetation can also bring about change in the well-being of fish as noted by Offem *et al*. (2008) [22]. The condition factor recorded in this work also agrees with what other authors recorded in the lower New Calabar River, Chukwu and Deekae, (2010) [8] reported the condition factor of mudskipper (*Periophthalamus*

barbarous) to be 1.214 for matured male and females. The recorded water quality parameters were within the acceptable range for fish production (Makinde *et al.* 2015) [30]. As the water variables were favourable for the growth of this species in this creek.

5. Conclusion and Recommendations

The variation in the condition factor and parameters of the length - weight of *P.barbarus* may be as a result of the differences in stage of maturity, sex, state of stomach fullness; differences in stock population, different growth rates at different stages of development. However, since the Fulton condition factor (K) reveals the well-being of fish species, Buguma Creek appears not to be toofavourable for the growth of *P.barbarus.*Measures should be taken to reduce impact of pollution on the water, so as to reduce fish mortality and improve the well-being of this specie in Buguma creek.

6. References

1. Abowei JFN. The Abundance Condition Factor and Length-Weight Relationship of Some *Sardinella maderensis* (Jenyms, 1842) from Nkoro River, Niger Delta, Nigeria, Advanced Journal of Food Science and Technology. 2009; 1(1):65-70.
2. Ahmed EO, Ali ME, Aziz AA. Length-weight Relationships and Condition factors of six fish species in Atbara River and Khashm el- girba Reservoir, Sudan. International Journal of Agriculture Sciences. 2011; 3(1): 65-70.
3. Akinrotimi OA. Issues limiting the expansion of brackish water aquaculture in the coastal area of Niger Delta. Pp. 169 – 178. *In:* R.J. Kolo and A.M. Orire (eds). Proceedings of the 26th Annual Conference of Fisheries Society of Nigeria (FISON), Federal University of Technology, Minna, Niger State, Nigeria. 28th November-2nd December, 2011, 169-178.
4. Akinrotimi OA, Abu OMG, Bekibele DO, George OS, Uedeme-Naa B. Seasonal variation in length – weight relationship of the grey mullets, *Liza falcipinnis* from Buguma creek, Niger delta, Nigeria. International Journal of National and Applied Sciences. 2009; 5(3):334-377.
5. Akinrotimi OA, Edun OM, Makinde OO. Seasonal variation of heavy metals in selected sea foods from Buguma and Ekerekana creeks, Niger delta. *International* Journal of Innovative Studies in Aquatic Biology and Fisheries. 2015; 1(1):46-53.
6. Akinrotimi OA, Edun OM, Uka U, Owhonda KN. Public perception of mudskipper consumption in some fishing communities of Rivers State, Nigeria. Journal of Fisheries and Aquatic Science. 2013; 8(1):208-212.
7. American Public Health Association (APHA). Standard method for the examination of water and wastewater, 1998, 1189.
8. Chukwu KO, Deekae SN. Length-Weight Relationship, Condition Factor and Size Composition of *Periophthalmus barbarous* (Linneaus 1766) In New Calabar River, Nigeria. Agriculture and Biological Journal of NorthAmerican. 2010; 12:45-56.
9. Deekae SN, Chukwu KO, George ADI. Length-Weight relationship and condition factor of *Alestis alexandrius* (Geoffrey Saint Hillarie 1817) in Bonny River, Nigeria. Journal of Agricultural Research and Policies. 2010; 5(4):16-18.
10. Gracia CO, Durate BJO, Sandoval N, Von Schiller D, Melo G, Navajas P. Length –Weight Relationship of demersal fishes from the Gulf of Salamanca, Colombia. Naga, ICLARM. Quarterly. 2008; 21:30-32.
11. Hile R. Age and growth of the cisco, *Leucichthysartedi*(Lesuur) in the lakes of three northern highlands. Wisconsin Bulletin of Fisheries. 1936; 48:211-317.
12. King M. Fisheries biology, assessment and management, Fishing News Books, Oxford, England, 1995, 32.
13. King RP. Length–Weight relationship of Nigerian Freshwater Fishes. Naga, ICLARM Quarterly. 1997; 20:41-50.
14. King M. Fisheries Biology, assessment and management. 2nd edition, Blackwell Scientific Publications, Oxford, 2007, 189-192.
15. King RP. Length-weight relationship of Nigeria. Freshwater fishes. Naga ICLARM Quarterly. 1996; 19(3):49-52.
16. Koutrakis ET, Isikliras AC. Length–Weight relationship of fishes from three Northern Aegean Estuarine Systems (Greece).Journal of Applied Icthyology. 2003; 19:258-260.
17. Kulbicki M, Guillemot N, Amand MA. general approach to length-weight relationships for New Caledonian Lagoon fishes. Cybium. 2005; 29:235- 252.
18. Kumolu Johnson CA, Ndimele PE. Length-weight relationships of nine fish species from Ologe Lagoon, Lagos, Nigeria. African Journal of Biotechnology. 2011; 10(2):241-243.
19. Le Cren, ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology. 1951; 20:201-219.
20. Mir JI, Sakar AK, Dwivedi OP, Gusain A, Pal A, Jena JK. Pattern of variation in condition factor, relative condition factor and form factor of an Indian major Carp, *Labeorohita* (Hamilton-Buchanan, 1822) in the Ganges Basin, India. European Journal of Biological Sciences. 2012; 4:126-135.
21. Ndimele PE, Kumolu Johnson CA, Aladetohun NF, Ayorinde OA. Length-weight relationship, condition factor and dietary composition of *Sarotherodon melanotheron*, Ruppell, 1852 (Pisces: Cichlidae) in Ologe Lagoon, Lagos, Nigeria. Agriculture Biological Journal of North America. 2010; 1:584-590.
22. Offem BO, Akegbejo O, Samsons Y, Isaac TI. Diet, size and reproductive biologyof silver catfish *Chrysichthys nigrodigitatus* (Suilformes, bagridae) in Cross River. Journal of Tropical and Biological Science. 2008; 54(4):1785-1779.
23. Pauly D, Gayanilo FC. An alternative approach to estimating the parameters of a Length–Weight Relationship from Length– Frequency samples and their bulk weight, Naga, ICLARM. Quaterly. 1997; 20:5-8.
24. Pauly D. Fishbyte Section. Editorial. Naga ICLARM Quarterly. 1983; 16:26-34.
25. Pauly D. The length–length table. In: Froese, R.; Pauly, D. (eds). Fishbase 1984: concepts, design and data sources. ICLARM, Manila, 1984, 124.
26. Pepple PCG, Ofor, CO. Length-weight relationship of *Heterobranchus longifilis* reared in earth ponds. Nigerian Journal of Fisheries. 2011; 8:315-321
27. Sarkar UK, Khan GE, Dabas A, Palhak AK, Mir JI,

Rebello JC *et al*. Length-Weight Relationship And Condition Factor Of Selected Freshwater Fish Species Found In River Ganga. India Journal of Environmental Biology. 2013; 23:123-132.
28. Schnieder W, Petrakis G, Stergiou KI. FAO species identification sheets for fishery purpose-field guide to the commercial marine resources of the Gulf of Guinea. Food and Agricultural Organisation of the United Nations, 2000, 234.
29. Viveen WR, Richter CJ, Van Oordt PJ, Janseen JL, Huisman EA. (Practical Manual for the Culture of African Catfish (*Clariasgariepinus*), Directorate General for International Technical Corporation, The Hague, The Netherlands, 1986, 407.
30. Makinde OO, Edun OM, Akinrotimi OA. Comparative Assessment of Physical and Chemical Characteristics of water in Ekerekana and Buguma Creeks, Niger Delta, Nigeria. Journal of Environmental Protection and Sustainable Development. 2015; (1)2:66-73.