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Growth, Mortality and Recruitment Studies of Periwinkle *Tympanotonus fuscatus* var *fuscatus* (Linnaeus, 1758) in the Bonny River, Niger Delta, Nigeria

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Abstract

The growth, mortality and recruitment pattern of *Tympanotonus fuscatus* var *fuscatus* were investigated using shell length (SL) and frequency data obtained from the mangrove swamps of the Bonny River. Sampling was done between January and December 2004. Computer based software package (FiSAT) was used for the analysis. Results show relatively high growth rate, low mortality and recruitment pattern with two peaks annually.

Key words : Growth, Recruitment, *Tympanotonus fuscatus,* Bonny River, Niger Delta.

The most common and dominant gastropods in the brackish waters of West Africa are *Tympanotonus* which is a delicacy for the local population. They inhabit quiet waters, where the substratum is muddy and rich in detritus, salinity, nature of bottom deposits, water depth and currents are factors that affect their distribution in the coastal areas of West Africa (1). The genus *T. fuscatus* comprises a single species which has two varieties, *T. fuscatus* var *fuscatus* and *T. fuscatus* var *radula.*

Growth of aquatic organisms is affected by several factors such as season, age, size at maturity and availability of food (2). For tropical shellfish species, the application of length-frequency data in stock assessment has been emphasized (3). Presently, several computer software packages for stock assessment exist. The annual growth pattern was estimated using the Von-Bertalanffy growth function (K). This is an important growth parameter in fisheries statistics. It depicts the rate of dimension per time (year, months, weeks or days) at which the asymptotic length is approached (4, 5). Although few studies have been carried out on the growth of the shellfish occurring in brackish ecosystem owing to its popularity in the Niger Delta, there is need to complement existing knowledge. The collection of *T. fuscatus* is from the wild and is not controlled. Sizes of 25—50 mm shell length are collected everyday from the natural beds at low tides, but no attempt has been made to improve these natural beds or establish new ones ; as a result the population of this species appears seriously reduced where it once flourished. Like many other edible species of molluscs, e.g. clams, oyster and mussels, the species is yet cultivated in Nigeria. Production of these molluscs in Nigeria is presently underdeveloped through neglect. However, accurate data on the exploitation level is lacking. This study will thus provide information on growth, mortality, recruitment and exploitation rates of the fishery. Knowledge of these population parameters is necessary for effective management and conservation of the stock.

Methods

The Niger Delta is one of the largest deltas in Africa in the Bonny River. The study area is located within the middle reaches of the Bonny River which lies between latitudes $4^0 45' - 4^0 50'$ N and longitude $7^0 05' — 7^0 15'$ E (6). It is characterized by several creeks that are tide dominated embayment with little fresh water input (Fig. 1). Salinity fluctuates with season and tidal regime. The intertidal amplitude lies between

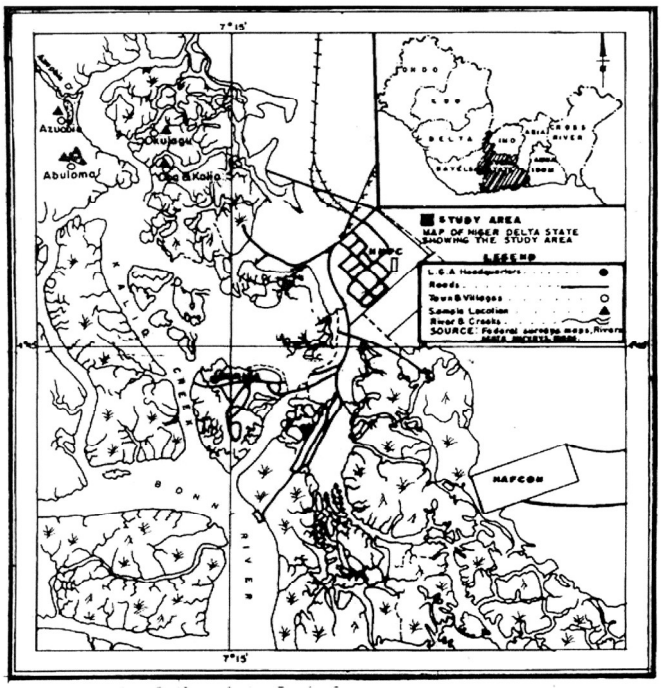

Figure 1. Map of Niger Delta showing the study stations.

0.80—2.20m(7).

The climate of the study area is sub-tropical with heavy rainfall as high as 900 mm, high temperatures of 28—32 C and high relative humidity of 80 – 100% (8). 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 low inter-tidal zone is usually bare of vegetation, with clay, peat and sand deposit. The area is also influenced by numerous human activities including fishing, sand mining, dredging, firewood cutting and boat traffic.

Four sampling stations were established along the river system based on ecological settings, accessibility and human activities in the area. Sampling was done monthly from January to December 2004. Samples of *T. fuscatus* var *fuscatus* were hand picked at ebb tide monthly and transported in synthetic polythene bag to the laboratory in an ice chest. In the laboratory, samples were washed and the shell length was measured using a vernier caliper to the nearest

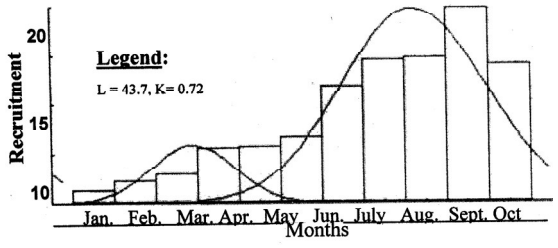

Figure 2. Recruitment pattern of *T. fuscatus* var *fuscatus* at Oba/Kalio.

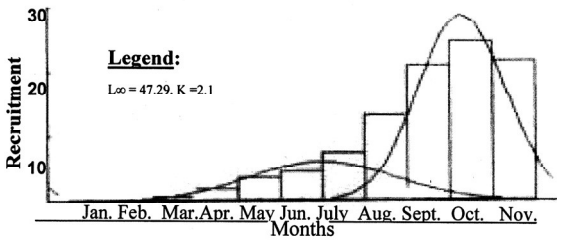

Figure 3. Recruitment pattern of *T. fuscatus* var *fuscatus* at Abuloma.

millimeters (mm). Shell weight was taken with a top loading balance measured to the nearest gram (g).

The length measurements were converted into length frequencies with constant class interval. Growth parameters t_0, L∞ and K were estimated using Powell-Wetherall plot routine which served as input into the scan of K value routine. The FiSAT was used to determine the ratio of the coefficient of total mortality and growth coefficient (Z/K). Total mortality Z was estimated using the length-converted catch curve analysis. Recruitment pattern were also estimated using FiSAT based on the values of t_0, L∞ and K.

Results and Discussion

The summary of the estimated value of the growth and mortality parameters is given in Tables 1 and 2. The Powell-Wetheral plot gave a mean value of asymptotic length (L∞) of 46.401 mm and the ratio of the coefficient of total mortality and growth coefficient (Z/K) of 2.185 and *r* value of -0.939 (Table 1). Growth parameters of *T. fuscatus* var *fuscatus* estimated from the non-seasonalized Von Bertalanffy growth function (VBGF) gave higher mean values of asymptotic length (L∞) of 60.85 mm. The mean growth coefficient (K) was 0.273/yr and t_0 = -0.253.

The growth performance index (∅') varied from 2.915—3.067 with a mean of 3.000. Using the length converted catch curve, the mean instantaneous total mortality (Z = F + M) for the stations was estimated at 3.37 . The instantaneous natural mortality (M) was 2.32/y, based on our Z from the seasonalized length converted catch curve, we obtained mean *F* value (the instantaneous fishing mortality) as 1.05/y from the relationship : F = Z-M., giving the current mean

Table 1. Growth parameters of *T. fuscatus* var *fuscatus* in the Bonny River estuary. L ∞ = Asymptotic length, *r* = Correlation coefficient, K =Growth coefficient expressing rate of growth per year, t_0 = Hypothetical age (y) at which length is zero, Z/K = Ratio of the coefficient of total mortality and growth coefficient, ∅' = Growth performance index.

Sampling station	Application	L ∞ (mm)	*r*	K (per y)	Z/K	t_0	∅'
Oba/Kalio	Powell-Wetherall plot	48.605	-0.997	-	1.580	-	
Abuloma	„	45.329	-0.826	-	1.966	-	
Okujagu	„	47.261	-0.960	-	2.297	-	
Azuabie	„	44.407	-0.973	-	2.898	-	
Mean	„	46.401	-0.939	-	2.185	-	
Oba/Kalio	Non-seasonalized (VBGF)	59.033	-	0.335	-	-0.361	3.067
Abuloma		61.872	-	0.282	-	-0.058	3.033
Okujagu		64.709	-	0.230	-	-0.312	2.984
Azuabie		57.808	-	0.246	-	-0.282	2.915
Mean		60.856	-	0.273	-	-0.253	3.000

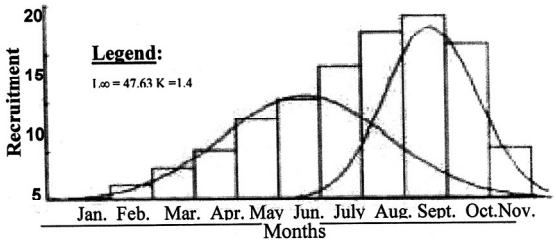

Figure 4. Recruitment pattern of *T. fuscatus* var *fuscatus* at Okujagu.

exploitation rate (E) of 0.200 (Table 2).

The recruitment pattern of *T. fuscatus* var *fuscatus* is shown in Figures 2—5. The pattern established indicated a year-round recruitment with two peaks of varying intensity with one larger than the other. The major recruitment period for this species occurred between April and September. The occurrences of these peaks are related to environmental variations associated with the wet and dry seasons.

The estimated growth parameters K (0.273) and L ∞ (46.401) obtained in this study indicated a fast growing species which approaches a maximum length at a relatively fast rate. A low K value of 0.0715 was obtained by Picken (9) for the Antarctic limpet *Nacella concinna.* Also, Green and Craig (10) reported low K values of 0.065 for tridacnid clams in the Rose Atoll. Ansa (11) reported a high growth coefficient K (0.62) for the bivalve *Senilia senilis* in the Andoni area of Rivers State, Niger Delta. The difference in the growth of the mollusks could be attributed to the fact that temperate species have slower growth rates than the tropical species.

The mean growth performance index ∅' of 3.000, estimated here provide a basis for comparing the growth of *T. fuscatus* var fuscatus of this study with stocks of other geographical locations or environments when such estimates become available. The application of Pauly's rule of thumb (12) using length-frequency data for growth and mortality studies is regarded excellent. The value for total and natural mortality indicated that mortality in the species was mainly due to over fishing, the values of exploitation ratio E of 0.200 indicate that the stock of *T. fuscatus* var *fuscatus* in the study area was relatively over exploited, since the values obtained are below the value of 0.5 which is the value obtained for an optimally exploited stock : where natural and fishing mortalities are equal i.e. E = F/Z = 0.5 (13). The instantaneous natural mortality coefficient (M) apart from indicating the fraction of death caused by all possible causes except fishing is a necessary input in the computation of many models in fish population dynamics study.

The present investigation observes that excessive harvesting appears to be leading to a marked reduction in abundance of shell sizes in the local population. Considering that the open access fisheries can become overcapitalized (or over-exploited) if not properly managed, effort must be stabilized or possibly reduced. Limiting the number of entry into the fishery and setting quotas are some of the options that could be considered. It is necessary to institute

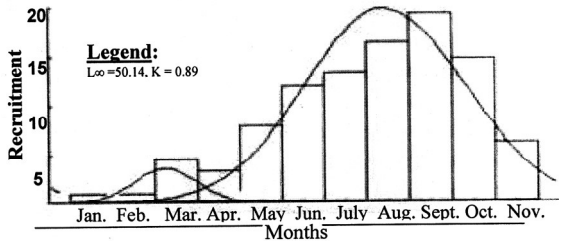

Figure 5. Recruitment pattern of *T. fuscatus* var *fuscatus* at Azuable.

Table 2. Summary of estimated mortality of *T. fuscatus* var *fuscatus.*

Stations	Z	M	F	E
Oba/Kalio	3.38	2.35	1.03	0.031
Abuloma	3.18	2.60	0.58	0.018
Okujagu	3.37	2.07	1.30	0.386
Azuabie	3.55	2.25	1.30	0.366
Mean	3.37	2.32	1.05	0.200

management procedures to avoid the collapse of the industry.

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