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Autoecological study of *Ricinodendron heudelotii* (Baill) Pierre et Pax. in Agulli forest

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ABSTRACT

Autoecology seeks to explain how, or to what extent species are regulated in nature, why some are common, others, rare, and why some remain relatively rare over many consecutive generations. Timber and non-timber resources have suffered serious decline due to unregulated exploitation. More than 11million hectares of mature tropical forest are converted into agricultural, pasturelands, and other land uses every year threatening the existence of species of ethnoforestry importance such as *Ricinodendron heudelotii.* Two sites of land were demarcated in *Agulli* Forest Reserve, Menchum Division of Cameroon. Each site had 20 subplots of 20 m x 25 m, mapped out systematically. This study aimed to investigate the stem density (D), frequency (F), cover (C), and the regeneration potential (RP) of *Ricinodendron heudelotii.* The t-test was carried out to determine the differences for independent variables of each site. D, F, C and RP for *Ricinodendron* tree stands at both sites were not significantly (p>0.05) different.

Keywords: Autoecology, *Ricinodendron,* regeneration potential, ethnoforestry, status.

INTRODUCTION

The importance of the forest and its product to the well being of the adjoining communities cannot be overemphasized. However, most natural forests which are the primary sources of these products have either been completely lost or seriously degraded. There is an urgent need to protect the remaining forests and to preserve the traditional knowledge associated with their uses (Okafor and Hamm, 1999).

Yandji (1999) defined NWFPs as all the resources or products derived from forests except wood. However, identification of these products is based on the part of the tree being used. Tchoudjeu and Atangana (2006) identified *Ricinodendron heudelotii* as a NWFP. It is found in central, western and southern Africa, occurring typically as a species of the fringing, deciduous and secondary forests, common throughout the semi-dry, wooded savannah zone, where it is scattered in gaps at forest edges and in secondary scrub and thickets (ICRAF, 2004) due to forest fragmentation. In Cameroon, it grows in secondary forests (Vivien and Faure, 1985) at altitudes ranging from 130 to 1030m above sea level (Fondoun et al., 1998). It is distributed especially in the forest zone (Southern Cameroon), excepting mountain forests. In the Northwest Region of Cameroon, it is found in the Menchum River Valley area (pers. Comm.).

Ricinodendron heudelotii belongs to the Euphorbiaceae family (Vivien and Faure, 1985; Tchoudjeu and Atangana, 2006). It is a large deciduous tree reaching 45 m high and 1.5 m in diameter. The crown is spherical, with much branched verticillate and horizontal branches (Souane, 1985). The bole is often straight, sometimes sinuous or twisted, cylindrical, enlarged and sometimes channelled at the base (Shiembo et al*.,* 1997).

A socio-economic survey by Foundon et al. (1999) reveals that this plant species is put into four main usage categories which are consumption, medicinal, sociocultural and soil fertility improvement. For consumption, Shiembo (1994) reports that the cotyledons are sought-after as ingredients for soups and used to supplement a wide variety of dishes. As a medicinal commodity, the bark, roots and leaves are extracted and steeped overnight in boiled water resulting in a yellow decant which if consumed as an infusion, can cure stomach pains, malaria, or to ease delivery for pregnant women (Fondoun et al*.,* 1999). The bark is also used to treat elephantiasis while the dried bark is used to ferment palm wine and the latex and leaves used as purgatives (Abbiw, 1990). The socio-cultural use of this tree is at the level of the dried stony seeds in many traditional games such as the local 'drou' game commonly called "songho", and at the level of its wood which is carved into antiquities and drums (Shiembo, 1994). Most farmers intentionally leave or spare this tree on their cocoa plantations as well as on cocoyam and plantain farms as a shade tree and also for soil fertility improvement. Most farmers indicated that cocoyam (*Xanthosomonas sp.)* and plantain (*Musa sp*) cropped in the vicinity of *Ricinodendron* trees give better yields (Fondoun et al., 1999). The large crowns of njangsang trees protect soils and crops from the sun, pounding rains and strong winds, especially in savannah zones (Anigbogu, 1996).

The cotyledons of *Ricinodendron* commonly called njangsang are a major source of income not only at the local and national levels but also at the international level where it acts as foreign exchange earner to Cameroon and other neighbouring countries in Central African States. Ndoye et al. (1998) observed that in the humid zone of Cameroon, the sale of NWFPs like *Dacryodes edulis, Irvingia sp, Cola acuminata* and *Ricinodendron heudelotii* amounted to at least \$1.75 million in the first half of 1995. They also observed that more than 1,100 traders mainly women were engaged in the distribution of these products. The cotyledons are processed in laboratories (Tchiegang et al., 2005) and a degree of crude processing by farmers to produce edible oil used in the manufacture of soap and varnish (Ekam, 2003). The iodine and saponification values also point to the potential of the oil in paint and cosmetics.

Most of the studies on *Ricinodendron* are based on the major production areas (Ndoye et al., 1998; Tchoundjeu and Atangana, 2006). Fondoun et al. (1999) adopted the use of questionnaires in their inventory in the open areas of southern Cameroon. Little is known on the ecological status in some production areas of savannah regions notably Agulli forest reserve in the Menchum Valley subdivision of Cameroon. *R. heudelotii*, just like other species in *Agulli* and other secondary forests in Cameroon, is becoming endangered (pers. Comm.; Tchoudjeu and Atangana, 2006). The stands within the forest are declining; those in the open areas of villages are not fruiting (pers. comm.) thus, heightening the fear of its extinction and making pertinent its conservation. There are no strategies set for any *in situ* and *ex situ* improvement of this species in this community. Sustainable management options for this species are necessary so as to curb over-exploitation leading to extinction.

It is thus in this light that investigations on some autoecological parameters such as the stem density (D), frequency (F), Cover (C), and the Regeneration Potentials for *R. heudelotii* were carried out in Agulli Forest Reserve.

MATERIALS AND METHODS

Study area

Figure 1 shows the distribution of *R. heudelotii* in Cameroon. This study was limited to the Wum forest of Menchum Division found in the Northwest Region of Cameroon. This division has its headquarter in Wum, which is 77 km from Bamenda, the headquarter of the Northwest Region (Ministry of Forestry and Wildlife, 1999) and has several village communities some of which lie along a river valley.

This River Valley Community shares boundaries with Wum Central Subdivision to the North, Akwaya Subdivision to the Southwest, the Federal Republic of Nigeria to

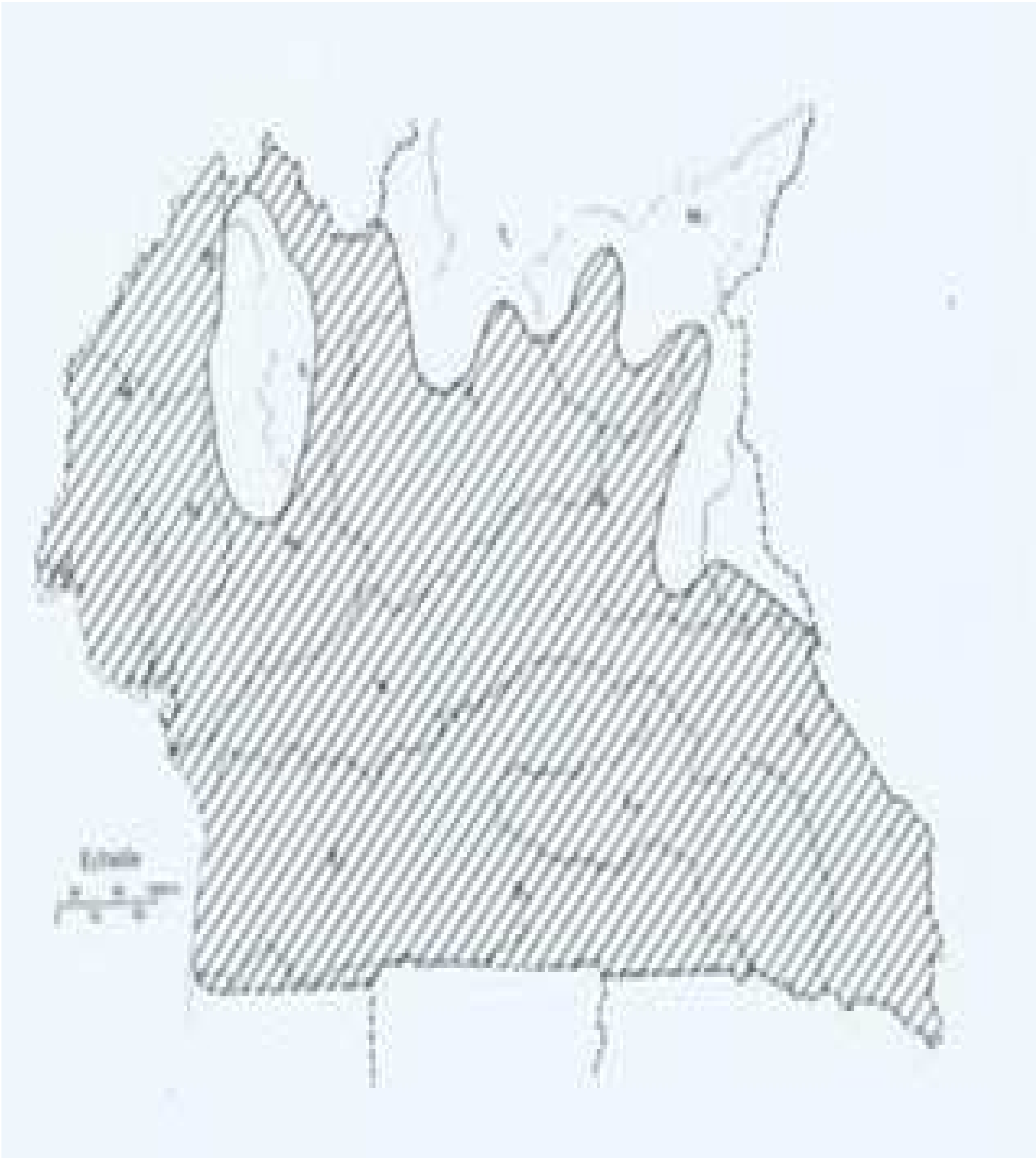

Figure 1: A map showing the distribution of *R. heudelotii* in Cameroon.

the West, Njikwa Subdivision to the South and the Bafut Subdivision to the East. It lies between longitude 9°10' and 10°20' East and latitude 6°10' and 6°31' North (MINFOWI, 1999). Some villages found this river valley include Befang (700 m.a.s.l), Agulli (700 m.a.s.l), Modele (400 m.a.s.l), Benakuma, Mukurou, Beba and Okoromanjang.

This Wum forest is about 89.24 ha (MINFOWI, 2003) and shares its boundaries with notably Agulli, and Bu. The forest edge of Agulli is bordered by vast acres of rice farms and human settlements. The mean annual temperature is between 17.6 ºC and 30.5 ºC, while the total annual rainfall per year is about 2,043.7 mm (IRAD, 1988).

Site preparation

Two major plots were demarcated for this study. One hectare each of 100 x 100 m was mapped out at the edge and interior of Agulli forest. The major plot at the edge was demarcated along the rice farms and forest trees mosaic while demarcation of the major plot in the interior was further into the forest, about 1 km away from the first plot. Each of these was later subdivided into 20 minor plots of 20 m x 25 m. From the major plots, all the trees having girths or circumferences of 30 cm and above at diameter at breast height were measured using a tape calibrated in cm. This data was used to calculate the following parameters in the minor plots;

(i) The Density of *Ricinodendron heudelotii*,
(ii) The Frequency,
(iii) The Relative Cover, and
(iv) The Regeneration potential.

Density

This was taken to be the number of *Ricinodendron* trees per hectare (Barbour et al., 1987). The number of trees were counted for each minor plot and recorded, giving the data for 20 minor plots respectively. This data was used to calculate the relative density of this species for each major plot using Colinvaux (1986) formula respectively.

Frequency

This was determined by assessing the number of minor plots containing *Ricinodendron* trees for each hectare (Chapman and Reiss, 1995) and converted to percentages to get the relative values for each major plot.

Relative cover

This was determined by using a calibrated tape and measuring the circumferences of each stem of *Ricinodendron* present in each minor plot and converting these values to percentages to obtain the relative values per major plot (Collinvaux, 1986).

Regeneration potential

In this study the regeneration potential was assessed based on the size classes of the *Ricinodendron* trees. The twenty minor plots of each major plot were used. The minor plots with *Ricinodendron* trees were noted. The circumferences at breast height of each tree were measured and recorded under respective size classes based on Igor et al. (2000) model. The null hypothesis considered was that a higher number of seedlings with respect to the other growth stages indicate a low and insignificant regeneration potential (Udah, 1995). The alternative hypothesis was that regeneration potential was significant if there were a lower number of seedlings.

The size classes were as follows:
Class 1 -------------- 10 to 50cm,
Class 2 -------------- 51 to 100 cm,
Class 3 -------------- 101 to 150cm,
Class 4 --------------- 151 to 200cm,
Class 5 --------------- 201 to >250cm.

Data analysis

Data collected for the density and cover were analyzed respectively by t-test for independent samples to compare any differences between major plots 1 and 2. Histograms were drawn using the frequency values obtained to compare relative frequency values of *Ricinodendron* trees at the edge and the interior major plots. The t-test was also used to analyze the data for regeneration potential in order to determine any differences in the regeneration potentials of *Ricinodendron* in major plots 1 and 2.

RESULTS

Density

The values for the Relative Density of *Ricinodendron heudelotii* at the edge and interior were; 19.7% and 15.6% respectively (Table 1). The t-test for the independent variables showed that there were no significant differences ($t = 5055$; $df = 38$) in the density values between the major plot 1 at the edge and major plot 2 in the interior at $p>0.05$.

Frequency

Species frequency of *Ricinodendron heudelotii* for the edge was 15% and for the interior, 10%. Relative frequency was 1.22% for plot 1 and 0.44% for plot 2.
Figure 2 shows the histogram for the relative frequency for plots 1 and 2.

Relative cover

Table 2 shows the Relative Cover values for edge and interior major plots. The t-test analysis indicated that there were no significant differences ($t = 14$; $df = 38$) for Relative Cover among the independent samples at $p >0.05$.

Table 1: Density values of *R. heudelotii* for egde and interior of forest (trees per hectare).

Quadrates	**1 (edge)**	**2 (interior)**
1	0	0
2	0	0
3	7.0	0
4	0	0
5	7.0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	4.0
15	0	5.0
16	0	0
17	0	0
18	6.0	5.0
19	0	0
20	0	0

* t-test for independent samples indicate no significant difference at p>0.05.

Table 2: Cover values of *R. heudelotii* for edge and interior of forest (trees per hectare).

Quadrats	1 (edge)	2 (interior)
1	0	0
2	0	0
3	21.0	0
4	0	0
5	5.0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	10.0
15	0	15.0
16	0	0
17	0	0
18	14.0	11.0
19	0	0
20	0	0

* t-test for independent samples indicate no significant differences at p>0.05.

Regeneration of *R. heudelotii* in Agulli forest

Studies on regeneration potentials of *Ricinodendron* showed that there were no seedlings, no saplings, 1 pole, and 2 mature trees at the edge; while in the interior, there were no seedlings, no saplings, no poles but 2 mature trees (Table 3).

The t-test reveals that there were no significant differences ($t = 0.361$; $df = 6$) between the two plots at $p>0.05$.

DISCUSSION

Considering human interferences at the edge of Agulli owing to cultivation of rice, one would have expected parameters of plot 1 to be significantly lower than those of plot 2. Also, owing to the fact that most or almost all the fruits are picked up at time of harvest within plot 1 relative to plot 2 which is further away from immediate human influence, one would have observed these values to differ with density, frequency, cover and regeneration potential, higher in the interior.

It can however be deduced that environmental factors such as more light at the forest edge and a lesser intensity and quality in the interior could influence these insignificant values (Nwoboshi, 1982). It can thus be assumed that, *R. heudeloti,* being a heliophyte growing in secondary forest (Doucet and Koufani, 1997; Ayuk et al., 1999; Fondoun et al., 1999; Tchoudjeu and Atangana, 2006), would have significantly higher values in plot 1 than in plot 2. This was not the case, as evidenced by no significant differences between the two in their D, F, C, and RP values. It was also expected that because of more light at the forest edge, more saplings, poles, and mature of *R. heudelotii* would be available, and more seedling buried in the understory, in the interior. This was not the case.

Thus going by the assessment of Udah (1995) that a higher proportion of seedlings compared to the other developmental stages of trees indicate a low and insignificant regeneration potential for a species, and vice-versa, we can thus reject the null hypothesis in Agulli forest because there were no significant differences. Most of the stands found were mostly mature trees indicating that the regeneration potential is high.

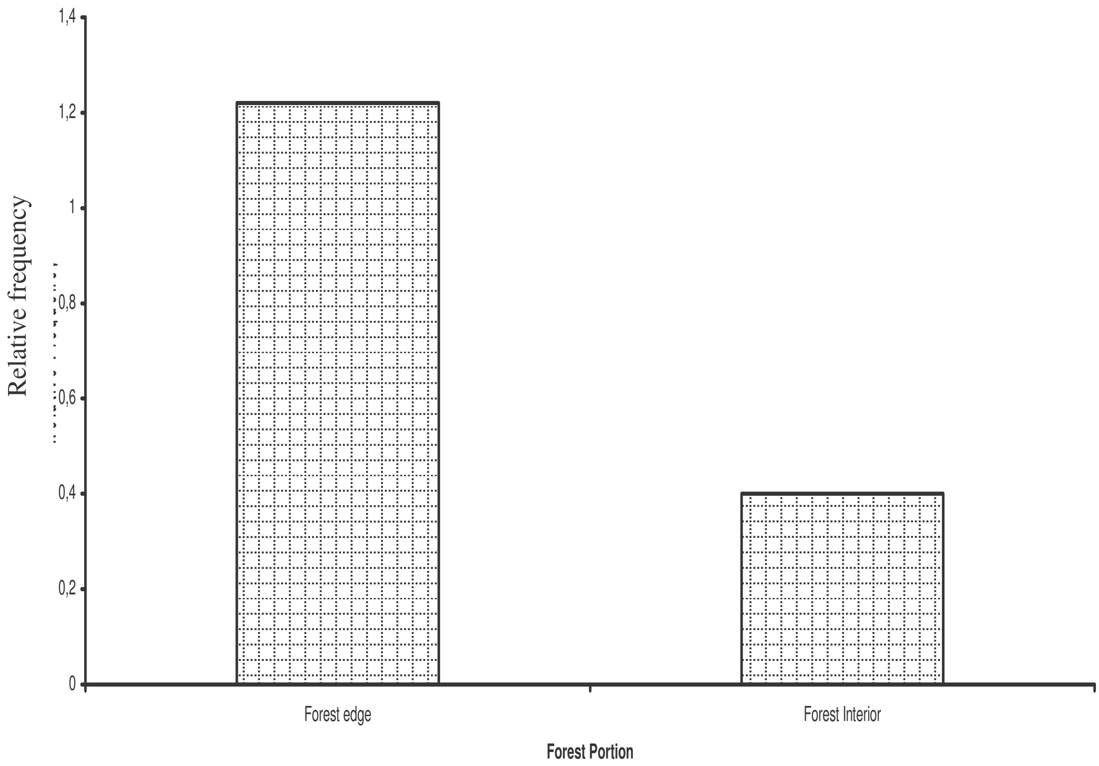

Figure 2: Frequency of *R. heudelotii* in forest edge and interior.

Table 3: Size class distribution of *Ricinodendron* trees in major plots 1 (edge) and 2 (interior).

Size-class	10 – 50 cm	51 – 100 cm	101–150 cm	151– 200 cm	≥ 201 cm
1	0	1	1	1	1
2	0	0	0	0	3

t-test for independent samples indicate no significant differences at $p>0.05$.

Van (1997) reported abundant regeneration of *R. heudelotii* after logging in Southern Cameroon. Van's report infers that logging creates a removal of canopy; thus more light penetrating the undergrowth which agrees with Luken et al. (1997) on the positive response of understory species to gap formation and soil disturbances. Similarly, Cintra and Horna (1997), observed a higher proportion of seedling understorey growth in gaps created in the shaded understory of the Amazonian forest.

Thus, if light did not produce significant effect on Agulli forest edge, nor non-interference producing higher values in the interior, it will thus imply that appropriate silvicultural systems be implemented for the propagation of *Ricinodendron* in this forest. Regeneration systems such as *Enrichment Planting* and *Clearfelling* can be options since logging improved this process in southern Cameroon (Van, 1997). If not successful, alternative methods rather than natural regeneration in the natural habitat to propagate *R. heudelotii* in the wild have to be sought to ensure the survival of this important tree species in this community.

Bringing the species out of the secondary forest to cropping land or homestead will necessitate studying the appropriate *ex situ* conditions under which this can be achieved (Reeds, 1999). Such studies would include factors for breaking dormancy, the growing medium for germination, the specific light conditions, nutrient requirements, storage conditions of seeds, sowing or burial depths of seeds and the use of vegetative propagation technique as an alternative to the use of seeds and thus giving us a clue to its coppicing potentials for clonal forestry.

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