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A comparative study of the decomposition of *Rhizophora racemosa* and *Nypa fruticans* of the Great Kwa River, Cross River State, Nigeria

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Abstract

Mangroves are specialized marine ecosystem which is highly productive. They act as shelter, breeding and nursery grounds for a variety of marine and brackish water invertebrates and fishes. Some of the dominant plant species in mangrove vegetation of Nigerian coastline are Rhizophora species and Nypa fruticans. Studies were conducted on the decomposition of Rhizophora species and N. fruticans. The objective was to compare their decomposition rates and proffer informed management decisions. Decomposition rates of the two species were monitored for 112 days using litter box experiment. Eight litter boxes were stocked with 20g of leaves of each species and fortnightly two boxes containing the respective plants species were removed and examined for dry matter, carbon and nitrogen contents. There was no significant difference in the rates of decomposition of Rhizophora and N. fruticans leaves ($p \geq 0.05$) even though N. fruticans showed slightly higher rate of decomposition than Rhizophora. The linear relationship between the loss in dry matter and number of days were expressed as $Y = 10.1 - 0.080x$ in N. fruticans, and $Y = 9.0 - 0.073x$ in Rhizophora sp. It was concluded that the argument in favour of the eradication of N. fruticans for the thriving of Rhizophora is inaccurate. Containment of the population rather than control is the logical strategy for the management of the riparian vegetation in the face of climate change.

Keywords: Decomposition rates, Nipa palm, mangrove, ecosystem management.

Introduction

Mangroves are specialized and highly productive marine ecosystem. They act as shelter, breeding, feeding and nursery grounds for a wide variety of marine and brackish water invertebrates and fishes. In the Nigerian coastline, the two dominant species of mangroves are *Rhizophora spp* and *N. fruticans*. However in recent years, there has been an alarming deterioration in the population of *Rhizophora*. Various reasons advanced include the displacement of the native *Rhizophora* by the exotic *N. fruticans*. Holzoehner and Nwosu (1997) observed that near settlement along the Cross River Estuary, there were more of *N. fruticans* than *Rhizophora* and farther away where there was no settlement, there was apparent peaceful coexistence between the two species. They therefore concluded that the disappearance of the *Rhizophora* species was more anthropogenic in origin than competition with *N. fruticans*. Some authors have argued that *N. fruticans* is not useful and should be eradicated in order to give room for the thriving of *Rhizophora* (Moses 1985). Most of these arguments do not have strong scientific evidence.

It was the objective of this study to compare the dry matter content, the carbon and nitrogen content of the two dominant species of mangrove and to compare their decomposition rates in order to proffer informed management decisions of the riparian vegetation.

Materials and Methods

Great Kwa River is a tributary of the Cross River Estuary taking its origin from the Oban Hills in Akamkpa Local government of Cross River State, Nigeria. Located between latitudes 4^0 45' and 5^0 15'N and longitudes 8^o 15' and $8^0$30'E, the river is 56 km long and 28km wide at the mouth where it empties into the Cross River estuary. The description of the hydrology and the vegetation of the Area is given by Okorafor, et al. (2012). The decomposition rates of *Rhizophora sp* and *N. fruticans* were monitored through litter box experiment. Approximately 20g of leaves of *Rhizophora* and *N. fruticans* were placed in boxes covered with netting material of about 1mm mesh size. Eight of such boxes contained *Rhizophora* leaves and 8 contained *Nypa* leaves. The boxes were placed at the intertidal zone of the Great Kwa River tied to mangrove roots to avoid being washed away by tidal waters. Another set of leaves with the same weight was oven- dried to constant to get the dry matter weight of the fresh leaves. The dry matter was weighed using sensitive electronic balance, model PM- 2000. The value of the dry matter was used as the starting point to monitor the decomposition of the leaves. At a fortnightly interval, a box containing the leaves of each of the species was removed and its contents washed to remove debris and mud particles. The decayed leaves were oven- dried to constant weight and the dry matter, carbon and nitrogen contents were determined. The experiment was run for 112 days. Organic carbon contents of the leaves was ascertained using 2g sample and by the dichromate wet oxidation method of Walkley and Black as outlined by Jackson (1969). The total nitrogen content of the leaves was determined using modified macro-Kjedahl method (Jackson, 1969).

Results and Discussion

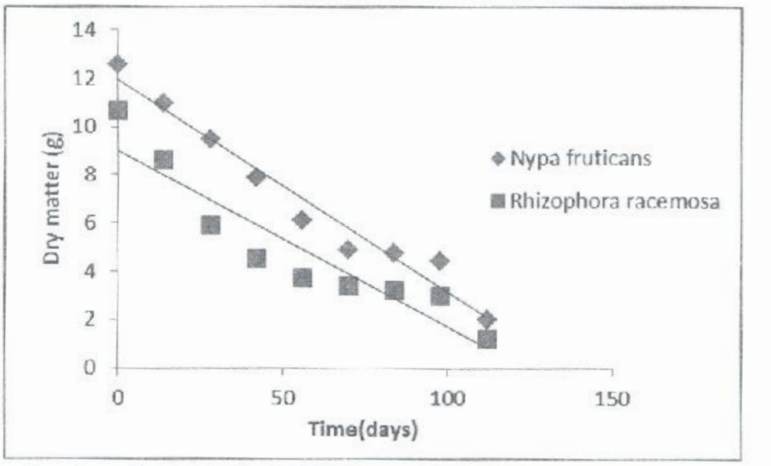

Fig. 1: Linear regression showing the rates of decomposition of two mangrove species *Rhizophora sp.*

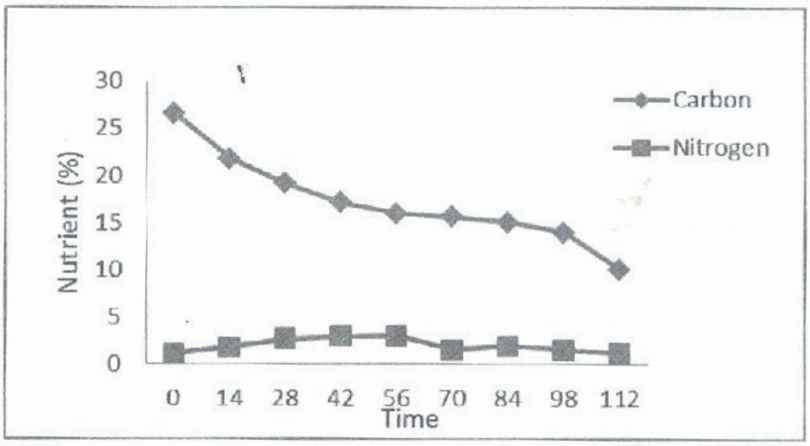

Fig. 2: Carbon and Nitrogen levels in decomposing leaves of *R. racemosa.*

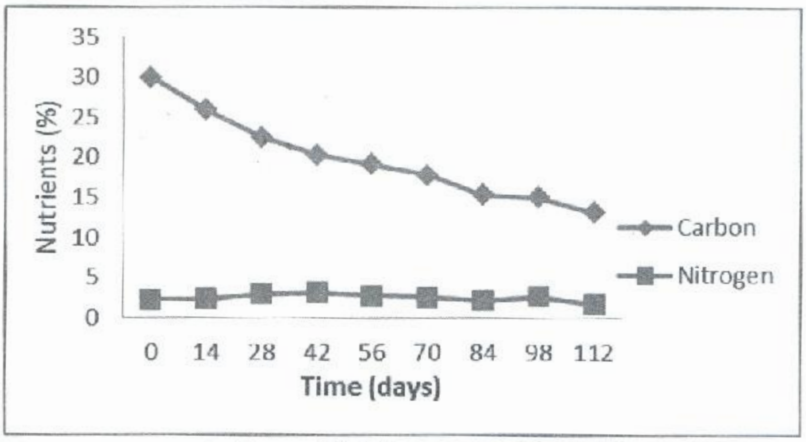

Fig. 3: Levels of carbon and nitrogen in decomposing leaves of N. fruticans.

The initial dry matter weight of *Rhizophora* was 10.70g while that of *N. fruticans* was 12.54g. The initial nitrogen was 2.26% and 1.12 % for *Nypa* and *Rhizophora* respectively. The organic carbon was 29.99 % and 26.62 % for *Nypa* and *Rhizophora* respectively. Fig. 1 shows the linear regression between the number of days and the dry matter loss as the experiment progressed. The dry matter was getting reduced signifying that part had been lost to the sediment through decomposition. As seen by the graph, decomposition progressed at a faster rate at the onset of the experiment as shown by the steep slope of the regression line, but slowed down in *Rhizophora* after the first sixty days but in *N. fruticans* it slowed down twelve days later, before finally dropping sharply again at the end of the experiment. The carbon level followed the same pattern as the dry matter loss (Fig 2). However, the nitrogen level rose during the first 56 days in *Rhizophora* while in *Nypa* it rose the first 42 days before declining to steady level till the end of the experiments (Fig 3). The linear regression model between the number of days and the dry matter loss was expressed as, $Y=9.0-0.073x$, in *Rhizophora* and $Y= 10.1-0.088x$, in *N. fruticans*. A student t-test distribution revealed that there was no significant difference between the rates of decomposition of *Rhizophora* and *N. fruticans* even though *N. fruticans* decomposed very slightly faster than *Rhizophora* ($p\geq0.05$, $n=8$).

The fact that the dry matter, carbon and nitrogen contents per unit gram of fresh leaves of *N. fruticans* were higher than that of *Rhizophora* shows that *Nypa* is richer in nutrients and biomass than *Rhizophora*. The initial faster rate of decomposition is due to high density of decomposers particularly bacteria and fungi. The decrease in the rate of decomposition later in the course of the experiment is as a result of the reduction in the density of these decomposers. Rajendran and Kathiresan (2007) reported that density of decomposers are much from the early days of decomposition and thereafter declines. They observed that both bacteria and fungi decreased in density towards the end of their experiment. Thus our work confirmed that earlier observation. The initial increase in the level of nitrogen before the drop is as a result of nitrogen fixing bacteria that colonized the leaves before the final decay Shunula and Whittick, (1999) made a similar observation. Akpan–Idiok and Solomon (2012) listed four autochthonous bacteria responsible for the decomposition of leaf litter in the mangrove swamp soils of the Cross River estuary to include *Pseudomonas sp*, *Micrococcus sp*, *Streptomyces sp* and *Bacillus sp*.

Given the rate of decomposition and reduction in carbon and nitrogen in *Nypa* compared to *Rhizophora*, *Nypa* is bound to contribute more to the fertilization of the sediment in the event of leaves litter. Therefore the assertion that Nipa palm is unproductive is incorrect. Udoidiong and Ekwu (2011) discovered that *Nypa fruticans* does not adversely affect epibenthic fauna species richness but, rather it increases species richness through habitat heterogeneity. It is the richness in dry matter and nutrient that probably attract many epibenthic fauna to *N.fruticans* as observed by Udoidiong and Ekwu (2011).

Conclusion

In conclusion the argument that *Nypa* palm should be eradicated because it is not beneficial to the ecosystem is inaccurate and lacks scientific proof. The containment of the *Nypa* population rather than control should be seen as the logical strategy in the management of the mangrove vegetation of the Great Kwa River and indeed other mangrove wetlands in the coastal communities of the country. This will enhance the conservation of the biodiversity of the coastal waters and check coastline erosion in the face of flooding occasioned by climate change.

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