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Length–Weight and Girth Relationship, Condition Factor, and Stomach Contents of *Pila Ovata* from Otuoke/Otuaba River, Bayelsa State, Nigeria

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Abstract

Otuoke/Otuaba River situated in Otuoke, Bayelsa State, Nigeria serves numerous purposes, such as fishing, laundry, human feacal disposal, amongst others. The river is home to Pila ovata, a mollusc which serves as a special delicacy in the meals of most Bayelsan due to its high protein content. The length-weight and girth relationship, condition factor and stomach contents of P. Ovata (Apple snail) from Otuoke/Otuaba River was studied. Snail samples were collected manually (handpicking) for a period of 5 weeks (May–June 2021). A total of 500 apple snails of varying sizes were analyzed. Results revealed negative allometric growth pattern for various relationships including length–weight relationship, shell length and shell width relationship, spiral length weight relationship, base length and weight relationship of P. ovata indicating a sigmoid growth pattern, slowing down after 5 weeks of life. The mean daily growth rates for all four subspecies ranged from 0.21–0.25 mm/day in the first 5 weeks, decreasing to 0.11–0.13 mm/day thereafter. The overall mean condition factor (0.02554) indicated that P. ovata was in good condition. Notably, the condition factor exceeded 1 during May and June, suggesting optimal health. Further research is necessary to fully understand the growth patterns and condition of P. ovata, as this study was limited to 5 weeks. In addition, urgent steps should be taken in the right direction to reduce the pollution load that has plagued the environment which these priced species thrive to avoid extinction.

Keywords: Growth pattern, wellbeing, food and feeding habits, *Pila ovata*, Otuoke/Otuaba River

INTRODUCTION

Pila ovata (the apple snail) belongs to the family *Ampullariidae* and is found from the lower Nile Southwards of Northern Mozambique, and Westwards Sudan to Southern Nigeria. This species is preponderant in the Niger Delta region of Nigeria. The shell of *P. Ovata* is around 55–59 mm wide and about 43–47 mm in height (Aboho et al., 2009) [1]. The umbilicus is minute, but deep and the lip a bit hardened, and popular for its use as clearing agent [2].

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In Ogbia Local Government Area of Bayelsa State, most rural people eat mollusks which is a major dietary composition which is a cholesterol free animal protein diet [3]. *P. ovata* is treasured because it has high protein make up and is a unique delicacy for most Bayelsans [4]. This species is also utilized as lime for paint (whitewash), soil fertilizer and buffer to neutralize s6oil acidity [5].

An animal's external features are assessed to calculate its live weight and to evaluate the growth

and development of the young [6]. The weight of an animal serves as an important biological and economic index used to determine the growth rate, fattening and development of animals [7]. Girths measurement are circumference taken at standard anatomical areas around the body to determine changes in body proportion over time [8]. This is done using a tape. The condition factor (K) reveals the biological and physical fluctuations and circumstances through physiological interaction, parasitic infections and feeding conditions [9].

Several authors have provided information on commercially exploited mollusks, in Nigeria and beyond which includes works by [10]. To the best of our knowledge, documented data on the morphometry length-weight and girth relationship, condition factor and stomach contents of *P. ovata* in Otuoke/Otuoba River, Bayelsa State, Nigeria is lacking. The study intended to provide information on length-weight and girth relationship and food of *P. ovata* (Apple Snail) in Otuoke/Otuaba River, Bayelsa State [11].

MATERIALS AND METHODS

Study Area

The study area was Otuoke/Otuaba River in Otuoke, Ogbia Local Government Area, Bayelsa State. Otuoke/Otuaba Community is a locality bounded by water which serves as means of transportation from one community to the other, and a ground for fish harvesting [12].

Sample Collection and Duration of Study

Various sizes of *P. ovata* were manually collected from Otuoke/Otuaba River. The shells were cleaned to remove waste materials [13]. Sampling was carried out weekly for 5 weeks between May and June 2021 and the sample size per sampling are indicated below.

Identification of Species

In the laboratory, the specimens were identified [14]. The morphometric measurements, such as Shell Length (SL), Spiral Length (SPL), Base Length (BL), Shell Width (SW) of the shells of *P. ovata* were measured with the aid of a digital Vernier caliper (0.00–150 mm) to the nearest millimeter (mm). The weight (g) was taken with the help of a mini digital scale (Diamond Series 7 kg x10 kg x1 g) [15].

Length–Weight Relationship

The relationship between Length (L) and Weight (W) of the snails sampled was expressed by the exponential Equation.

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

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, when converted to logarithm form gives a straight-line relationship

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

The “a” and “b” values are obtained from a linear regression of the length and weight of fish [16]. 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) [13].

Condition Factor (K)

The condition factor (k) of the snails was determined from the relationship between shell length and weight measurements using the equation:

$$k = \frac{100w}{L^3}$$

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

Stomach Contents Analysis

The food organisms in the stomach of the snail were microscopically determined. They were identified using standard keys of [17] were adopted to analyze the stomach contents of the snail.

Statistical Analysis

Data collected were analyzed using FAO- ICLARM Stock Assessment Tools (FISAT II) 2007 for length-weight and girth relationship which was used to determine the mean, standard deviation and condition factor. T-test was employed to test the hypothesis and variability of the length and weight to determine the levels of significance. Microsoft Excel (2010) was used for the descriptive statistics [18].

RESULTS

Morphometric parameters of *Pila ovata*

A total of 500 apple snails were collected during the period of study with 100 specimens each in the week of May and June; 400 specimens in May, and 100 snails in June (Table 1). Table 2 shows the morphometric parameters of *P. ovata* from Otuoke/Otuoba River in Bayelsa State. The spiral width of *P. ovata* ranged between 1.1. cm and 8. 3cm. The minimum spiral length of *P. ovata* was 0.9 cm while the maximum was 1.8 cm. Aperture length of *P. ovata* ranged from 1.2 cm to 8.0 cm [19]. The minimum aperture width of *P. ovata* was 1.0 cm while the maximum was 4.3 cm. Tables 3 to Tables 4 show other measured morphometric parameters [20].

Table 1. Morphometric parameters of *Pila ovata* from Otuoke/Otuaba River, Bayelsa State (May–June 2021).

Morphometry	Week	N	Mean	Minimum	Maximum
Spiral Width girth (cm)	1	100	2.61 ± 5.41^{b}	1.6	4.0
	2	100	2.55 ± 4.16^{b}	1.1	4.1
	3	100	3.02 ± 7.07^{a}	1.8	8.3
	4	100	2.88 ± 6.33^{a}	1.2	4.1
	5	100	2.59 ± 4.73^{b}	1.2	4.2
	Total	500	2.73 ± 5.92	1.1	8.3
Spiral length (cm)	1	100	1.63 ± 4.61^{ab}	0.9	3.9
	2	100	1.58 ± 3.49^{b}	1.0	3.1
	3	100	1.85 ± 16.98^{ab}	1.0	1.8
	4	100	1.93 ± 5.40^{a}	0.9	3.6
	5	100	1.60 ± 3.84^{ab}	1.0	3.2
	Total	500	1.72 ± 8.63	0.9	1.8
SS Aperture length (cm)	1	100	2.94 ± 5.78^{b}	1.2	4.4
	2	100	2.94 ± 6.68^{b}	1.3	8.0
	3	100	3.29 ± 4.30^{a}	2.1	4.3
	4	100	3.05 ± 5.86^{b}	1.8	4.3
	5	100	2.96 ± 4.95^{b}	1.2	4.2
	Total	500	3.04 ± 5.71	1.2	8.0

Aperture width (cm)	1	100	1.91 ± 3.57^{bc}	1.2	2.9
	2	100	1.83 ± 3.02^{c}	1.1	2.8
	3	100	2.08 ± 3.97^{a}	1.2	4.3
	4	100	2.04 ± 3.29^{ab}	1.0	3.0
	5	100	1.87 ± 3.50^{c}	1.1	2.9
	Total	500	1.95 ± 3.60	1.0	4.3
Overall					
			2.73 ± 5.92		
			1.72 ± 8.63		
			3.04 ± 5.71		
			1.95 ± 3.60		

Note: Means with different superscripts within the column are significantly different at $p < 0.05$.

Table 2. Lengths and weights of *Pila ovata* from Otuoke/Otuaba Rivers (mean ± SD).

Morphometry	Week	N	Mean	Minimum	Maximum
Length (cm)	1	100	3.85 ± 7.72^{b}	1.5	5.7
	2	100	3.85 ± 6.02^{b}	2.6	6.0
	3	100	4.31 ± 8.36^{a}	1.9	8.7
	4	100	4.24 ± 8.29^{a}	2.5	6.0
	5	100	3.92 ± 6.86^{b}	2.6	6.1
	Total	500	4.04 ± 7.74	1.5	8.7
Weight (g)	1	100	16.07 ± 8.81^{bc}	3	45
	2	100	12.79 ± 6.80^{c}	3	54
	3	100	18.91 ± 9.14^{b}	5	47
	4	100	23.37 ± 12.81^{a}	4	55
	5	100	14.57 ± 8.31^{c}	4	55
	Total	500	17.15 ± 10.06	3	55

Note: Means with different superscripts with the same column are significantly different $p < 0.05$.

Table 3. Weekly collection of size class length of *Pila ovata* from Otuoke/Otuaba Rivers.

S.N.	Size Class Length	Week 1	Week 2	Week 3	Week 4	Week 5	Total
1.	15.3–29.8	12	5	1	7	7	32
2.	29.8–44.3	43	64	57	47	68	279
3.	44.3–58.8	45	29	40	44	24	182
4.	58.8–73.3	0	2	1	2	1	6
5.	73.3–87.8	0	0	1	0	0	1
Total		100	100	100	100	100	500

Table 4. Weekly collection of size class weight of *Pila ovata* from Otuoke/Otuaba Rivers.

S.N.	Size Class Weight (g)	Week 1	Week 2	Week 3	Week 4	Week 5	Total
1.	3–13.4	43	67	33	29	57	229
2.	13.4–23.8	40	28	39	26	32	165
3.	23.8–34.2	13	3	20	23	8	67
4.	34.2–44.6	3	0	7	17	2	29
5.	44.6–55	1	2	1	5	1	10
	Total	100	100	100	100	100	500

Length–Weight Relationship of *Pila ovata*

From Table 5, the values of "a" (intercept) ranged between –0.1303 (Week 3) and –0.7127 (Week 4) [16]. The minimum value of "b", the length exponent (slope) was 0.8243 (Week 3) and maximum was

1.2412 (Week 4). The values of "r" ranged between –0.6586 (Week 2) and –0.8907 (Week 3). The minimum value of "r^2", (Sample correlation coefficient) was 0.4337 (Week 2). The growth pattern of *P. ovata* was negative allometric. The "b" values were less than 3 (Week 1 to Week 5).

Condition Factor of *Pila ovata*

Condition factor values of *P. ovata* ranged between 0.02176 (Week 2) and 0.02929 (Week 1) with overall value of 0.02554 (Table 5). The variation of the values of the condition factor was significant ($p < 0.05$).

Table 5. Growth pattern using length–weight relationship in relation to weeks and condition factor (Fulton's K).

Week	N	A	b	R	r^2	Fulton's K	Growth Pattern
1	100	–0.6395	1.1191	0.7461	0.5567	0.02929[a]	Negative allometric growth
2	100	–0.3243	0.8759	0.6586	0.4337	0.02176[b]	Negative allometric growth
3	100	0.1303	0.8243	0.8907	0.7934	0.02504[ab]	Negative allometric growth
4	100	–0.7127	1.2412	0.732	0.5358	0.02858[ab]	Negative allometric growth
5	100	–0.4714	0.9985	0.7202	0.611	0.02303[ab]	Negative allometric growth
Overall	500					0.02554	

Notes: Means with different superscripts within the column are significantly different at $p < 0.05$.
a = y-intercept, b = growth coefficient, r^2 = sample correlation coefficient.

Stomach Contents of *Pila ovata*

Eight families of phytoplankton are observed (Table 6).

Table 6. Stomach Contents of Pila ovata from Otuoke/Otuaba River.

S.N.	Family	Species	Number of Individual Species
1	Cyanophyceae	*Marssoniella flegans lemm*	83
2	Chlorophyceae	*Volvox aureus warm*	25
3	Chlorophyceae	*Gonium Sociale warm*	39
4	Desmidiaceae	*Closterium*	5
5	Chlorangiellaceae	*Prasinocladus*	3
6	Chlorophyceae	*Gloeotcerium Loulesbergeianum hansg*	7
7	Chrysophyceae	*Mallomonas Litomesa Stokes*	12
8	Chlorophyceae	*Schizomeris*	8
9	Euglenophyceae	*Ascoglena Vaginicola*	3
10	Cyanophyceae	*Raphidiopsis Mediterranea Skuja*	4
11	Euglenophyceae	*Trachelomonas Similis Stokes*	20
12	Chlorophycaea	*Polmodictyon*	8
13	Euglenophyceae	*Colacium Vesiculosum Ehr*	29
14	Oscillatoriaceae	*Splendida Grev*	12
15	Chrysophyceae	*Mozlomonas Acrocomos Ruttn*	107
16	Bacillariophyceae	*Cyclotella Operculata*	12
17	Bacillariophyceae	*Stauroneis anceps*	8
18	Euglenophyceae	*Eughena Variabilis Klebs*	25

DISCUSSION

Data derived from length–weight relationships are dependable in assessing growth patterns of molluscs [21]. This species showed negative allometric growth for length/weight relationships, shell length/shell width relationship, spiral length/weight relationship and base length/weight relationship. This indicates that the species got slender with increase in weight [22]. Ascertained that b-value established in most snails is between 2–4. The results in this study were within that range and was

consistent with the records by [23] 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 suggesting that they change shape as they grow [24]. The clear departure from isometry could be linked to environmental factors, such as temperature, availability of food, predator abundance, competition for nutrition and water [23]. Furthermore, variations in morphometric measurements in mollusks could be linked to food availability, sexual maturity, tidal variation and changes in seasonality [24]. The moderately strong correlation coefficient observed for the spiral length-weight relationship and shell/length width relationship is a pointer to the fact 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 [25].

While the strong correlation coefficient exhibited for length–weight relationship and base length–weight relationship (r–0.7461, r–0.9985) 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 [26] who recorded strong positive correlation for the length–weight of the gastropod *T. fuscatus* in Okrika [27].

The species b values of *P. ovata* indicated a negative allometric growth. However, correlation coefficient for length–weight relationship indicated a strong relationship between parameters. The above "b" value gave a significant departure from isometry. The obtained correlation coefficient signified a moderately strong correlation [28].

Condition factors are used in assessing the well-being of gastropods in their environment. The overall mean k value recorded in this study indicated that the gastropod (*P. ovata*) was in poor physiological condition. K values of less than 1, is an indication of a poor condition. The difference in the condition factor of the different species could be attributable to difference in the species of study and other biotic or abiotic factors influencing parameters of organisms from different places [29].

The good physiological condition recorded for *P. 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 [30]. This assertion conforms favorably to (Barnham and Charles, 1998) who stated that if the K value of a gastropod is more than one, it is a pointer to the fact that they have access to adequate food [31].

CONCLUSIONS

P. ovata in Otuoke/Otuaba river displayed negative allometric growth. However, there was a strong correlation between the length and weight of the gastropods. Information on the condition factor of this species suggests that the environment is probably not suitable for its physiological condition. There is therefore a need for urgent investigation into the environmental conditions in Bayelsa State, where the molluscs are found.

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