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A prelimenary study on the population estimation of the *periwinkles Tympanotonus fuscatus* (Linnaeus, 1758) and *Pachymelania aurita* (Muller) at the Rumuolumeni mangrove swamp creek, Niger Delta, Nigeria

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ABSTRACT

A study was carried out to estimate the populations of the periwinkles *Tympanotonus fuscatus* and *Pachymelania aurita* at the Rumuolumeni mangrove swamp creek in the Nigeria, Niger Delta sub-region. Weekly sampling of the gastropods was done and the capture mark-release-recapture method was used for the population estimation. The Lincoln index was used for the calculation of the total population. The results indicated that *T. fuscatus* was more abundant in the area than *P. aurita*. It was opined that since *P. aurita* was more susceptible to pollution than *T. fuscatus*, its reduced population density could be attributed to the activities of oil companies operating in the Niger Delta region and their attendant pollution of the brackish water ecosystem, in addition to reproductive failure resulting from climate change.

Key words. Population estimation, *T. fuscatus*, *P. aurita*, Rumuolumeni creek, mangrove swamps, Niger Delta.

INTRODUCTION

Periwinkles are shell fish found in the littoral region of the sea, brackish or estuarine waters which are seasonally submerged regions like the mangrove swamps. They are univalve gastropods of the phylum mollusca. The genera consist of *Tympanotonus Pachymelania* and *Merceneria*. The two species of Periwinkle commonly found in the estuarine habitat and benthos of the Niger Delta are *Tympanotonus fuscatus* and *Pachymelania aurita. T. fuscatus* occurs in the littoral habitat e.g. Mangrove swamps and *P. aurita* colonized the subtidal and mud beaches (Olaniyan, 1975, Dambo, 1985; Dambo 1993). The two species are morphologically different. *P. aurita* develops sharp spines, broader aperture, although the sharpness of the spines depends on the age of the organism; the older it becomes, the spines gets blunt and thicker. The genus *T. fuscatus* is characterized by turreted, granular and spiny shells with tapering ends. *T. fuscatus* tends to concentrate under the roots and decaying red mangrove trees and small collection of waters during low tide.

The genus Pachymelania is endemic to West Africa (Buchanan, 1954; Oyenekan, 1975). It is one of the commonest gastropod molluscs in the Lagos Lagoon (Ajao and Fagade 1990).

The ecology of the genus as related to changes in temperature, salinity and survival out of water under experimental condition has been documented (Oyenekan, 1979)

T. fuscatus and *P. aurita* are euryhaline and have the ability to tolerate a wide range of salinities between O.1mg/l to 25mg/l. (Jamabo and Chinda 2010).

The prosobranch grastropods are the most abundant and commonest molluscs in the brackish waters in West Africa (Nickles, 1950). Dekae (1987) stated that the factors that affect their distribution in the coastal areas of West Africa include salinity, water depth, currents and nature of bottom deposits. The two genera are commonly referred to as “periwinkle” in Nigeria. They inhabit the quiet waters where the substratum is rich in decaying organic matter and muddy (Jamabo and Chinda 2010). The periwinkles feed on the mud and other decaying organic matter. They are deposit feeders. Both genera are found in most brackish water creeks and mangrove swamps in the Niger Delta area at the intertidal zone.

The Periwinkle are estuarine snails and are found in the intertidal area of the mangrove edges and surfaces, therefore could be hand-picked (Dambo, 1993). Odum (1977) also reported that the mud surfaces in West Africa mangrove swamps are littered with periwinkles Moisev, (1971) confirm *T.*

fuscatus as primary consumers in the marine food chain. Periwinkles also make regular feeding excursions and trace paths back to their former ecological niches hence remains within a short distance for many weeks Oyenekan (1979) reported that *T. fuscatus* can survive for a long period in the absence of water, but only make use of their reserve food. The littoral *T. fuscatus* occurs abundantly in the intertidal regions and surfaces of mangrove swamps, concentrates on decaying organic matter and densely grown prop/breathing roots including small collection of water. Ajao and Fagade (1990) reported that the abundance of *P. aurita* at the Lagos Lagoon was related to silt-clay, total organic matter and the metal contents. They also observed that the greatest densities occurred at the site further from anthropogenic inputs of sewage and industrial effluents and in sediments containing 6-40% silt-clay.

Other fauna found associating with the periwinkles at the Rumuolumeni Mangrove swamp Creek and mud flat include the fiddler crab (*Uca tangeri*), the hermit crab *Clibernariu*s *spp* which occupy the empty shells of the periwinkles the blue or swimming crab *Callinectes latimanus*, the hairy mangrove crab *Sesrma huzardi* found crawling around the mangrove roots. The molluscs found on the roots of mangrove trees are the bivalve or mangrove oyster *Casostrea gasar* and the gastropod *Littorina angulitera* and the bloody clam *Anadara senilis* (Bob-Manuel, 2006). The mudskipper *Periophthalmus koelreuteri* is also found here. It is a gobid which swims like other fishes in addition to skipping, crutching and climbing (Bob-Manuel, 2011). The flora associated with this area include the red mangrove *Rhizophora racemosa, Rhizophora mangle* and the white mangrove *Avicennia africana*. According to Dambo (1985 and1993), *P. aurita* could be easily affected by pollutants than *T*. *fuscatus* due to the ability of the latter to contract faster and deeply up to ¾ into the shell. *T. fuscatus* also maintain a healthy condition in adverse periods due to factors yet to be established.

T. fuscatus tends to concentrate under the roots and decaying red mangrove trees and small collection of water during low tide. The population distribution of *T. fuscatus* is as a result of searching for blue-green algae for food and for shelter particularly during the low tide as well as the temperature exerted on the soil surface especially in the dry season. (Dambo, 1985).

The Periwinkles flesh is edible and also used as bait by fisher folks. They are rich in protein (about 21%), vitamins and minerals (Egonmwan 1980). The organism is also very medicinal for cases like endemic goiter due to its iodine content. The calcium, phosphate and iron content also recommend it for pregnant women. The periwinkle shell is grounded for several purposes such as powder for pimples, cleansing, (e.g vim for washing) as fertilizers, as calcium source in animal feed. (Grolier, 1980). Other uses include building construction, ornamentals and cosmetics.

These molluscs are important food delicacy among the riverine communities of the Niger Delta and an importance source of animal protein. In recent times, it has been observed that this mollusc are gradually vanishing from the market and becoming more and more expensive. The wild population of these two genera are disappearing alarmingly, and larger sizes are no more available in the market. Powell *et al* (1985) reported that the periwinkles were over exploited from the mangrove swamps in the Niger Delta. According to FAO/FIDI (1994) and Alfred-Ockiya (1999), the market demands for the periwinkles is very high. Jamabo *et al.* (2009) reported that the population of these species appear seriously reduced where they once flourished.

A number of literature exist on work done in Nigeria on the periwinkles (Egonmwan 1980, Dekae 1987; Ideria *et al*. 2005, Powell *et al.* 1985; Ansa 2005; Jamabo *et al* 2009; Jamabo and Chinda 2010; But none has considered the population estimation of these two genera that co-habit and relate closely in the mangrove swamps of the Niger Delta sub-region.

They are hand-picked from the wild at low tide without any effort at biodiversity conservation or to improve their natural beds or culture them in Nigeria. This study is therefore an attempt at estimating the population of the periwinkles in a selected habitat in the Niger Delta sub-region with a view to obtaining information about their relative abundance which is a pre-requisite for effective management, culture and conservation of this important fishery.

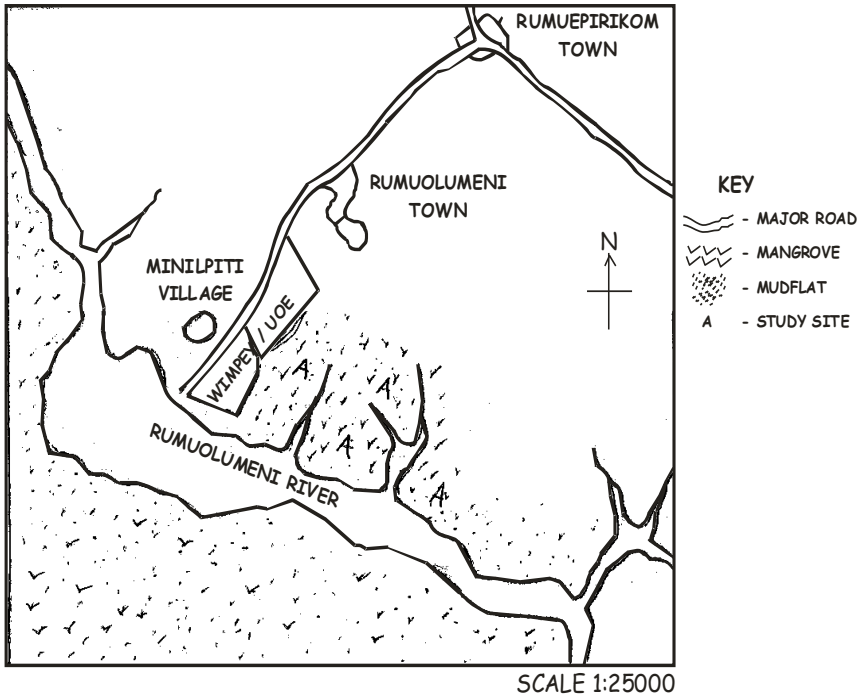

Fig. 1: Map of Rumuolumeni Creek showing the study site

MATERIALS AND METHODS

The study area covered the mangrove swamps of the Rumuolumeni creek which lies between latitude 4^0 45^1 – $4^0 50^1$ N and longitude $7^0 05^1$-$7^0 15^1$E (Fig. I). The creek is an offshoot of the New Calabar River. It is characterized by extensive mangrove swamps, tidal flats, influenced by semi-diurnal tidal regime (NEDECO, 1961). The salinity range between 1.2 and 23.3mg/l all year round (Jamabo and Chinda 2010). The climate of the area is sub-tropical with heavy rainfall, high temperature and relative humidity. The vegetation is characterized by thick mangrove forest dominated by the red mangrove, *Rhizophora racemosa* and *R. mangle*. There is also the presence of the white mangrove *Avicennia africana*. The low inter-tidal zone exposes the mud flats which is bare of vegetation but impregnated by peat, detritus and sand deposits.

The study site was an open natural mangrove swamp forest with mud flats (Fig. 1). To prevent immigration and emigration during the period of investigation, the study site was mapped out by cutting through the prop, stilt and breathing roots of the mangrove trees of the swamp forest. This was followed by improvised construction to restrict movement in and out of the study site by individual organisms.

Sampling method used was the capture mark-release-recapture method. This was used for estimating the population size. This method involves capturing the organism, marking it in some way without causing it any damage and replacing it so that it can resume a normal role in the population. This method was used for the population estimation of *T. fuscatus* and *P. aurita* at the Rumuolumeni mangrove swamp creek. A $1m^2$ quadrat was used. This was thrown randomly within the designated area to obtain the density per unit area. Periwinkles caught in each throw were identified and marked with a white water resistant paint and released back to the same experimental site to re-integrate with the population. This was done weekly for a period of eight weeks. Once every week the population was trapped again counted, and the population size estimated using the Lincoln index as presented below:

$$\text{Estimated total population} = \frac{\text{Number of organisms In initial sample} \times \text{Number of organisms in second sample}}{\text{Number of marked organisms recaptured}}$$

i.e. $N = \frac{an}{r}$

Where: N = Total population

a = Original number marked

n = Total of 2nd sample

r = Total recapture

Some of the precautions taken during the study using this method include:

1. Organisms mix randomly within the population
2. Sufficient time was allowed to elapse between capture and recapture to allow for random mixing.
3. Marking does not hinder the movement of the organisms or make them conspicuous to predators.
4. Changes in population size as a result of immigration emigration, birth and deaths are negligible

RESULTS

Table I gave the weekly Periwinkle samples collected during the study period.

Table 2 showed the estimated total weekly population using the Lincoln's index and the population density (per square metre) using a $1m^2$ quadrat. The results indicated that apart from wk 3 and wk 4 the populations of *T. fuscatus* was higher than those of *P. aurita* both in terms of estimated total weekly populations and the weekly population densities (Table 2).

Table 1. Samples of T. fuscatus and P. aurita collected and marked during the study period

weeks	**Total *T. fuscatus* marked**	**Total *T. fuscatus* unmarked**	**Total *P. aurita marked***	**Total *P. aurita unmarked***	**Total Quadrat thrown**
WK . I		1500 sample (Initial)		500 sample (Initial)	30
WK. 2	1100	500	100	100	”
WK. 3	1300	300	10	40	”
Wk. 4	1400	60	40	100	”
WK. 5	1500	100	80	70	”
WK. 6	1250	500	120	40	”
WK. 7	1450	500	30	50	”
WK. 8	2000	0.2	78	-	”

Table 2. Estimated total weekly Population and population density of *T. fuscatus* and *P. aurita* at Rumuolumeni during the study period.

			Population Density (m^{-2})	*Population Density* (m^{-2})
Weeks	*T. fuscatus*	*P. aurita*	*T. fuscatus*	*P. aurita*
Wk .2	2,182	1,000	72	33
Wk 3	1,846	2,500	62	83
Wk 4	1,562	1,750	52	58
Wk. 5	1,600	937	53	31
Wk. 6	2,100	667	70	22
Wk. 7	2,017	1,333	67	44
Wk. 8	1,501	500	50	16
Total = 12,808	8,687			

DISCUSSION

The result of the population estimation of the periwinkles at the Rumuolumeni mangrove creek indicated that *T. fuscatus* was more abundant in number than *P. aurita*. This is contrary to the findings of Ajao and Fagade (1990) who reported that large numbers of the gastropod *P. aurita* occurred in shallow shoal sands in the Lagos Lagoon and referred to then as one of the commonest gastropod molluscs in the Lagoon.

P. aurita could easily be affected by pollutants than *T. fuscatus* (Dambo 1985 and 1993). He also reported that *T. fuscatus* has the ability to contract faster and deeply up to three-quarter (3/4) into its shell and maintain a healthy condition in adverse conditions more than *P. aurita*.

Ajao and Fagade (1990) also observed that the greatest densities occurred in areas further away from anthropogenic inputs of sewage and industrial effluents.

The Niger Delta area is characterized by the activities of oil exploitation and exploration, resulting in regular population of the brackish water environment.

It is likely that the decline in the population of *P. aurita* at the Rumuolumeni mud flats as compared to *T. fuscatus* population may not be unconnected with the factors described earlier by Ajao and Fagade (1990) and Dambo (1985 and 1993).

Oyenekan (1979) reported that temperature among other factors affects the ecology of *P. aurita*. Dambo, (1985) also observed that the population distribution is affected by temperature exerted on soil surface during low tide and could therefore look for shelter. As a result of the global warming or green house effect in recent time it is possible that some of the *P. aurita* could avoid being exposed during low tide and could move down the subtidal zone. This view is further supported by the findings of earlier investigators that *T. fuscatus* occurs in the littoral habitat such as the mangrove swamps while *P. aurita* colonized the subtidal and mud beaches (Olaniyan, 1975; Dambo, 1993).

Investigation into the life-cycle of *P. aurita* population in the Lagos Lagoon showed that the gastropod had a definite breeding season which co-incided with the high salinity period (Ajao and Fagade 1990). It has been observed in recent times that due to climate changes, the high salinity period which co-incides with the dry season in the brackish water area (estuaries and Lagoons) is drastically reduced, since it rains in most part of the year in the Niger Delta. This is another factor that may have affected the production and recruitment of young ones into the population. Hence the paucity in numbers. Further investigation is required in the study of these two species with a view to creating the necessary conducive environment for their culture, avert their possible extinction and increase biodiversity conservation of this important fishery.

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