International Journal of Geography, Earth and Environment Science
Volume 1, Issue 1, 2021
Pages. 07-14
www.ijgees.com

Age and Growth Determination of West African Clam (*Galatea Paradoxa*) From River Benue in Makurdi Benue State, Nigeria

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ABSTRACT:

Age and growth of freshwater clam, Galatea paradoxa from River Benue, Nigeria was studied within three months (June - August 2021). Sixty (60) clams were collected from the River Benue, in three (3) different locations (behind Benue state University, between old and new bridges and behind Makurdi water board headquarters) in Makurdi Local Government Area of Benue State with 10 clams collected per location on monthly basis and body parameters and water quality were analyzed. Data from the growth experiment were subjected to analysis of variance (ANOVA) using SPSS software to test for differences in the growth variables (weight and specific growth parameters) of the different locations and Microsoft excel was used to plot the histogram of the physiochemical water parameters. The results revealed variations in clams' body weights are caused by physicochemical variables of different habitat with shell length ranges from 6.77 ± 1.41cm to 8.04 ± 0.91cm, weight ranges from 41.32 ± 0.61 cm and width ranges from 2.01mm to 2.75mm. Conclusively, the West African Clam, G. paradoxa in River Benue exhibits variations in the growth pattern in the three locations sampled; with clams in Sample A (Behind Benue state University) consistently had higher growth parameters and the habitat and compared to other locations in this study. It is therefore recommended that Clams in the study locations should be collected for a longer period to determine if age of harvest affect body parameters and Clams body weight and shell weight should be correlate to determine if shell and body weight varied among the ages of clams.

Keywords: *Galatea paradoxa, Age, Growth, determination*

Article Citations:

Iwar, I.M., Ater, R., Kaa, A.E., *"Age and Growth Determination of West African Clam (Galatea Paradoxa) From River Benue in Makurdi Benue State, Nigeria"*, International Journal of Geography, Earth and Environment Science, Volume 1, Issue 1, 2021, 07-14.

1. Introduction

The West African Clam, *Galatea paradoxa* (Donacidae), is a bivalve mollusc that is largely abundant in a few large rivers in West Africa countries like Cross and Nun (Nigeria), Sanaga (Cameroon) and the Volta (Ghana) (Adjei-Boateng *et al.,* 2009). The species is a very common bivalve species found almost throughout the coastal regions of Nigeria (Adeyemo *et al.,* 2013); it spawns and develops mostly in freshwater environment. However, if transferred into the stagnant water like dams, it will still grow but may not reproduce, and the meat would be less palatable (Ikpeme and Johnny, 2018). In Itu Local Government Area of Akwa Ibom State, it is heavily harvested by artisanal fishermen except during the wet season when the water level is high. This act puts pressure on the very young members of the species; hence the need for conservation measures to be applied (Ikpeme and Johnny, 2018). A number of environmental factors which influence shell properties of bivalve species include water quality, depth, turbulence and current, quality of phytoplankton, type of sediment, amongst others (Obirikokang *et al.,* 2013).

The freshwater clam*, Galatea paradoxa* (Born 1778) is a bivalve mollusc belonging to Tellinoidea and Donacidae (Purchon 1963*). Galatea paradoxa* is restricted to narrow stretches of a few rivers in West Africa including the Volta (Ghana), Cross and Nun (Nigeria) and Sanaga (Cameroon) (Etim and Brey, 1994), where it supports a vibrant artisanal fishery. The clam, *Galatea paradoxa* is a commercially important bivalve species exploited mainly for its flesh and is consumed boiled or fried. It is a filter-feeding organism with a wide distribution extending from the Gulf of Guinea to the Congo (Moses 1990).

Clam fishing represents a viable source of income and livelihood for the local people. Furthermore, it constitutes an important and affordable protein source to the riparian communities along the Volta estuary and beyond (Amador 1997). On dry matter basis, the average protein content of the smoked clam is 46.5% (Kwei, 1965). The shell of the clam has various uses, notably as the main source of calcium in poultry feeds and lime manufacturing industries. One interesting use to which the clam shells have been put in the southern parts of the Volta region is in the construction industry. The shells are used as an alternative to stone chippings in concrete. Additionally, it is used as a pavement material to overcome muddy conditions in village compounds. Thus, the economic importance of the clam cannot be underestimated. This clam has high nutritional value and constitutes an important protein source to the riparian human community where it occurs (King, 2000). The soft tissue is consumed after frying, smoking. roasting, steaming or cooking. The Clam *Galatea paradoxa* is widely consumed in Southern Nigeria and serve as a means of livelihood to young men and women in these communities who fish and process this clam.

Age and growth parameters of mollusks (bivalves) provide indispensable data for understanding the dynamics of mollusk populations and essential indications for fisheries management (Beamish and Macfarlane, 1987). Ability to comprehend the dynamics involved in age determination of bivalves is an essential tool in fishery biology. In tropical regions, the determination of age and growth pattern often imposes difficulty (Menon, 1953; De Bont, 1967). The hard shell of bivalves may show rings, but these are not necessarily annual, and their frequency per year must be determined.

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2. Materials and Methods

Study Area

The study was carried out at River Benue, latitude 7°38'N - 7°50'N, and longitude 8°24'E and 8°38'E. It is situated in the Benue valley in the North Central region of Nigeria. It is traversed by the second largest river in the country, the River Benue (Figure 1).

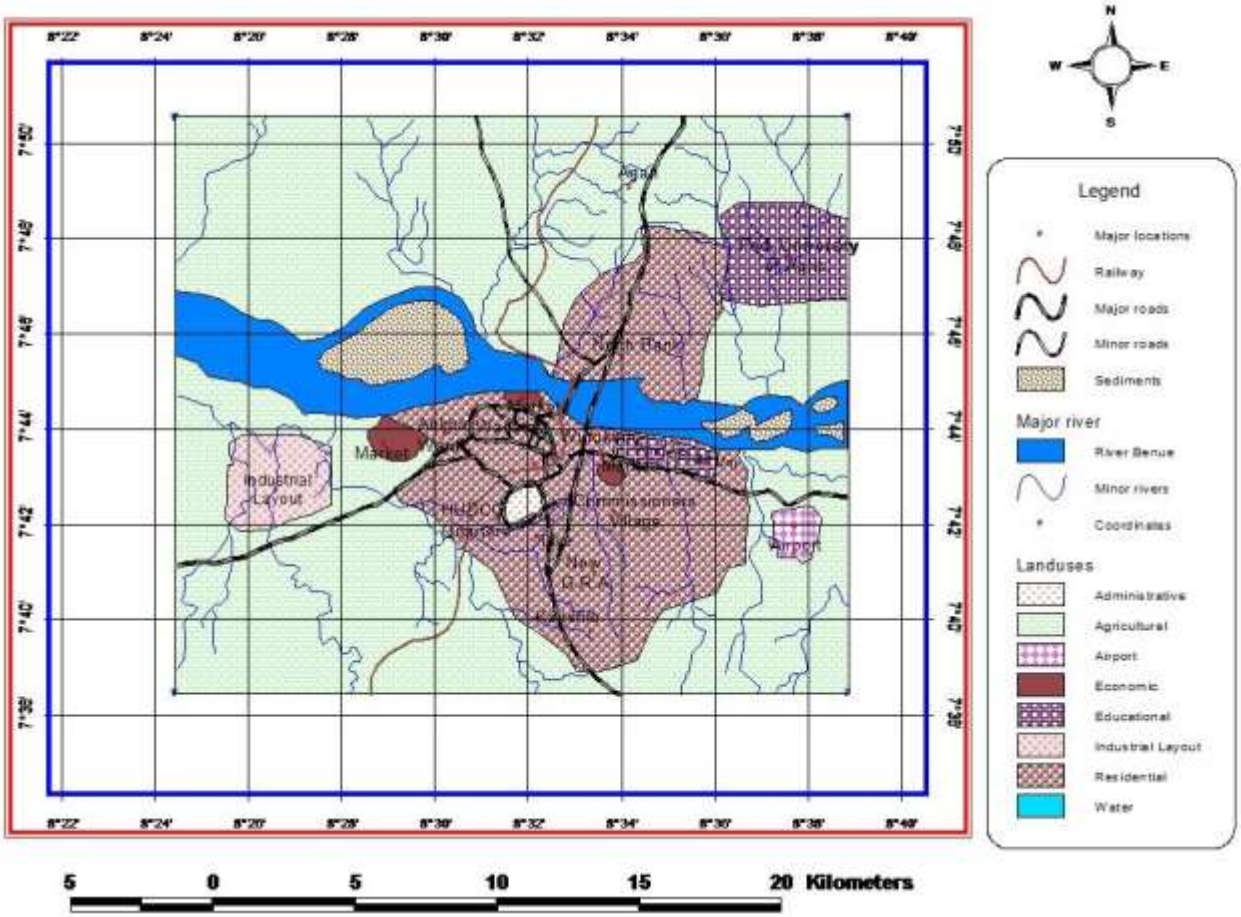


Figure 1: Map of Makurdi showing built up extent

Physiochemical Water Quality Characteristics

The following physiochemical parameters; electrical conductivity (EC), total dissolve solids (TDS), dissolved oxygen (late morning readings around 10 am) was measured with an oxygen meter (L933246), pH , and temperature were monitored at the study sites with a Hanna (H19813) crochek meter. Water quality variables were measured monthly from the period of sampling.

Clam sampling

This study was carried out between months of June and August 2021, where sixty (60) clam samples were collected from the River Benue, in three (3) different locations (behind Benue state University, between old and new bridges and behind Makurdi water board headquarters) in Makurdi Local Government Area of Benue State. 10 clams were collected per location and different sizes were randomly collected on monthly bases and were analyzed. The samples were sacked in white bag which exposed them to air and was transported from the locations to Fishery department laboratory, Federal University of Agriculture Makurdi for measurements.

Age and growth measurements

Each clam was numbered with pen marker to differentiate one from another. A pair of digital vernier caliper with accuracy of 0.01 mm was used to measure the shells' length (maximum dimension of the anterior – posterior axis), shell height (maximum distance from the hinge to ventral margin) and width (maximum distance between outer edges of the halves) of each specimen. A sensitive (Golden Melter) weighing balance was used to obtain weight of each sample. Each live clam was weighed individually to obtain total weight.

Data Analysis

Data from the growth experiment were subjected to analysis of variance (ANOVA) using SPSS software to test for differences in the growth variables (weight and specific growth parameters) of the different locations. The Tukey multiple comparisons post-test was used to further test for specific differences among the location means. In all cases differences were considered significant at $p<0.05$. Microsoft excel was used to plot the histogram of the physiochemical water parameters.

Results

Table 1: Summary of Body Parameters of freshwater clams along River Benue,makurdi

SAMPLE	Weight (g)	Length (cm)	Breath (cm)	Height (cm)	Rings
A	61.11 (31.25)^{a}	8.04 (0.91)^{a}	2.75 (0.58)^{a}	4.30 (1.03)^{a}	4.70 (1.26)^{a}
B	25.42 (13.89)^{c}	6.77 (1.41)^{b}	2.01 (0.40)^{c}	3.12 (0.66)^{c}	3.75 (0.91)^{b}
C	43.74 (6.74)^{b}	7.61 (0.38)^{a}	2.42 (0.20)^{b}	3.68 (0.25)^{b}	4.55 (1.05)^{a}

In a column, values with the same superscript are not statistically significant ($P<0.05$); Values in parentheses are standard deviation values

SAMPLE A: Behind Benue State University

SAMPLE B: Between old and new bridges

SAMPLE C: Behind Makurdi Water Board

Water Parameters

Total Dissolved Solids (TDS)

The TDS showed significant difference among the three locations as shown in figure 2. Sample C location had higher TDS as compared to those obtained from Sample A location, however, the difference was not significant among the two locations. TDS obtained from Sample B location was lower as compared to the other locations and the values obtained represented the lowest TDS from the three locations and the difference was significant (Figure 2).

pH

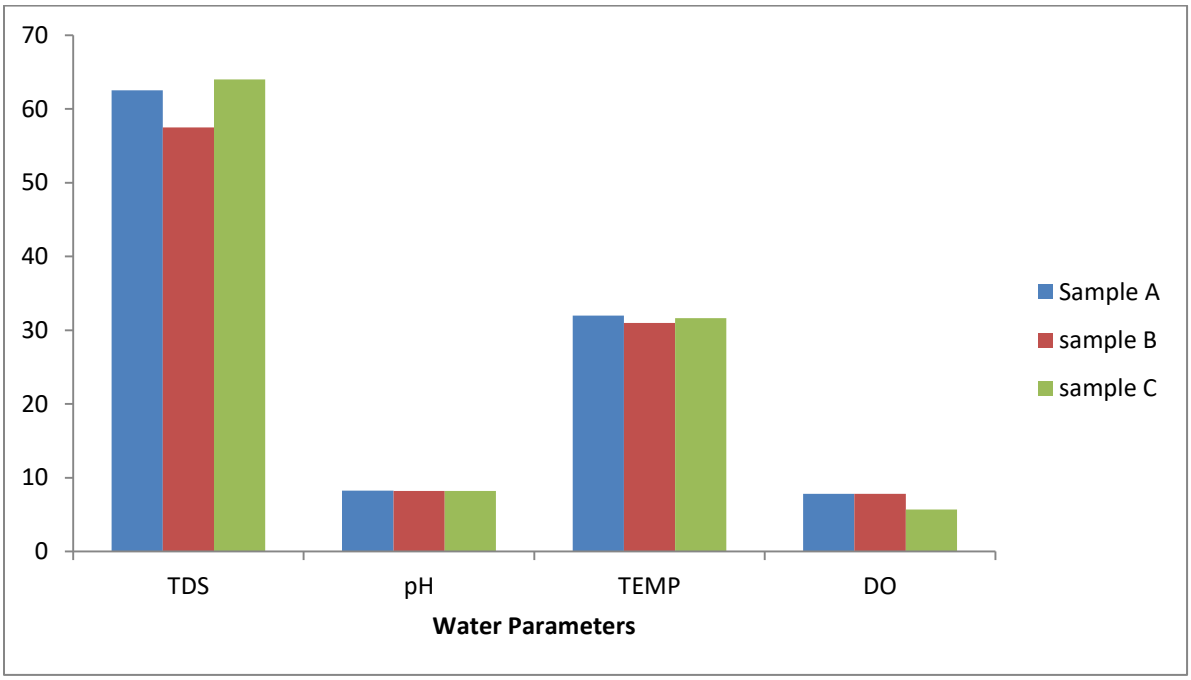
The pH values obtained from the three sample locations as shown in figure 2 revealed that the pH values ranges from 8.25 in Sample A to 8.20 in both sample B and C and the difference was not statistically significant (Figure 2).

Temperature

The temperature values obtained from the three sample locations as shown in figure 2 revealed that the temperature values ranges from 31.0^0C in Sample B to 31.65^0C in sample C and 32.0^0C in sample location C however the temperature difference among the three location showed no statistical difference (Figure 2).

Dissolved Oxygen (DO)

The values for dissolved oxygen from the samples collected from the three locations are shown in figure 2. Sample A and B locations obtained the same values for dissolved oxygen and this represented the highest dissolved oxygen value from the sampled locations. However, Sample C location recorded the lowest dissolved oxygen value and the difference was statistically significant as compared to the other two locations (Figure 2).



3. Discussion

The body parameters examined in this study revealed that shell length ranges from 6.77 ± 1.41cm to 8.04 ± 0.91cm was higher than 7.01 ± 0.34cm as reported by Kingdom *et al.,* (2012) for G. paradoxi in Ikebiri creek. This was similarly lower than 9.71 ± 0.09cm shell length reported by Akinjogunla and Moruf (2019) in Itu creek. Likewise, the 63.23 ± 0.05mm recorded by Ehigiator and Osawaru (2016) for Egeriaradiata in the Forcados river was smaller than those reported in this study.

The weight in the study showed higher values than the highest value of 41.32 ± 0.61 cm as reported by the same species in the Volta river Estuary (Obirikokang *et al.,* (2013) but lower than the highest value of 115.70 ± 1.09 cm of clams in the Itu creek (Akinjogunla and Moruf, 2019). The width reported in this present study ranges from 2.01mm to 2.75mm, which had lower width of clams as compared of the same species reported by Kingdom and Azagba (2017) in Apoi creek. Similarly, the present study revealed the height of clams which was lower than the height (46.97 ± 0.54) of clams in the Apoi creek (Kingdom and Azagba, 2017). The surface rings reported in this study revealed a smaller number of rings as compared to clams collected at age one (19.4 ± 4.5) in Volta River Estuary, Ghana (Adjei-Boateng and Wilson, 2013).

The difference in the weight, shell length, height, width (breadth) and number of rings maybe physiological and could also be a function of environmental conditions (water parameters). The current study conform with earlier findings of Moses (1990), Kingdom and Azagba (2017), Ehigiator and Osawaru (2016), Akinjogunla and Moruf (2019) who reported that variations in clams body weights are caused by physicochemical variables of habitat such as temperature, pH, total dissolved solids and dissolved oxygen of the various locations (in this study, sample A, B and C), as this factors determine the growth and age of clams at the time of collection.

4. Conclusion

The West African Clam, *G. paradoxa* in River Benue exhibits variations in the growth pattern in the three locations sampled; with clams in Sample A (Behind Benue state University) consistently had higher growth parameters and the habitat and compared to other locations in this study.

5. Recommendation

From the study, the following recommendations are made;

1. Clams in the study locations should be collected for a longer period to determine if age of harvest affect body parameters
2. Clams body weight and shell weight should be correlate to determine if shell and body weight varied among the ages of clams.
3. Further studies should be carried out in part of the river Benue, not just Makurdi alone.

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