

## **BIOMETRIC ASSESSMENT AND GROWTH DYNAMICS OF WEST AFRICAN CLAMS (*Galatea paradoxa*, BORN 1778) IN ITU RIVER: IMPLICATIONS FOR FOOD SECURITY AND SUSTAINABLE FISHERIES**

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### **Abstract**

*Galatea paradoxa*, the West African clam, plays a vital role in regional food security and sustainable livelihoods. This study investigates the morphometrics, length-weight relationship, condition factor, and fecundity of *G. paradoxa* from the Itu River, Nigeria. A total of 64 specimens were sampled over three months (May–July 2025) to assess growth patterns and reproductive potential. Morphometric analysis revealed shell length ranging from 2.2 to 5.1 cm and body weight from 12.7 to 39.9 g. The length-weight relationship showed negative allometric growth ( $b = 0.955$ ), indicating that clams grow longer faster than they gain weight. Condition factor ( $K = 0.052$ ) was low, suggesting limited energy reserves. No visible gonads were observed, preventing fecundity estimation. These findings highlight the need for seasonal monitoring and reproductive studies to support sustainable harvesting. Given the clam's importance in local diets and economies, understanding its biology is essential for conservation and food system resilience. This research contributes baseline data for future stock assessments and supports sustainable development goals through informed fisheries management.

**Keywords:** Aquatic biodiversity, Shellfish biology, Allometric growth, Reproductive biology, Sustainable development

### **Introduction**

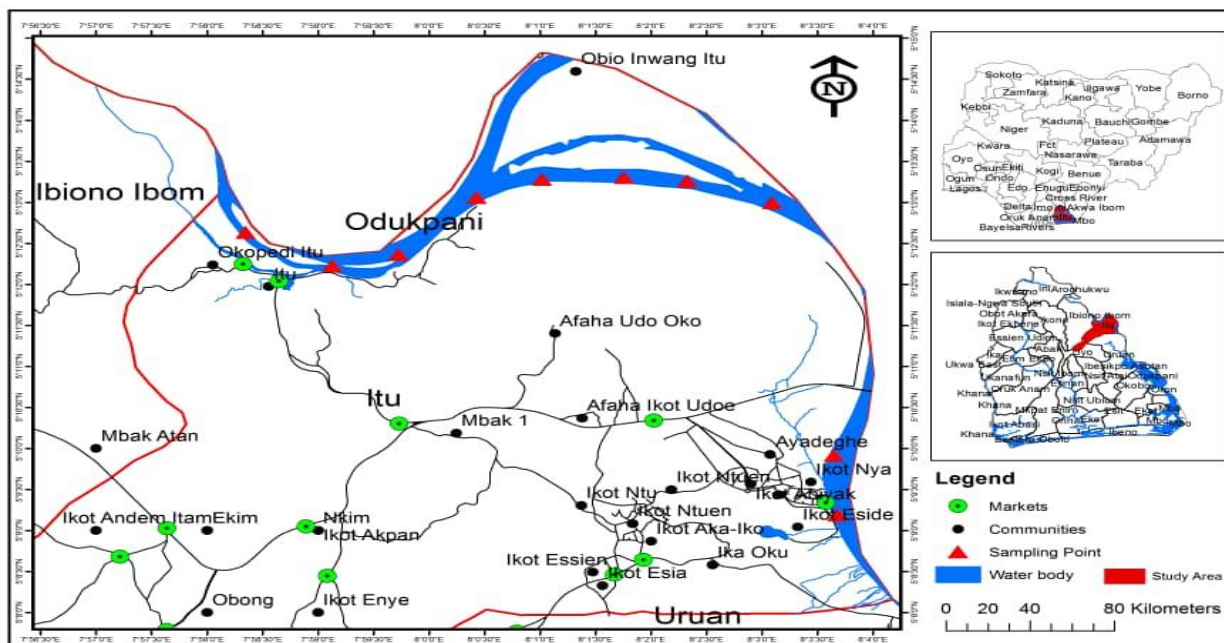
Shellfish, including bivalves like *Galatea paradoxa* (Born 1778), are integral to global aquatic food systems. In West Africa, *G. paradoxa* supports artisanal fisheries and provides affordable protein to riparian communities (FAO, 2018; Tekou Guegang *et al.*, 2022). Despite its ecological and economic significance, biological data on Nigerian populations—especially in Cross River—remain sparse. Morphometric and reproductive studies are essential for stock assessment, conservation, and sustainable exploitation (Ogamba, 2014; Arup Kumar *et al.*, 2018). Clams are packed with nutrients and they are especially high in Iron, Vitamin B12 and offer a good amount of Omega-3 fatty acids (Joseph, 2022).

*Galatea paradoxa*, is endemic to a few West African river systems, occurring in the lower estuaries of rivers such as the Volta (Ghana), Niger and Cross River (Nigeria), and the Sanaga (Cameroon). As a result, its distribution is highly restricted compared to marine clams. The species supports important artisanal fisheries: it is a major protein source for riparian communities in Ghana and is the economically most important clam in Cameroon (Tekou Guegang *et al.*, 2022). This study aims to fill regional data gaps by analyzing growth and reproductive parameters of *G. paradoxa* from Itu River.

## Methodology

### Study Area

See Fig 1. Itu River flows through Itu Local Government Area in Akwa Ibom State, Nigeria. Bordered at the North by Odukpani and Arochukwu, the West, by Ibiono Ibom and Ikono, and the South, by Uyo and Uruan Local Government Areas.



**Figure 1: Map of Itu River**

### Sample Collection

The clam species were purchased monthly for a period of three (3) months between May to July, 2025, from the local fishermen using wooden boats or canoes powered by small outboard engines. Samples were then transferred to the laboratory, in an ice chest for further analysis.

### Laboratory Analysis

In the laboratory, each sample was properly cleaned by rinsing with distilled water to remove debris and other external adherent.

### Morphometrics

The biometrics which includes the shell length(SL),shell height(SH), shell width(SW) anterior auricle length(AAL), umbonal angle(UA), total body weight(TBW) were measured. Total body weight (TBW) was measured using an electronic weighing balance and recorded to the nearest gram while the morphometric measurement was done using a Vernier Caliper in Centimeter (cm) (Powell, 1982; Yeh *et al.*, 2000).

### Fecundity

Although fecundity analysis was planned using Bagenal (1978), no visible eggs or developing gonads were observed in any of the sampled *Galatea paradoxa* individuals during the study period (May –July, 2025). As a result, fecundity data could not be obtained.

### **Length Weight Relationship (LWR)**

The raw data of shell total lengths (SL) and weights (TBW) of the clam species were collected and used to compute the length weight relationship with the formula;

$$W = aL^b \dots\dots\dots (Ricker 1973)$$

Where:

W=body weight,

L=total length,

a=intercept on the length axis,

b=slope or regression coefficient (Sokal, 1987).

### **3.6.2 Condition Factor**

Condition factor was computed for the clams with the equation;

$$K = (W / L^b) \times 100$$

Where:

- K = condition factor
- W = weight of the clams (in grams)
- L = length of the clams (in centimeters)
- b = the exponent of the length-weight relationship, which varies depending on the species and population of fish. (Enin and Amabasi, 2019)

### **Statistical Analysis**

Descriptive statistics (mean and standard deviation) were used to analyze the summary data for the morphometrics. Results of these data analysis were presented in tables Biological data was used to summarize the data for the morphometric measurement. Regression analysis tool was used to determine the relationship between shell total length and total body weight of the clams.

## **Result**

### **Morphometric Parameters**

A total of 64 West African Clams were collected and examined for morphometric, length weight relationship and fecundity. Table 1 shows the summary of morphometric measurements throughout the sampling period.

### **Length Weight Relationship (LWr) and Condition Factor (K)**

The length-weight relationship and condition factor (k) are presented in Table 2. The length-weight relationship was determined using logarithmic transformation. The linear relationship of the log-weight and log-length is shown for the three (3) months (May –June, 2025) (Figure 3-4) respectively. The intercept, a, was 1.09 and the growth exponent, b (0.955) R<sup>2</sup> was 0.68 and K was 0.052.

**Table 1: Summary of Morphometric Measurement for *Galatea paradoxa***

Morphometric Characters	May	June	July
<b>SL(cm)</b>	4.54±0.091 (3.7-5.0)	3.66±0.181 (2.7-5.1)	2.43±0.028 (2.2-2.6)
<b>SH</b>	3.67±0.09 (2.3-4.0)	4.47±0.22 (3.2-6.3)	4.47±0.22 (2.3-3.5)
<b>AAL</b>	1.01±0.056 (0.8-1.9)	1.21±0.068 (0.8-1.7)	1.21±0.068 (0.7-1.7)
<b>UA</b>	1.22±0.025 (1.0-1.4)	1.59±0.103 (0.9-2.2)	1.01±0.056 (0.7-1.9)
<b>SW</b>	1.91±0.085 (1.2-2.4)	2.28±0.135 (1.6-3.4)	1.43±0.035 (1.2-1.8)
<b>TBW(g)</b>	27.57±1.45 (13.0-34.54)	23.58±1.16 (18.6--39.9)	12.70±0.22 (10.1-13.2)

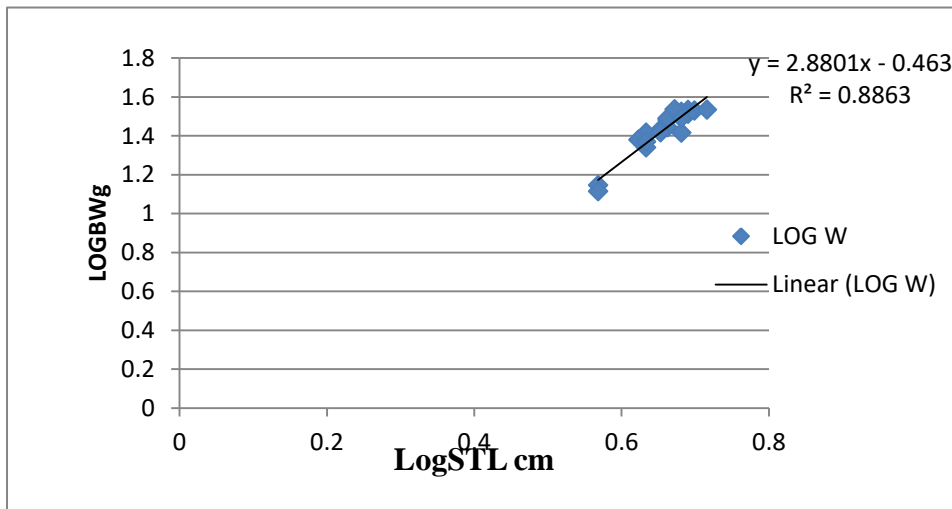
**Table 2: Summary of Morphometrics, Length-Weight Relationship And Condition Factor Of Clams In The Study Area**

Species	Mean STL(cm)	Mean BWT (g)	a	b	R <sup>2</sup>	Mean k
<i>G. paradoxa</i>	3.56±0.66	21.29±4.44	1.09	0.955	0.68	0.052

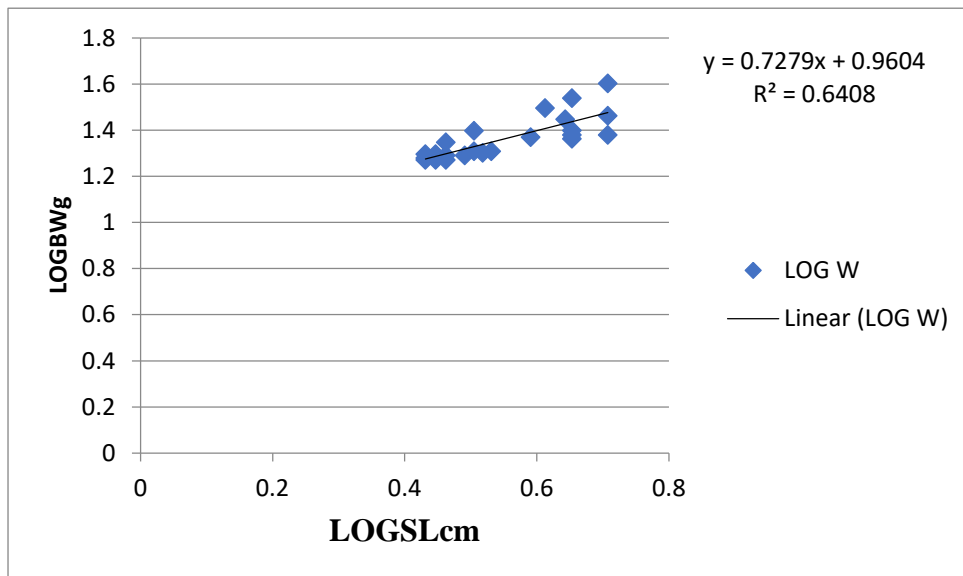


(Source: Fieldwork, 2025)

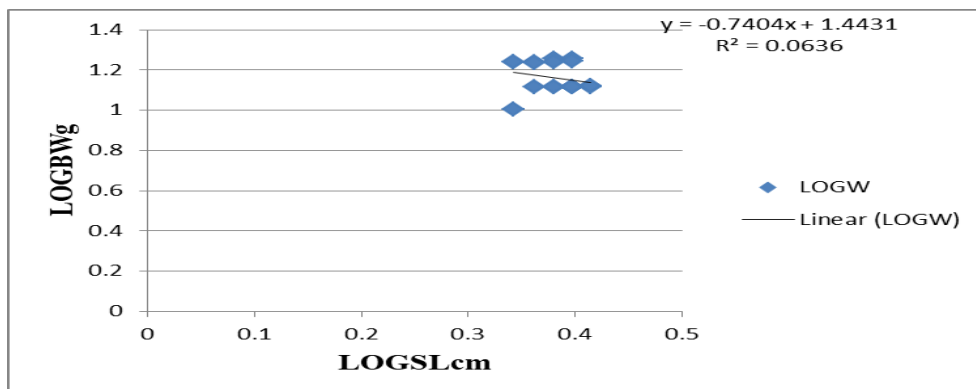
**PLATE 1; *Galatea paradoxa* (West African clam)**



**Figure 2: Length-Weight Relationship for the Month Of May**



**Figure 3: Length-Weight Relationship For The Month Of June**



**Figure 4: Length-Weight Relationship for the Month of July**

### Footnote:

- **y**: The exponent  $b$  which describes how weight scales with length
- **R<sup>2</sup>** : The correlation coefficient  $r$ , indicating the strength and relationship between length and weight
- **LOGBWg**: Log of body weight (grams),
- **LOGSLcm**: Log of shell length (centimeters)

### Discussion

#### Morphometric Characteristics

The mean shell length (STL) of *G. paradoxa* was  $3.56 \pm 0.66$ cm, with a mean body weight (BWT) of  $21.29 \pm 4.44$ g. These values are lower than those reported by Quintana *et al.* (2008) in the Volta River, Ghana, where *G. paradoxa* specimens reached mean lengths of 6.2 cm. Similarly, Ndimele *et al.* (2011) recorded higher mean sizes in clams from less-polluted sites along the Ogun River in Nigeria. The relatively small size of clams in this study may reflect suboptimal environmental conditions in Calabar Itu River, such as nutrient depletion, high sedimentation, or contaminant exposure. The presence of pollutants from agricultural runoff, domestic waste, and oil-related activities likely affects food availability and the overall health of benthic organisms.

#### Length-Weight Relationship (LWR)

The slope ( $b$ ) value of 0.955 indicates negative allometric growth, suggesting that the clams grow more in length than in weight. This deviates significantly from isometric growth ( $b = 3$ ) which is considered ideal in healthy aquatic species. This result is similar to the findings of Arukwe *et al.* (2021), who also reported  $b$ -values  $< 1$  in *G. paradoxa* from polluted areas of the Niger Delta. In contrast, Eyo and Akpati (2013) recorded a  $b$ -value of 2.87 for *G. paradoxa* in the Cross River estuary, an area with relatively lower anthropogenic disturbance. These differences highlight the influence of environmental conditions on growth patterns. Low  $b$ -values are often associated with environmental stressors, reduced feeding efficiency, or altered energy allocation due to sub lethal toxicity.

#### Coefficient of Determination (R<sup>2</sup>)

The coefficient of determination (R<sup>2</sup>) of 0.68 suggests a moderate correlation between length and weight in the studied clams. While this indicates that 68% of the variation in weight is explained by changes in length, the remaining 32% could be due to unmeasured environmental and physiological factors, such as reproductive stage, food availability, or pollutant load. Akinwale *et al.* (2019) reported R<sup>2</sup> values ranging from 0.70 to 0.95 in *G. paradoxa* from various Nigerian water bodies, indicating stronger correlations in less stressed environments. Therefore, the moderate R<sup>2</sup> value in this study further supports the possibility of environmental degradation affecting growth consistency.

### Condition Factor (K)

The mean condition factor (K) of 0.052 is alarmingly low, far below the acceptable threshold (0.5–1.0) considered typical for healthy bivalves (Bagenal and Tesch, 1978). Low condition factor implies that clams are under nutritional and physiological stress, which could stem from: Polluted sediment or water, insufficient food for filter feeders, Oxygen stress due to eutrophication or organic matter buildup. Comparable findings were reported by Edokpayi *et al.* (2017), who linked low K values in clams to heavy metal contamination in the Benin River. Conversely, Fafioye *et al.* (2012) recorded higher condition factors in clams from cleaner environments, suggesting that K can be a reliable bio indicator of habitat quality.

### Conclusion

This study provides foundational data on the morphometrics and growth dynamics of *G. paradoxa* in Itu River. Negative allometric growth and low condition factor suggest ecological constraints or seasonal effects. These findings are critical for sustainable fisheries management and contribute to food security by informing conservation strategies.

### Recommendations

1. Pollution Mitigation: Immediate action is needed to reduce pollutant input into the Calabar Itu River system. Government agencies should enforce environmental protection laws.
2. Habitat Protection: Establish clam conservation zones where harvesting is restricted to allow stock recovery.
3. Monitoring Programs: Implement seasonal bio-monitoring of water and sediment quality, using clams as sentinel species.
4. Community Engagement: Train local clam collectors on sustainable harvesting and the impact of pollution on fisheries.
5. The findings should be used to inform policy and conservation efforts aligned with SDG 2 (Zero Hunger) and SDG 14 (Life Below Water).

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