

**Length-Weight Relationship of a Mangrove Prosobranch
Tympanotonus fuscatus var fuscatus (Linnaeus, 1758)
from the Bonny Estuary, Niger Delta, Nigeria**

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Abstract: The length-weight relationship of *T. fuscatus var fuscatus* was studied along the Bonny River estuary, Niger Delta, Nigeria, between January and December 2004. Weight increases faster than the length. The pattern of growth (allometric) was verified from the value of 'b' in the equation, mean b value was 1.415. Regression equation derived from the logarithmically transformed data of shell length and weight was $\text{Log } W = \text{Log } -1.761 + 1.415 \text{ Log } TL$ $r = 0.892$, $P < 0.001$.

Key words: Length-weight % Mangrove prosobranch % Bonny River % Niger Delta

INTRODUCTION

The length-weight relationships (LWR) of fish are important in fisheries biology and population dynamics where many stock assessment models require the use of LWR parameters. Length-weight relationships allow for the conversion of growth-in-length equations to growth-in-weight for use in stock assessment models, estimation of biomass from length observations and estimation of the condition of fish. The length/weight relationship of *T. fuscatus* shows that its growth is negatively allometric, i.e. weight increasing faster than the length [1, 2].

Tympanotonus commonly referred to in Nigeria as periwinkle; inhabit the brackish intertidal waters where the substratum is muddy and rich in detritus [3]. They have wide distribution in brackish wetland of the Niger Delta and the distribution is influenced by a number of factors such as salinity, nature of bottom deposit, water depth and current [4]. The species is a high delicacy for the inhabitants and no effort at present to culture it thus the exploitation is from the wild and harvest pressure has considerably impacted on the abundance and community

structure. In spite of it being a relatively cheap source of animal protein and its shell can be used as a source of calcium in animal feeds and for construction. Presently, the market demand for this mollusk appears very high [5].

Despite the economic importance of the species, studies have been limited and these include the works of Gabriel [2], on some aspects of the ecology of the species in Port Harcourt area, [3] on the biology of *T. fuscatus var radula* of the Lagos lagoon and [6] on tolerance of the species to refined oils. These studies were limited in approach and did not provide clear understanding on the community structure assessment.

Several studies have been carried out in this regard for fin fish species [7-9], but there is a dearth of information on length-weight relationships in shellfish in particular from Nigerian waters. It is on the basis of this dearth in knowledge that this study is aimed at providing useful information on the length-weight relationship of *T. fuscatus var fuscatus* in the mangrove swamps of the Bonny estuary. This will serve as important inputs into fish stock assessment models upon which sustainable management and development of the resources could be achieved.

MATERIALS AND METHODS

The Niger Delta is one of the largest deltas in Africa upon which the Bonny estuary is found. The study area is located within the middle reaches of the Bonny estuary which lies between latitudes 4°45' - 4°50' N and longitude 7°05' - 7°15' E [10]. It is characterized by several creeks that are tide dominated embayment with little fresh water input and are extensively mangrove vegetations (Fig. 1). The intertidal amplitude lies between 0.80m - 2.20m [11].

The climate of the study area is sub-tropical with heavy rainfall as high as 700mm, high temperatures of 28-32°C and high relative humidity of 80 – 100% [12]. The vegetation consists of thick mangrove forest dominated by the red mangrove *Rhizophora racemosa* and *Rhizophora mangle*. In some areas, the white mangrove *Avicennia africana* is interspersed with *Nypa palm*. The lowest inter-tidal zone is usually bare of vegetation, with clay, peat and sand deposit. The predominant human activities in the area include fishing, sand mining and mangrove timber exploitation.

Four sampling stations were established (at interval of about 900m) along the River system (Fig.1). Sampling was done for a period of one year (January to December 2004). *T. fuscatus var fuscatus* samples were hand picked at ebb tide monthly from the four designated sampling stations. All samples collected from each station were placed in a synthetic polythene bag. The samples were

placed in a cool box and taken to the laboratory. In the laboratory, the samples were washed to remove the mud. The shell length was measured using a vernier caliper to the nearest millimeters (mm) and shell weight was obtained using a top loading balance measured to the nearest gram (g). The length measurements were converted into length frequencies with constant class interval of 1mm. Only the mid-length and mean weight of the classes was employed in data analysis since this was the format accepted by FISAT (13).

The data collected was used to evaluate the relationship of the shell length (SL) and weight (SW) of *T. fuscatus*. Using the formula expressed below:

$$W = aL^b \tag{1}$$

Where

W = Weight

L = Length

a = Regression constant (intercept)

b = Regression coefficient (slope)

A log scale regression of dry weight on length was then computed.

$$\text{Log } W = \text{Log } a + b \text{ Log } L \tag{2}$$

The linear regression routine option 3 in FiSAT (FAO-ICLARM stock assessment tool) software was used for the analysis.

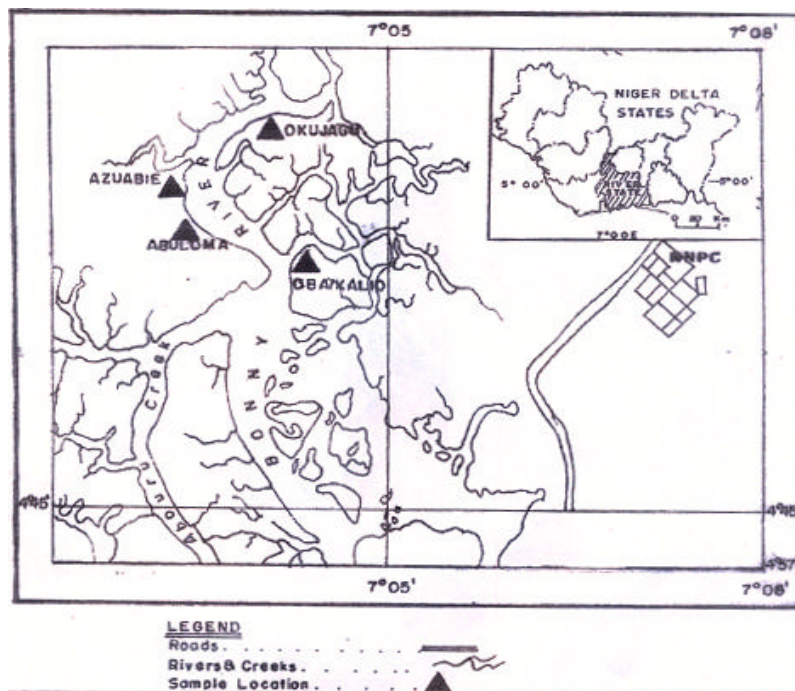


Fig. 1: Map of Niger delta, River State and Bonny River showing this study station

RESULTS AND DISCUSSION

T. fuscatus var fuscatus of the mangrove swamps of the Bonny estuary showed body weight increasing faster than the shell length. The smallest size examined measured 11.0mm shell length and weighed 0.61g weight, while; the largest size was 48.0mm and weighed 5.01g. The range of length observations for Oba/Kalio station was 13.0 - 48.0mm, 11.0 - 46.0mm for Abuloma and Okujagu stations and 13.0 - 43mm for Azuabie station. The lowest mean shell length was recorded at Abuloma station while the highest mean shell length was recorded at Oba/Kalio station.

The length-weight relationship was determined following a logarithmic transformation. The statistics of regression are shown in Table 1. The regression trends indicated variation in the growth pattern for the stations. The linear relationships of the log-weight and log-length are shown in Figs. 2, 3, 4 and 5. The slope or regression coefficient b ranged from $b_{min} = 1.195$ to $b_{max} = 1.639$. The intercept (a) varied between -1.420 to -2.086 for all the stations. The correlation coefficient (r) was highest (0.982) at Oba/Kalio station and lowest at Azuabie station (0.781).

Table 1: Exponential equations and correlation coefficient (r) of Length-weight relationship of *T. fuscatus var fuscatus*

Station	Regression Equation	r
Oba/Kalio	$W = -2.086 L^{1.639}$	0.982
Abuloma	$W = -1.420 L^{1.195}$	0.915
Okujagu	$W = -1.655 L^{1.344}$	0.888
Azuabie	$W = -1.882 L^{1.482}$	0.781

Growth exhibited a negatively allometric pattern, weight increases faster than the length. The intercept (a) of all the stations was negative which indicates a perfect linear relationship between the variables. The highest correlation coefficients in the present study show that regression values were highly significant ($P < 0.001$).

There was a noticeable difference between the sizes of the individuals within the sampling stations. *T. fuscatus var fuscatus* at Abuloma station which is the lowest sizes, comprises mostly of small individuals. This could be attributed to the following: (1) over-fishing by the natives owing to the easy accessibility to the sampling station, hence making it difficult for the species to grow to a sizeable population. (2) The effluent discharges from

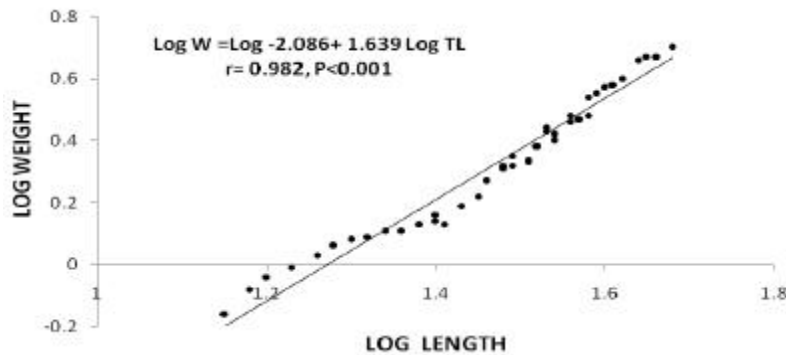


Fig. 2: Length-weight relationship of *T. fuscatus var fuscatus* in Oba/Kalio station

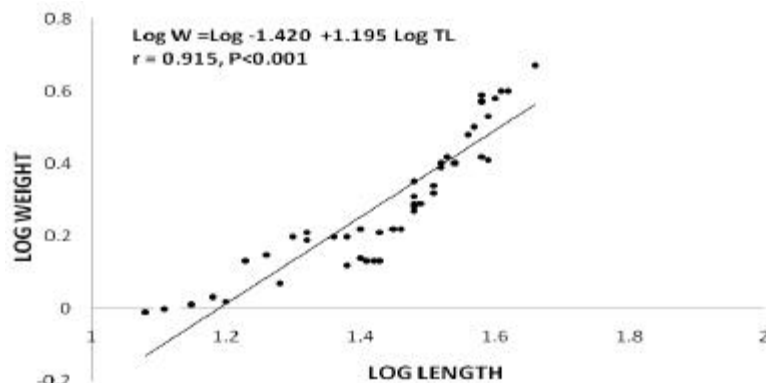


Fig.3: Length-weight relationship of *T. fuscatus var fuscatus* in Abuloma station

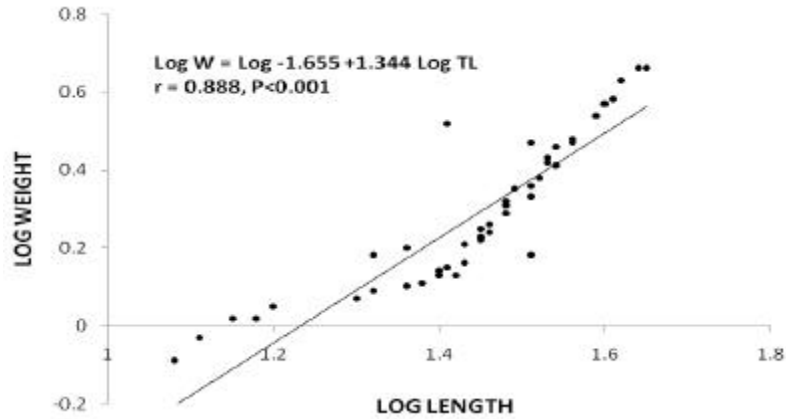


Fig. 4: Length-weight relationship of *T. fuscatus var fuscatus* in Okujagu station

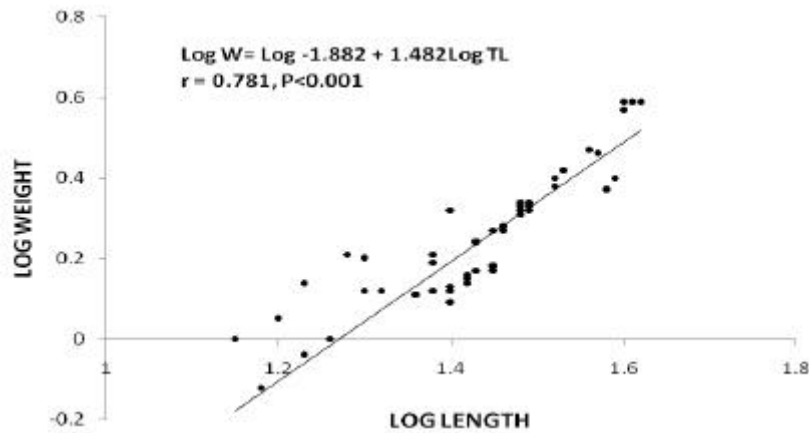


Fig. 5: Length-weight relationship of *T. fuscatus var fuscatus* in Azuabie station

industries within the vicinity also impacted negatively on the size of the species harvested [10]. However, there is a tremendous increase in size in Oba/Kalio station. Here the thick mangrove vegetation limits easy access to the fishing areas effluent discharges is reduced.

The range of the slope values *b* obtained in this study compare favorably with report of length – weight relationship of bivalves [14], they estimated *b* value of 2.44 in *Arina (Servatina) pinmata japonica* and 3.31 in *Scaphora broughtonii* from coastal waters of Korea. Lawal-Are [15] had *b* range of 2.719 for lagoon crab *Callinectes amnicola* in the Lagos lagoon, Nigeria. Prasad [16] had *b* range of 3.03 and 3.22 for prawns (*Penaecus monodon*).

Length-weight relationship with *b* value typical for most fishes has been recorded by Royce [17] *b* = 2.0-3.5; Lagler *et al.* [18] *b* = 2.5-4.0 and King [7]. According to Frosta *et al.* [19] the slope value *b* indicates the rate of weight gain relative to growth in length and varies among different populations of the same species or within the

same species. The correlation coefficient (*r*=0.892), indicates that there is a high degree of correlation between shell length and shell weight in the sample, its positive value reflects the fact that the slope is positive.

The exponent *b* obtained for *T. fuscatus var fuscatus* of this study being less than 3 generally is in agreement with work done by Gabriel [2] indicating negative allometric growth in *T. fuscatus var radula*. This means that weight increases faster than the length. The relationship was however influenced by seasonal changes in weights of *T. fuscatus var fuscatus*. Ajayi [20] observed positive allometry (*b*=3.177) for *Cynoglossus canariensis*. Wootton [21] however opined that *b*<3 indicates that the fish gets relatively thinner as it grows larger while *b*>3, it gets plumper as it grows larger.

Picken [22] gave a length-weight relationship of adult limpet, *Nacella concinna* as $\log_{10}W = 2.629 \log_{10}L - 1.427$ and immature forms as $\log_{10}W = 3.064 \log_{10}L - 1.054$. The intercept (*a*) of all the stations was negative which indicates a perfect linear relationship between the

variables. Length and weight are two indices that can be used in determining the growth rate of fish and hence in estimating the age. The study will provide important inputs into fish stock assessment models and data for sustainable management and development of the resources.

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