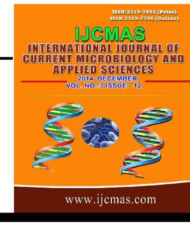

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Original Research Article

Girth class distribution analysis of some tree species in the parklands of North-Western Katsina State, Nigeria

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A B S T R A C T

The girth at breast height (GBH) of individuals of the six selected tree species was sampled and measured on fifty four sample plots (100m x100m in size) spread across eighteen village communities in three localities of north-western Katsina State, Nigeria. Using direct field measurements and collecting data through Tree Inventory Forms I analyzed the girths of the 335 selected trees in the parkland landscape by categorizing them into four girth classes and applying one-way ANOVA to show variation in their GBH. The results suggest that there are differences in the girth classes of the selected trees in the area which shows three main patterns; normal distribution, reverse J-shape and J-shape. Most of the individual members of these tree species belong to moderate and fairly big girth classes with less saplings and young trees including the bigger diameter ones suggesting a very low regeneration status. Results of the one-way analysis of variance also show that there are significant variations between the means of the selected trees GBH indicating a significant difference in selected tree girths in the area. There is need to improve the system by which the selected tree seedlings will continue to be distributed to the smallholders in the rural communities in order to encourage them to grow these trees.

Keywords

Selected trees, sample plots, ANOVA, GBH, Saplings, Katsina

Introduction

The interaction between disturbances, succession processes and forest regeneration is responsible for the size and age distribution of trees (Kuuluvainen *et al.*, 2002). Human-related disturbances that tend to affect tree sizes in dry land include grazing by ruminants such as livestock, annual bush fire events, clear-cutting and trampling by both people and animals. This particularly affects seedlings, saplings and other young trees. It is this class that provide the necessary regeneration potential and hence stability of an ecosystem. Lemenih (2011) has added that adequate regeneration status make it possible for the occurrence of sustainable forest management. A study of boreal forest landscape in Vienaansalo wilderness in Russian Karelia by

Kuuluvainen *et al.* (2002) have revealed that the most abundant trees were the smallest ones while tree density reduces gradually towards the bigger trees.

In the more natural forests the size classes of the trees tend to have lots of saplings and younger trees. However in the more managed agricultural landscapes of dry lands trees tend to be towards medium and bigger ones obviously due to human disturbances of the former and protection of the latter especially in on-farm situation. The occurrence of bigger size classes in agroforestry landscapes connotes more protection of the trees since they are allowed to grow without much disturbance. This condition however does not allow much regeneration and therefore depicts an unstable situation in which saplings and young trees were not allowed to grow up to matured ones to allow for more ecosystem restoration. Trees with high socio-economic value to people are usually the ones left standing on farms as a way of conserving them when forest areas are converted into farming systems as a result of expanding agricultural lands (Kakai *et al.*, 2011; Lemenih, 2011; Bounkoungou, 2009; Teklehaimanat, 2004).

This study deals with six selected indigenous tree species which include *Anogeissus leiocarpus* (African Birch), *Balanites aegyptiaca* (Desert Date), *Faidherbia albida* (Winter Thorn), *Khaya senegalensis* (African Mahogany), *Parkia biglobosa* (African Locust Bean) and *Vitellaria paradoxa* (Shea Butter). Empirical studies on these selected tree girth distributions (size structures) in the study area are very scarce or even nonexistent and information to that effect has been much less examined. The major purpose of this study thus was to describe the variability in the selected trees girth class distributions found within the savannah parklands in three localities of north-western Katsina State, Nigeria.

Materials and Methods

Location of the study area

The study location comprise Batsari, Kurfi and Jibia – Local Government Areas (Figure 1) that spans an agro-ecological landscape with a range of site types that fall within latitudes 12^{o} 30' North and 13^{o} 06' North of the equator and longitudes 7^{0} 15' East and 7^{0} 30' East of the Greenwich Meridian. It is within these three localities that the actual study sites or communities were situated (Figure 2). This Sudano-Sahelian area lying in the North-Western part of Katsina State in the extreme north of Nigeria extends for some 80 km from west to east and 100 km from north to south. The cumulative land area of this sampled area is 2,716 km^2 representing about 10 % of the state's total land mass. Its combined population is about 496,307 people (NPC, 2006). The proximity of the area to the Sahara desert to the north makes it to have biophysical constraints like low and unpredictable rainfall.

Sampling technique

Eighteen rural communities were selected using stratified random sampling method ensuring that samples spread over the three administrative units. Here the three Local Government Areas have served as the strata and within each stratum, random sampling took place so that each locality was accorded certain number of communities based on its proportional geographical area thus Batsari has eight, Kurfi has four while Jibia has six rural communities each altogether making eighteen from which fifty four quadrates (100m x 100m) were also selected using stratified random sampling based on proportional sampling scheme where the number of quadrates in each of the stratum is proportional to the size of the stratum. Three sample plots were established around each of the selected community.

Fidelibus and Mac Aller (1993) have agreed that in a study site quadrates can be established regularly, subjectively or randomly. The reason for choosing this number of quadrates is also because of the size of the area as well as cost consideration and convenience. Strahlgren et al (1997, p. 1064) also added that “only a small portion of any landscape can be sampled for vascular plant diversity because of constraints of cost (salaries, travel time between sites, etc.)”. One may stress that Kindt and Coe (2005) have argued that the issue of choosing a standard or common sample size in any place is not hard and fast.

Data collection and analysis

Each quadrate was established near the selected communities using measuring tape and ranging poles. For the inventory of the selected trees, transects were laid across different land uses and made to run from each of the eighteen selected communities. Three quadrates were established at random positions along both sides of each transect. In each quadrate, the girth at breast height (GBH) i.e. 1.37m from the ground of individual trees of the six selected tree species was directly measured using the 100 meter measuring tape wrapped around the tree stem and the diameter is measured (in meters) and recorded until all the 335 selected trees in the quadrates in the study area were covered. This is with a view to defining the trees diameter into four girth classes, small (GBH<1m), moderate (GBH 1-1.99m), big (GBH 2-2.99m) and very big (GBH >3m).

One-Way Analysis of Variance (ANOVA) was also employed in order to test the hypothesis that there is no difference (equal means) in the selected trees GBH. It basically compares two or more means in a situation where there is only one independent variable which is the means of the selected trees (GBH) in this case.

Results and Discussion

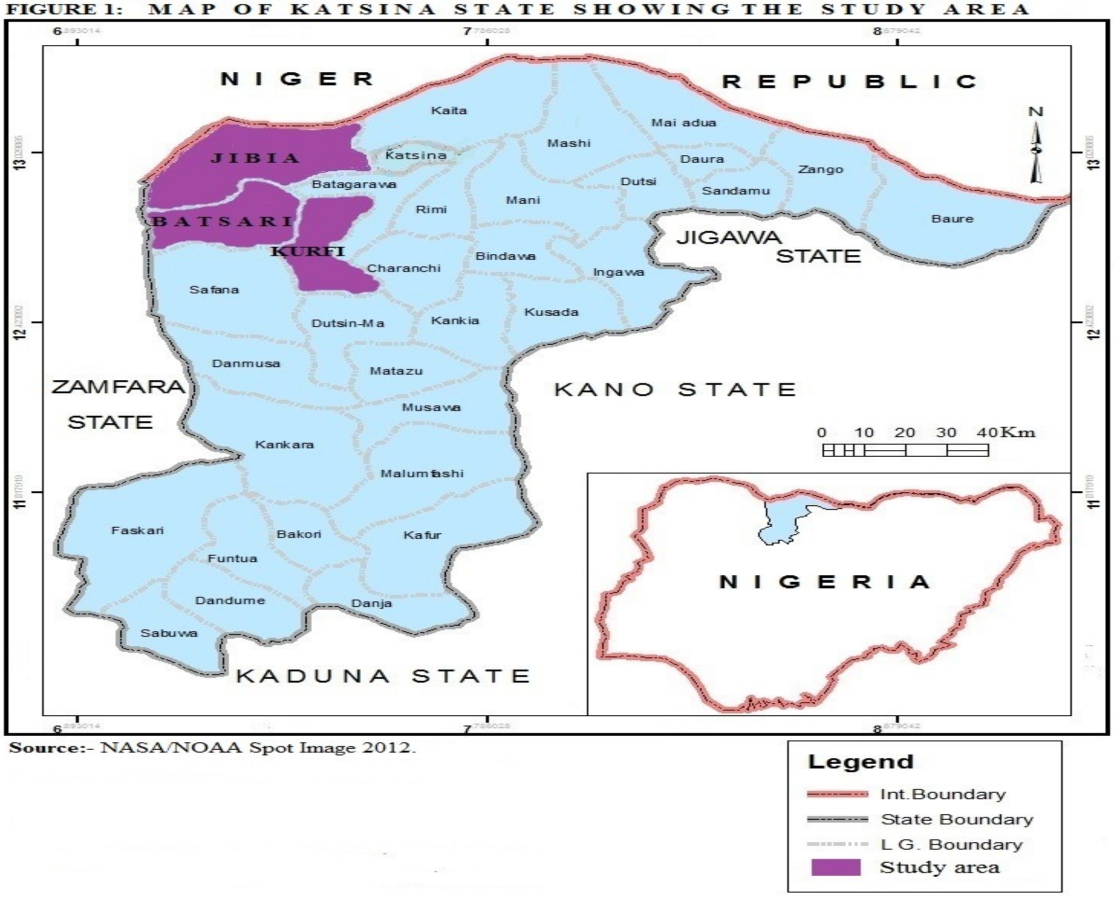
Figure 3 shows that generally, there is higher density of more mature stems and lower density of smaller stems including seedlings and saplings of the selected trees in the area. The outcome has gone contrary to Shackleton (2000); Luoga *et al.* (2004) and Mlambo and Huizing (2004) reported in Shackleton *et al.* (2005, p. 282) that “the high density of small stems is also a result of the high capacity of savanna trees to regrow after chopping via coppice stems”. This is probably due to human disturbance as the seedlings tend to be destroyed from trampling by people and livestock as well as other unfavorable effects.

The Girth Class profiles of the selected trees followed three patterns namely a normal distribution, reverse J-shape and J-shape. The tree species *A. leiocarpus* followed almost a normal distribution curve with less trees belonging to smaller and big GBH classes than moderate to fairly big GBH classes suggesting a fairly stable population. A reverse J-shaped curve for *B. aegyptiaca* and *F. albida* which depicts more of the characteristics of a stable population is found. In both tree species, there is larger proportion of recruits or smaller GBH class to moderate GBH class than fairly big to big GBH classes which in the case of *B. aegyptiaca* does exist as the tree hardly grows to bigger GBH classes.

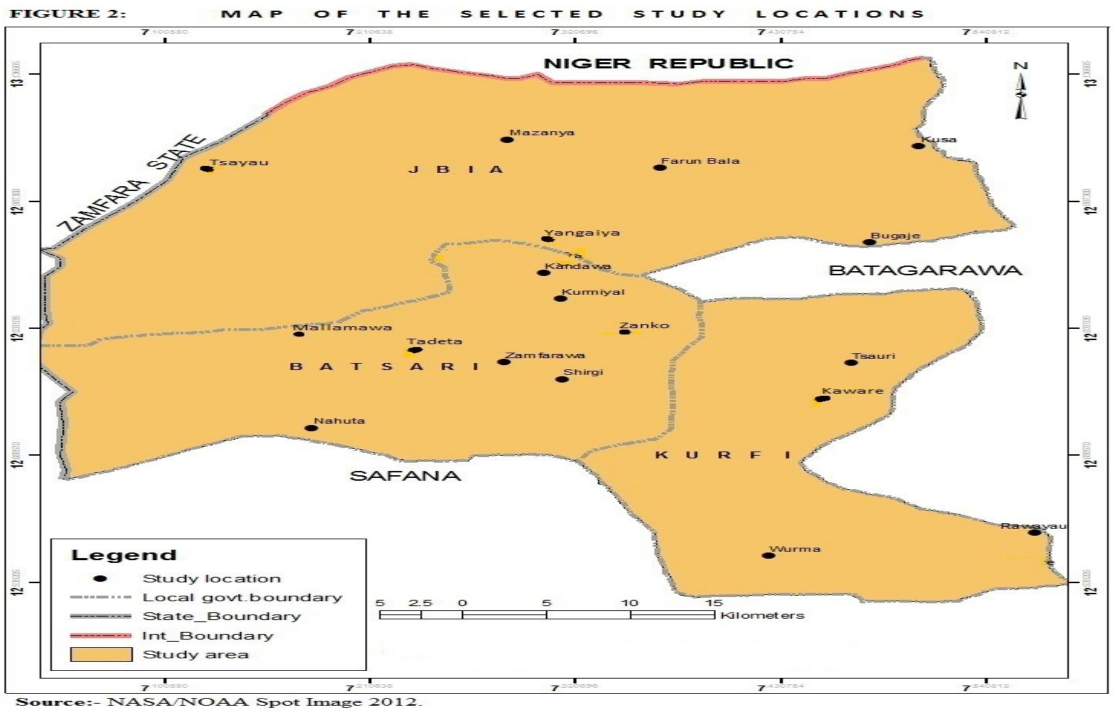
This suggests that the population of these trees is more stable and is capable of regenerating to mature trees under favorable conditions. Lemenih (2011, p. 33) buttressed this point by saying that "under normal regeneration conditions, the population structure should show an inverted J-shape, with a higher density of lower diameter classes than of higher diameter classes". A J-shaped curve exists for *P. biglobosa* and *V. paradoxa* tree species which depicts the characteristics of an unstable population as there were very few or no trees in the smaller GBH Class. *V. paradoxa* tree seeds are reportedly difficult to germinate. This categorization of the selected trees according to GBH tells something about the trees stand structure, their level of exploitation as well as regeneration (Omeja et al, 2004).

Results of the one-way analysis of variance indicated a significant difference in tree girths based upon their GBH measurements by comparing the calculated F value (48.8948) with the tabulated F value (2.39) at 95% level of significance and 1 degree of freedom. We therefore reject H_0 and accept H_A hypothesis which says there is a significant difference in tree species GBH in the study area. Further information has also shown that the GBH means of the selected trees have two groups with equal means; one group involves *Vitellaria paradoxa* and *Parkia biglobosa* and the other one *Anogeissus leiocarpus, Faidherbia albida* and *Balanites aegyptiaca.*

FIGURE 1: MAP OF KATSINA STATE SHOWING THE STUDY AREA



Source:- NASA/NOAA Spot Image 2012.



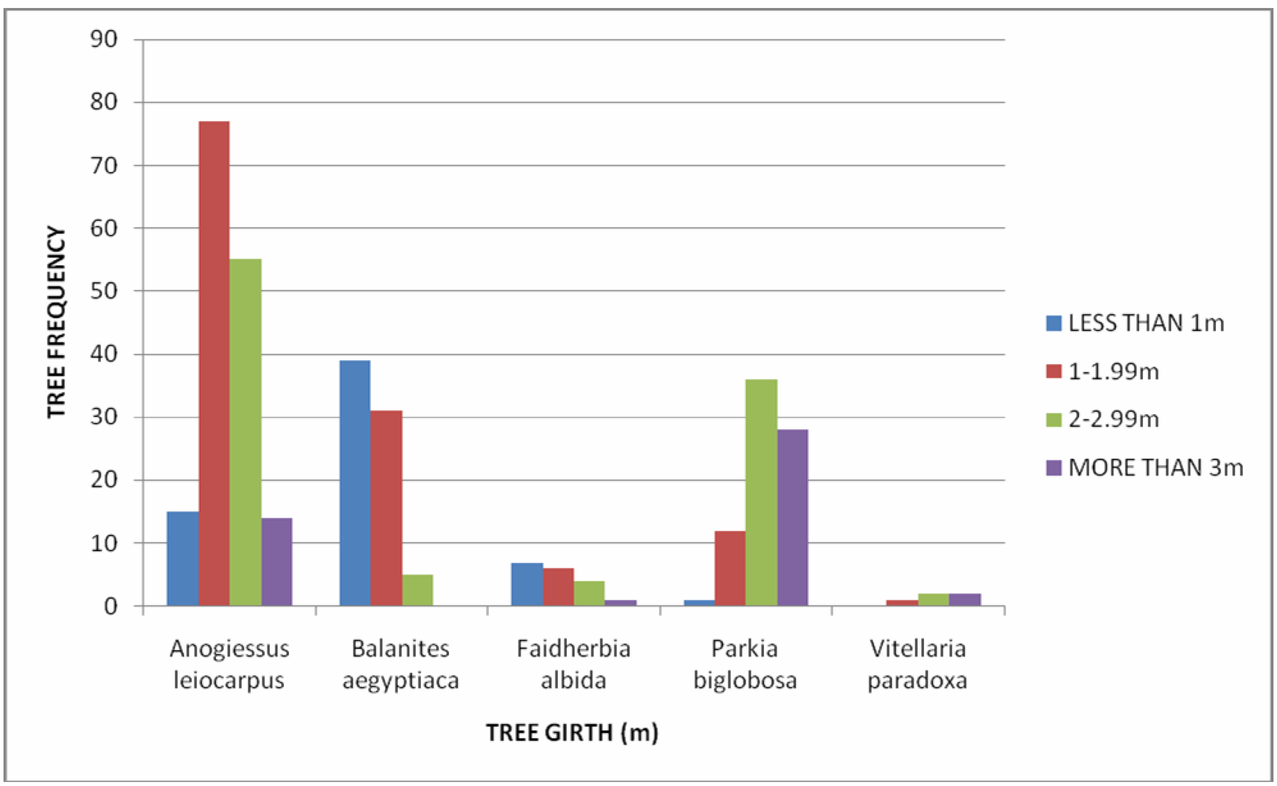


Figure.3 Girth class profiles of the selected tree species in all sample plots

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