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Morphometry length-weight relationship and condition factor of *Pila ovata* (Olivier, 1804) from oil mill market, port Harcourt area, rivers state

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Abstract
The morphometry length-weight relationship and condition factor of *Pila ovata* from Oil mill market, Port-Harcourt, Rivers State, was carried out fortnightly for a period of 4 months (March-June, 2019). A total of 1000 apple snails of different sizes were used for the analysis. The result indicated a negative allometric growth for length – weight relationship, spiral length weight relationship, shell length and shell width relationship and base length and weight relationship of the gastropod with a growth exponent b value of (2.0518-2.1081). This value was confirmed negative allometric when a t-test was carried out (P<0.05). It was < 3 which is a clear deviation from isometry. The mean condition factor value for all the months sampled was 0.9150 which reveals that the gastropods are in poor condition. However, the mean condition factor for the months of March and June was >1 indicating a good condition. There is therefore need for longer research since this research was conducted for only 4 months. However, urgent steps should be taken in the right direction to reduce the pollution load that has plagued the environment which this priced species thrive to avoid extinction of these species.

Keywords: morphometry, length-weight relationship, apple snail, *Pila ovata*, rivers state

1. Introduction
The apple snail, *Pila* belongs to the family Ampullariidae and is widespread along tropical freshwater states (Dillion, 2006) [8]. The common species in Nigeria and the Niger Delta is *Pila ovata* which is distributed from the lower Nile Southwards of Northern Mozambique, and Westwards from Sudan to Southern Nigeria. It is also found in the same habitat with *Biomphalaria pfeifferi*, *Bulinus globosus* and *Lymnae natelensis* (Ndifon *et al*., 1989) [16]. *P. ovata*, the most common species of water snail is usually found on the bottom of streams, ponds, lakes, pet stones and people's aquaria. The shell is about 55-59mm wide and 43-47mm in height (Aboho *et al*., 2009) [1]. The umbilicus is small, but deep and the lip somewhat thickened, it is usually found in association with macrophytes feeding on algae. It is believed to be a clearing agent for aquaria, hence many people utilize it for cleaning aquariums (Ajayi *et al*., 1978) [2]. In the Niger Delta region mollusks constitutes a major dietary component of the people especially amongst rural population. They provide cholesterol free animal protein diets (Deekae and Idionoboye-Obu, 1995) [7]. *P. ovata* is cherished because of its high protein content and is a special delicacy in the meals of most Niger Deltans. This species is also used as lime for paint (white wash), soil enrichment fertilizer and it's used as a buffer to neutralize soil acidity (Neubert and Van-Damme 2012) [17]. Apart from its subsistence use, they are commercially exploited, because they are sold at local markets.
Several authors have provided information on commercially exploited mollusks, in Nigeria and beyond which includes, Paul (2013) [19] on length-weight/girth relationship and condition factor of periwinkle *Tympanotonous fuscatus*, (Cerithidae: Gastropoda) of the Cross River Nigeria. Martyn *et al.* (2013) [14] on the status of the Apple snail *Pila scutata* (Gastropoda: Ampullariidae) in Singapore. Saha *et al*. (2016) [21] reported on morphometries, length-weight relationship and ecological factors affecting the habitat of *P. globosa* in Bangladesh, India. However, no data exists for the morphometry length-weight relationship and condition factor of *Pila ovata* which is commercially exploited in Rivers State Niger Delta. It is against this backdrop we present this work.

2 Materials and Methods
2.1 Study Area
Oil Mill Market, a Port Harcourt Midweek Market is located at Rumukwrushi Community in Obio/Akpor Local Government Area of Rivers State. The market holds every Wednesday and draws traders from different parts of Rivers State and traders from Abia, Onitsha, Akwa Ibom and other parts of Nigeria.
It is located along Mini-Chinda Stream, between longitude $6^0$50'E - $7^0$50'E and latitude $5^0$05'N - $5^0$06'N. It is characterized by a high atmospheric temperature fluctuating between 65-90%. It is a low land of Niger Delta and thick tropical rainforest vegetation (Gobo, 1998) [12].

2.2 Sample Collection
The freshwater apple snail *Pila ovata* were collected from Oil Mill Market Port Harcourt. Various sizes of the samples were selected from the market. The shells of the snails were brushed and washed with fresh and clean water to remove algal blot and other waste materials. Sampling was done fortnightly for a period of four months between April – June, 2018. Further analysis were done at the laboratory of the Department of Fisheries and Aquatic Environment,

Rivers State University Port Harcourt, Nigeria

2.3 Identification of Species
In the laboratory, the specimens were identified using appropriate Mollusca taxonomic keys (Edmunds 1978 and Brown, 1980) [10, 5]. The morphometric measurements such as; Shell Length (SL), Base Length (BL), Spiral Length (SPL), Shell Width (SW) of the shells of *P. ovata* were measured with the help of a Vernier caliper to the nearest centimeter (cm). The weight (g) was taken with the help of a mini digital scale (Diamond Series A04 max 500g, Made in China).

2.4 Length-Weight Relationship
The relationship between Length (L) and Weight (W) of the snails sampled was expressed by the exponential equation (Bagenal and Tesch, 1978) [3].

$$W = al^b \quad (1)$$

Where:
W = Weight of snail in g (grams)
L = Total length of snail in cm (centimeters)
A = Constant (intercept of the regression with the y-axis)
B = Slope of the regression line.

The relationship $W = al^b$, when converted to logarithm form gives a straight-line relationship

$$Log\ w = \log a + \log L \quad (2)$$

The 'a' and 'b' values are obtained from a linear regression of the length and weight of fish. The correlation (r^2) that is the degree of association between the length and weight was computed from the linear regression analysis

$$R = r^2 \text{ (Ricker 1975)} \quad (3)$$

The "b" values were used to determine the growth pattern (b = 3 – isometric growth, b > 3 positive allometric growth or b < 3 = negative allometric growth or b > 3 = negative allometric growth).

2.5 Condition Factor (K)
The condition factor (k) of the snails was determined from the relationship between the shell length and weight measurements using the equation;

$$k = \frac{100w}{L^3} \text{ (Gayanilo and Pauly, 1997)}$$

Where:
K = Fulton's condition factor
W = Weight of shell in grams (g)
L = Total length of shell in centimeters (cm)

2.6 Statistical Analysis
Data collected was subjected to FAO- ICLARM Stock Assessment Tools (FISAT II) 2007 for length-weight relationship which was used to determine the mean, standard deviation and condition factor.
T-test was used to test the hypothesis and variability of the length and weight to determine the levels of significance.

3 Results
A total of 1000 apple snails were collected during the period of study with 200 specimens each in the months of March and April, 250 specimens in May, and 350 snail specimen in June (Table 1). Table 2 shows the parameters of the Shell Length (SL) and Weight (g) relationship of *P. ovata* from Oil Mill Market Port Harcourt Rivers State. The values of "a" (intercept), "b" the length exponent (slope), "r" correlation coefficient of determination for the species is a = -0.0337, b = 2.0518, r = 0.7094, and r^2 = 0.5032 respectively.
The species had b values (2.0518-2.1081) less than 3, for length – weight relationship, spiral length weight relationship, shell length and shell width relationship and base length and weight relationship of *P. ovata* which indicates a negative allometric growth. However, correlation coefficient for length-weight relationship r = (0.7094), indicated a strong relationship between parameters. The above "b" value gave a significant departure from isometry (t = 0.04068, $P<0.05$).The linear relationship of log weight and log length are shown in Figs. 1, 2, 3 and 4. The spiral length-weight relationship and shell length/shell width of *P. ovata* was examined. The correlation coefficient of determination obtained was r = (0.5826 and 0.5987) respectively, indicating a moderately strong correlation for both (Table 2) While the correlation coefficient of determination of the base length-weight of *P. ovata* was relatively high r (0.8557) indicating a strong correlation (Table 2, Fig. 1-4).
The results for the condition factor of *P. ovata* revealed a total mean value of 0.9150 for all the months sampled indicating a poor condition of the fish. However, a mean K value of 1 and above was recorded for the months of March and June respectively indicating a good physiological condition of the gastropod (*Pila ovata*), while the other months (April - June) had mean values of 0.6989, 0.0829 and 0.0995 respectively, indicating a poor condition (Table 3).

Table 1: Total Number of *Pila ovata* sampled from oil mill market, Rivers State (March - June 2018)

S/No	Date	Sample months	No. of samples
1	8	March	80
	18		120
2	3	April	100
	15		150
3	7	May	120
	20		130
4	6	June	160
	19		190
Total			1000

Table 2: Relationship parameters of Length-Weight Relationship of *P. ovata* from Oil Mill Market, Rivers State

Relationship parameter	No. of observations	A	Standard deviation	B	Standard deviation	R	r^2
Length/Weight	1000	-0.337	0.0429	2.0518	0.065	0.7094	0.5032
Spiral length/ Weight	1000	-0.9799	0.0162	2.7832	0.0788	0.5826	0.3394
Shell length/Shell width	1000	-0.083	0.0222	2.7879	0.0334	0.5987	0.3585
Base length/weight	1000	0.1607	0.0225	2.1081	0.0403	0.8557	0.7323

Table 3: Monthly Condition Factor (k) of *P. ovata* from Oil Mill Market, Rivers State

Months	Mean	Overall mean
March 8	1.15693035	1.1358
March 18	1.114635284	
April 3	0.7139408	0.6989
April 15	0.684022664	
May 7	0.851202046	0.8297
May 20	0.808340493	
June 6	1.070509675	0.9955
June 16	0.92057955	
Total		0.9150

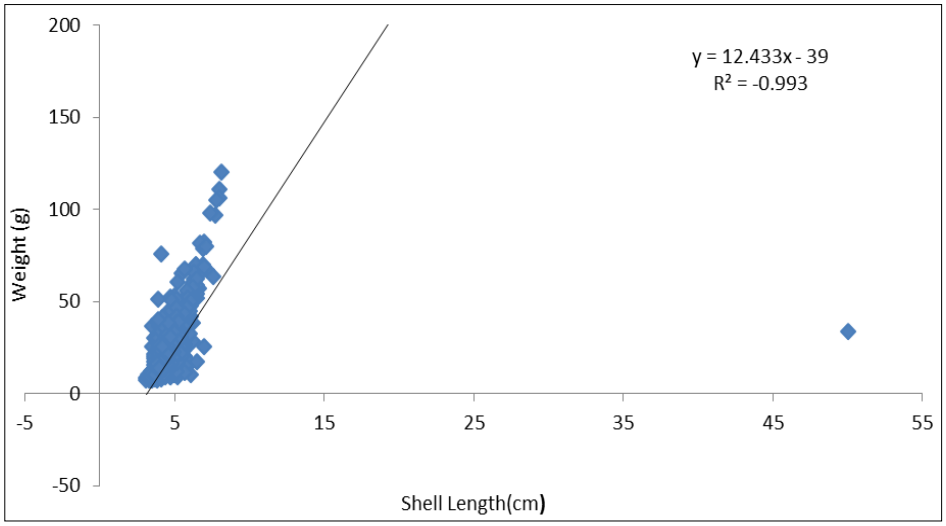

Fig 1: Shell length/Weight Relationship of *Pila ovata* from Oil Mill Market, Rivers State

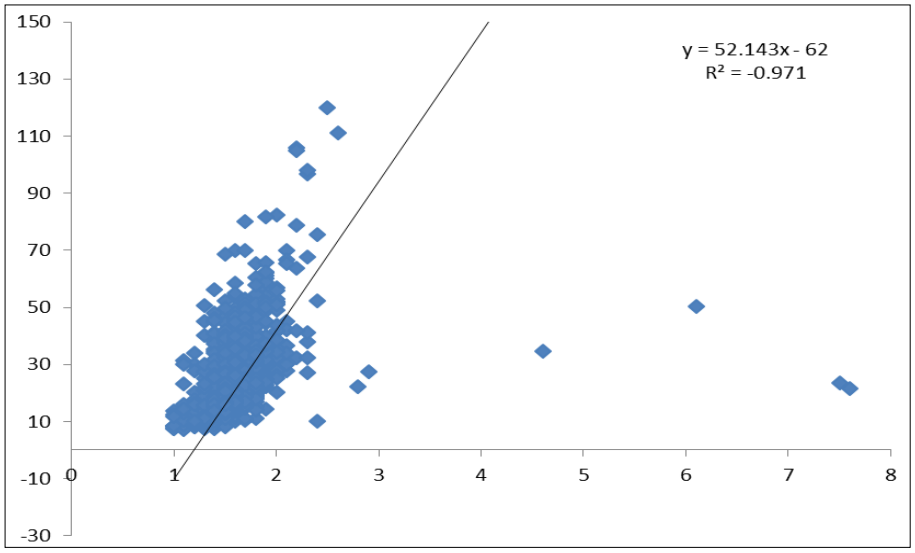

Fig 2: Spiral length/Weight relationship of *Pila ovata* from Oil Mill Market, Rivers State

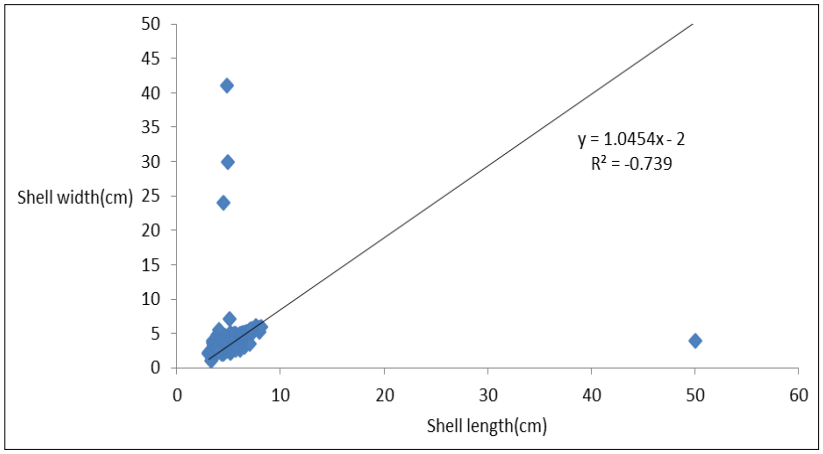

Fig 3: Shell length/Shell width relationship of *Pila ovata* from oil mill market, Rivers State

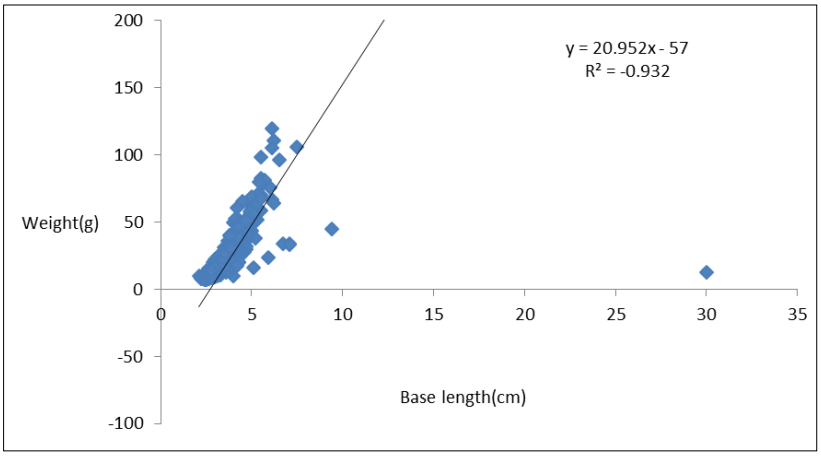

Fig 4: Base length/weight relationship of *Pila ovata* from Oil mill market, Rivers State

4 Discussions

Data obtained from length-weight relationships are very reliable in evaluating growth patterns and relative well-being of fishes and shellfish. The species possessed negative allometric growth for length/weight relationships, spiral length/weight relationship; shell length/shell width relationship and base length/weight relationship. This means that the species became slender with increase in weight. Moslen and Miebaka (2018) [15] reported that b-value encountered in most fishes is usually between 2 - 4. The results in this study was within that range and was consistent with the findings of Dafit *et al*. (2018) [6]; Ramesh *et al*. (2009) [20] that observed a negative allometric growth for *Telescopium telescopium* (gastropod) and *T. bruneus*. This result is a clear departure from isometry (b = 3), commonly observed in shellfish indicating that they change shape as they grow (Thomas *et al*., 2003) [22], the clear departure from isometry could be linked to environmental factors such as the competition for nutrition, availability of food, water temperature and predator abundance (Trussell, 2011) [23]. The morphometric variation sizes and length range found in mollusks is presumably triggered by various factor such as tidal variation, food availability, changes in seasonality and sexual maturity (Ramesh *et al*., 2009; Ecoutin *et al*., 2003) [20, 9]. The moderately strong correlation coefficient observed for the spiral length-weight relationship and shell/length width relationship is an indication that the spiral length and weight, as well as the shell/length width of the gastropods exhibited a moderate correspondence and proportionate increase with each other (Paul, 2013) [19]. While the strong correlation coefficient exhibited for length-weight relationship and base length-weight relationship (r-0.7094, r-0.8557) respectively, indicated that the length of the species increased with increase in weight and the base length also increased with increase in weight of the species. This assertion corroborates with the findings of Ogunola *et al.* (2017) [18] who stated that the strong positive correlation recorded for the length-weight of the gastropod *Tympanotanous fuscatus* in Okrika and thus allows for a fair prediction of weight for a given length.

Condition factor is a tool used to assess the physiological well being of gastropods in its environment. The overall mean condition factor value recorded in this study is indicative of a poor physiological condition of the gastropod (*Pila ovata*). K values of less than 1, is an indication of a poor condition. If the K value is one and above the shell fish is in good condition and receives adequate food to maintain optimal condition and growth (Barnham and Charles 1998) [4]. The overall condition factor value of 0.9150 recorded in this study was lower than the K value of 1.13 recorded for *Egeria radiata* of the Cross River at Itu by Etim and Taege (1993) [11], but higher than the K value of 0.28 recorded in Cross River, Nigeria for *Tympanotonous fuscatus* by Paul (2013) [19]. The difference in the condition factor of the different species could be attributable to difference in the species of study, their origin and other biotic or abiotic factors known to influence parameters of organisms originating from different places (Paul, 2013) [19]. The mollusk condition factor was also strongly influenced by the conditions of the abiotic and biotic environment it was

obtained and could be used as a tool to assess the ecosystem health.

The good physiological condition recorded for *Pila ovata* in the months of March and June in this study could be attributable to adequate food supply and suitable physical and chemical parameters in its environment (Lazarus, 2018) [13]. This assertion conforms favorably with Barnham and Charles (1998) [4] who stated that if the K value of a gastropod is greater than one, the gastropods are above average condition and receive adequate natural food for their food.

5 Conclusions

The gastropods all had negative allometric growth. However, there was strong correlation for length weight and base length-weight relationship of the gastropods. Information on the condition factor of these species suggests that the environment that this gastropod thrives is not suitable for its physiological condition. This could be attributed to many factors which could include alteration of the physical and chemical parameters of the waters that support the life of the species as a result of pollution and food availability. There is a need for urgent investigation into the environmental conditions in the Niger Delta, where the mollusks were found.

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