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Logging, arboricide treatments and regeneration at Budongo Forest, Uganda

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Abstract

A study was carried out to detect whether logging and arboricide treatments had influences on floristic composition of four compartments in Budongo Forest, Uganda. The compartments were (N15) which had never been logged or treated; B4) logged 50 years; N4 logged 40 years, and W21 logged 30 years ago. The species treated were *Ficus* species, *Alstonia boonei* and *Cynometra alexandri*. In addition to arboricide treatment logging was mainly on trees of the meliaceae family. Data were collected from 16 points in each compartment and gradient of variation were identified using the stand tables for each compartment. Results were compared with Eggeling's plot data collected at Budongo 50 years ago. It was found that logging affected the forest structure, and the floristiccomposition was influenced by the succession state at the time of treatment. Furthermore, variation in the forest was not readily related to the time of logging/arboricide treatment. Despite the treatments, the residual stands retained the general character of the pre-exploitation forest and in the ensuing time they all assumed broadly similar compositions. The most distinct (compartment B4) still showed features of colonising forest which were much less evident in others. The control compartment (N15) was still different; it contained more forest tree individuals of secondary species than any of the other compartments. This suggests that Eggeling's time scale for the forest succession, and perhaps even his successional assumption should be reconsidered.

Key words: Arboricide treatement, logging, forest structure, species composition, natural regeneration

Introduction

Uganda's natural forest reserves have for a long time been managed primarily to provide economic and environmental benefits to the country. The importance of forestry in this regard is clearly stated in the forest policy and legislation Act which regulate the resource use. Since its inception in 1898 the Uganda Forest Department has been working toward achieving its major goals and objectives, one of which has been to determine the methods of increasing the stocking of the most valuable species through appropriate management actions (Eggeling, 1947). There are two ways in which this could have been achieved, one is by leaving the forest to regenerate naturally after logging and the other is through silvicultural interventions. In Budongo the latter option was chosen in the 1940s and selective logging and arboricide treatments were carried out as a way of increasing the stocking of the highly valuable African mahogany such as *Khaya anthotheca* and *Entandrophragma* spp. The environmental conditions and management history of the Budongo forest are described in the Forest Department working Plans (Harris, 1933; Eggeling, 1947; Philip, 1965 cited in Synnott, 1975). There is still little information known about the regeneration of tree species deemed to be ecologically and economically important in Uganda (Synnott, 1975). The need to provide such information provided the impetus to carry out this study.

Background to timber exploitation in Budongo

Budongo Forest, 1°37'-2°3' N; 31°22-31°46' E is located at the top of an escarpment east of Lake Albert near the eastern edge of the western rift valley, in Masindi District. The terrain is gently undulating with a general downhill slope to the North North West (NNW). Two small rivers, the Sonso and Waisoke drain the forest (Figure 1). The underlying rocks are ancient gneisses, schists and granulites of the basement complex, overlain by the Bunyoro series sediments in a small area of the Siba block (Howard, 1991). The soils are ferralitic, mainly sandy to sandy clay loam of low to moderate fertility. The area has a bimodal rainfall with a peak in the March-May period and another during September-November. The mean average annual rainfall is 1150-1500 mm. The mean minimum daily temperature ranges from 17°C in April to 20°C in October. The corresponding mean maximum daily temperature ranges from an average of 28°C in July to 29°C in January.

The gazetted area of Budongo Forest Reserve is 825 km² subdivided into five blocks: Nyakafunjo, Siba, Kaniyo Pabidi, Waibira and Biiso (Eggeling, 1947 and Howard, 1991) (Table 1). Several of the dominant species are deciduous and the forest can broadly be classified as a medium altitude moist semi-deciduous forest (Langdale-Brown et al., 1964). There are three different major forest types and extensive grassland areas (Table 1). The main forest blocks (Biiso, Kaniyo Pabidi, Nyakafunjo, Siba and

Waibira), have all been logged and have not regenerated successfully (Howard, 1991).

Management history

Management of Budongo forest started in the 1932 after the first aerial survey covering 500 km² of the forest followed by ground enumeration ((Eggeling, 1947; FAO, 1989). In 1922 planting of *Khaya anthotheca*, *Entandrophragma* spp. and *Maesopsis eminii* was attempted in parts of Biiso block (FAO, 1989) in order to increase the regeneration density after realising that the upper and middle layer species of the forest canopy lacked seedlings. Earlier attempts through enrichment planting were unsuccessful because of the closed forest canopy that allowed little light to reach the undergrowth, and as a result natural regeneration was poor. Regeneration failure was also partly due to grazing and browsing by wild game. Destruction by Elephants, Buffaloes, Antelopes, wild pig, Bush bucks and rodents also posed a serious problem to enrichment planting (Philip, 1965; Synnott, 1975; FAO. 1989). Controlled shooting was initiated in order to reduce the animal population and to save the seedlings, but this method too was unsuccessful.

Budongo forest was also managed for production of wild rubber tapped from *Funtumia elastica*. The history of rubber tapping in Budongo dates as far back as 1942 when about 40 tonnes of rubber was produced per annum. The activity was gradually replaced by the taungya system introduced in Nyakafunjo in the 1940s as a way of establishing plantations in Budongo (Paterson, 1991). The method was cheap to the Forest Department and simple enough for the local people to adopt and practice.

From the 1940s, research initiatives were taken in the silviculture of indigenous timber species with trials of both natural and artificial methods of regeneration (FAO, 1989). Later, investigations of fast growing species particularly *Maesopsis eminii* and mahogany were made. This involved the establishment of research plots followed by periodic assessments of species in the research plots to guide management decisions.

During the late 1960s and 1970s, the high demand for charcoal prompted the forest Department to reduce and finally eliminate arboricide treatments in Budongo. Previously, much of the charcoal burning had been done on public land outside the forest reserve. However, these resources become depleted and the department attracted

Table 1. Blocks of Budongo and their areas in square km

Block	Forest (km²)	Grassland (km²)	Total (km²)
Biiso	68.30	3.567	1.86
Kaniyo Pabidi	107.00	95.00	202.00
Nyakafunjo	125.49	4.49	129.98
Siba	82.97	20.58	103.55
Waibira	288.56	29.05	315.61
Total	670.32	152.68	825.00

The main forest blocks (Biiso, Kaniyo Pabidi, Nyakafunjo, Siba and Waibira), have all been logged and have not regenerated successfully (Howard, 1991).

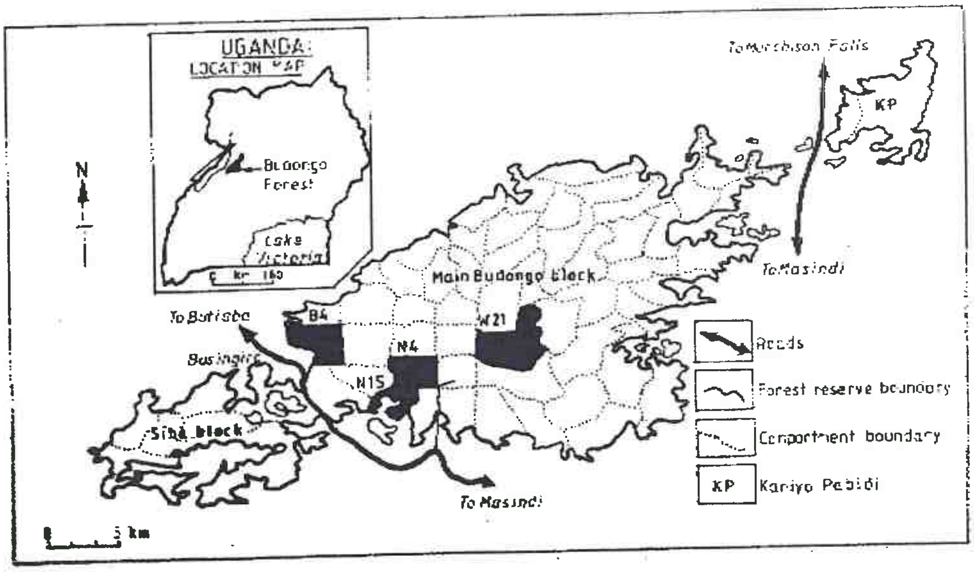

Fig. 1. Sketch map of Budongo Forest showing the sampled compartments B4, N4 , W 21 and N15 (dark shaded)

private charcoal dealers into the forest reserve to utilise the wood that remained after logging. Thus, the introduction of large scale charcoal production helped in some ways to get rid of arboricidal treatments.

The first sawmill was established in Budongo in 1911 and small quantities of timber were cut in the southern part of the forest. The amount of wood removed then was negligible. From 1926 up to the 1960s, there was gradual increase in the amount of timber cut in two concessions, one in Siba block and onther in the main Budongo block (Fig. 1). By early 1960, Budongo sawmill was turning out sawn lumber at a rate of 600 m^3 per month (Paterson, 1991).

For almost 30 years, most of the management operations in Budongo concentrated on removing "weed tree species", growth impeders (principally lianas) and strangler figs using arboricides (2,4-D) (Dichlorophenoxyacetic acid) and (2,4,5-T) (Trichlorophenoxyacetic acid). There have since been some concern that mechanical logging and arboricide treatment have left severe effects on the natural regeneration in Budongo forest.

In order to understand the extent of forest regeneration problems in Budongo, a detailed ecological study in the various forest types after differing periods of logging and arboricide treatment was felt necessary. The objectives of this study were to: (i) assess the impact of past logging and arboricide treatments carried out from the early 1940s to the late 1960s on the forest structure and species composition; (ii) determine the population status of selected tree species considered ecologically and economically important in Budongo and to compare the findings with what has been reported before the exploitation and treatments were done; and (iii) recommend appropriate management guidelines that would help to improve and maintain the ecological stability of Budongo.

Materials and methods

Sampling design

Budongo Forest Project's floristic gradients (Plumptre and Reynolds, 1994) were used in designing the sampling procedure. Sampling was limited to areas within 10 km radius in compartments which were logged and treated with arboricide in three different periods (1941-42, 1952-54, 1965) and the undisturbed compartment (N15). The availability of the trail system and location of a strict nature reserve in the study area facilitated the selection of the compartments for the study. Circular-sizeless plots, whose peripheral boundary was determined by the pre-determined species individual observations were used (Table 2).

The main objective of the field survey was to reveal the abundance of the species in each of the five size classes. Five classes were selected because of the great variation in stem size classes arising from species diversity, growth rate and differences in seeding and germination period. Characterisation of species groupings were done according to variations in time of logging and arboricide treatments.

Determination of Transect/grids

This was done in two stages. In stage one, a management map of the forest was used to randomly select and mark the sample points, and the existing Budongo Forest Project trail system was used to locate sample pointson the ground. In stage two, the trails were traversed in order to mark the sample point centres using existing transects demarcating 200 m x200 m square units in compartments B4, N4, N15 (Strict Nature Reserve) and W21 were used.

Each compartment was divided into two parts (Replicates 1 and 2) of approximately the same area and shape. Each part was randomly sampled in eight places each within a different grid unit. Grid units in the vicinity of the line separating two parts of each compartment were not sampled to ensure clear separation of the two areas. For each grid unit, corner positions within the compartments were given notional codes (Table 3).

Sample points were positioned in the grid unit by identifying one corner from a random number table (codes 1-4). A point on the boundary of the grid unit was located by moving along it with the interior of the grid unit always kept to the right (i.e clockwise movement around the unit periphery while looking down) for a randomly selected distance. The distance was determined using a table of two digit random numbers from 00 to 99, and multiplied by 2 since grid units are 200 m x 200 m.

From the point on the grid boundary (e.g. 61x2 = 122), a perpendicular offset line was followed into the grid unit for 60 m to locate the centre of the sample plot. Sampling points less than 100 m from the forest edge were rejected and replaced with an acceptable alternative positioned through the same procedure. The target was to evaluate 64 samples with at least 100 observations in each size class not having fewer than 5 key species.

Table 2. Numbers of observations in five diameter classes sampled

Tree size	Minimum diameter (cm)	Maximum diameter (cm)	Number of observations
Saplings	2.5	4.9 cm	40
Poles	5.0 cm	8.9 cm	35
Small trees	9.0 cm	13.9 cm	30
Medium trees	14.0 cm	20 cm	25
Big trees	20.0 cm	20+	20

Table 3. Notional corner codes of the compartments sampled

Compartment	Approximate corner position alignment			
B4	NE	SE	SW	NW
N4	NE	SE	SW	NW
N15	N	E	S	W
W21	NE	SE	SW	NW
Corner codes	1	2	3	4

Measurements

For each sampling point, tree size classes were assessed separately. All species represented by individuals having ^{3} 2.5 cm dbh were recorded. The number of observations recorded were the tree species individuals indicated in Table 2) and taken from the centre of the sample plot. Each individual encountered within the sample was identified and measured with a caliper or tape to the nearest 0.1 cm diameter (dbh)

A hypsometer was used for measuring height in addition to using a measuring tape. Individuals having multiple stems or sprouts from a common stump were measured from the smallest to the largest size class (^{3} 2.5 cm to over 20 cm dbh). Trees with buttresses or malformations were measured or estimated just above the point of columnar formation. Distances from the centre point to the outer most observation in each size class were recorded to estimate the area (ha) of each sample.

Supplementary information

The following supplementary information was recorded: evidence of past disturbance (presence of stumps, saw-pits, evidence of arboricide treatment, landing sites and skidding roads). Tree and soil damage was estimated by walking about in the sample plots and recording observations. The number of stumps and saw-pits were also recorded:

- general soil characteristics of the forest floor, pest infestation, vegetation structure and canopy cover were observed and recorded.
- topographic position of the sampling points on the plain, hill top, valley side, dry valley bottom, river valley and their slope was measured with clinometer and the aspect of the sample points determined with a compass.
- the approximate sample altitudes were recorded from the 1:50, 000 topographic map. Eggeling's records (1947) from permanent sample plots in the same area, and the records obtained from the strict nature reserve (N15) were used to show the state of the forest before logging.

Data Analysis

Data collected were analysed for stand population and species diversity, and summarised into stand tables to facilitate concise characterization of each sample plot in terms of species abundance and distribution patterns (expressed per hectare for both regeneration and larger sizes. The smallest size classes were divided into more groups than the larger ones as they were the most represented. The number of individuals per hectare for the five classes were calculated for each sample area to indicate the general structure of the stand. Records from the Strict Nature Reserve (N15) and those extracted from (Eggeling , 1947) were used as a basis for examining the condition of the forest before the logging and arboricide treatments were done.

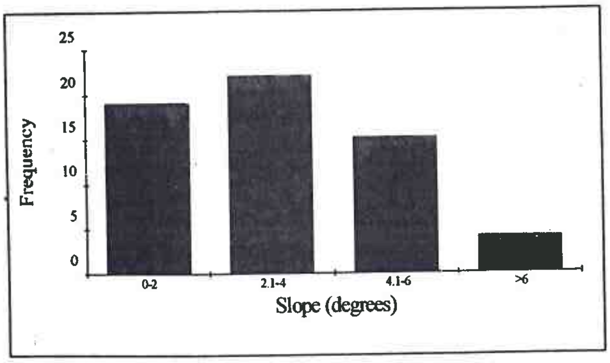

Fig. 2. Frequency of sample points in the study area in relation to slope

Results

General Sample Plot Slope and Aspect

The sampling points were aligned in the East-West, South and North-South direction. The entire area had an average slope of 0-7°. As a result of the gentle slope, there were no marked variations in the sample distribution due to slope influence. Figure 2 shows the frequency of sample points in relation to slope and the aspect of the compartments respectively.

Forest structure

The mean sample areas supporting the tallies of individuals of different sizes showed high density of the 2.5-4.9 cm dbh group relative to the 14-20 cm dbh group in all compartments and little variation with compartments in these size classes (Table 4). There was more variation in the > 20 cm dbh class, because it lacked an upper limit and was assumed to contain individuals of widely different ages (some persisting from before the forest treatments were applied).

In the size classes, 5-8.9 cm dbh and 9-13.9 cm dbh, the density in compartment N15 indicates the "climax" nature of the samples with conditions not favouring regeneration because of the well established synusia of mature trees monopolising site resources. In compartment N4 and W21, the most recently disturbed compartments, however, the denser stands of individuals 5-13.9 cm dbh were consequences of canopy opening from forestry operations. Table 5 shows the individuals per hectare enumerated for each of the sampled compartments and Table 6 indicates individuals enumerated to height classes.

Discussion

Timber harvesting is considered to be an important agent of forest degradation. It is well known that forest disturbance by logging changes the structure and species composition and ultimately upsets the ecological balance. Wyatt-Smith (1987) and Hendrison (1990) have reported on the impact of logging on the ecological stability of tropical rain forests and in particular the structural disturbance. The results of this study indicates that logging activities over the past 30 to 50 years have had considerable effects on Budongo forest. The stocking density and hence the forest structure has been changed in compartments W21, N4 and B4. However, all the four compartments had floristic similarities but Compartment B4, was more distinct. This was observed in all the five size classes studied.

Table 4. Budongo Forest, Uganda: average area(ha.) Of the sample plot in the sampled compartment showing the observations made in each of them

		Compartment Area (ha)			
Year of last operation Size class	Number of observations	1942 B4	1954 N4	1965 W21	None N15
2.5 - 4.9	40	0.088	0.046	0.045	0.066
5 - 8.9	35	0.152	0.097	0.101	0.252
9 - 13.9	30	0.254	0.198	0.209	0.300
14 - 20	25	0.308	0.316	0.332	0.293
> 20	20	0.225	0.175	0.249	0.186

Eggeling's (1947) data shows that much of the western part of Budongo (where compartments B4, N4, N15 and W21 are located) did not have as much *C. alexandri* and *Celtis* spp. in the 1940s. This study shows that the situation has remained more or less the same in compartments W21, N4 and B4 except in N15. The obvious explanation that can be offered here is that logging and arboricidal treatments in compartments W21, N4 and B4 has not remarkably reduced the number of either species and they both remain very numerous, so that species composition and distribution appears to be similar as in N15 which has remained largely as an undisturbed nature reserve for a long time.

Compartments W21 and N4 are basically similar to each other and display mixed forest character (in the way Eggeling characterised the forest in relation to forest succession). B4 is more or less of the mixed character but there are greater contrasts with Eggeling's most advanced successional condition (ironwood forest) than in the cases of N4, N15 and W21. Furthermore, B4 has fewer mixed/climax forest species well represented than the other compartments studied although it has been recovering longer from logging. This can be explained by its vulnerable location near the motor road through Budongo and at the edge of the forest. In fact, it was roughly where Eggeling's plot 5 was located and this was a plot representing the ecotone to young (colonising) forest. Tables 7 and 8 give the best six represented species that features in the present study (1995) in size classes greater than 20 cm dbh and the survey before the disturbances (1935-45). The numbers 1-6 represent quantitative number of individuals enumerated in each compartment and plot.

In B4, the successional state remains a stronger influence than the logging treatments and although logged 50 years ago it has not progressed to mixed forest. W21 and N4 in contrast have retained their mixed forest character. The difference in time since logging between these plots is not evident in their vegetation at present. They are very similar structurally and floristically.

Common among the best six represented species were *Celtis mildbraedii, C. zenkeri, Cynometra alexandri, Funtumia elastica, Khaya anthotheca* and *Lasiodiscus mildbraedii*. *Cola gigantea, Croton macrostachyus, Maesopsis eminii* and *Margaritaria discoidea* were among the best six species in the present study and not in Eggeling's while *Strychnos mitis, Belonophora hypoglauca, Maerua duchesnei, Crossonephelis africanus* and *Tapura fischeri* were among the best six represented species in the plots Eggeling surveyed in 1940s. Other than the differences in quantitative data sets, the floristic situation at Budongo in the categories of understorey, later secondary, and colonising appears to have been relatively stable.

As earlier mentioned, there were variations in the compartments studied both structurally and floristically. A glance at Budongo gives the impression that the forest is homogeneous. However, this is not true especially when the four compartments studied were examined. The forest

Table 5: Budongo Forest, Uganda: allocation individuals enumerated to diameter classes(cm)

	Individuals (per hectare)			
Year of last operation	1965	1954	1942	None
Size class (cm)	W21	N4	B4	**N15**
2.5-4.9	889	869	455	606
5-8.9	347	361	230	139
9-13.9	144	151	118	100
14-20	75	81	117	85
>20	80	114	81	108

Table 6: Budongo Forest, Uganda: allocation of individuals enumerated to height classes (m)

Height class	Compartments			
Year of last operation	1942	1954	1965	None
	W21	N4	B4	**N15**
1.0-3	8	76	84	14
3.1-10	1545	1453	1503	1544
10.1-15	495	504	475	547
15.1-20	295	246	210	221
20.1-30	55	99	111	62
30.1-40	2	22	17	10
40.1-50	0	0	0	2

structure in Budongo is not homogenous given the period and intensity of exploitation and arboricide treatments.

Cynometra alexandri was more prominent in the large size group enumerated particularly in compartment N15 but less in the compartments subjected to logging and arboricide treatments characterised by reduced numbers of individuals. Increased numbers of *Celtis mildbraedii, Funtumia elastica* and *Khaya anthotheca* were noted. However, due to the fact that enrichment planting was carried out on *Khaya* the situation for this species has not resulted from natural regeneration process alone. Records from Eggeling (1947) confirms this as the species was abundant in plots 7, 8 and 9 (Table 7), located in climax forest and the ecotone between mixed and climax forest.

Table 7. Budongo Forest, Uganda: the best six represented species enumerated between 1935-45 in the six plots (plots 5-10) shown by ranks

Species	Category	Individuals in plots 5 - 10					
		5	6	7	8	9	**10**
Alchornea laxiflora	Understorey	6	+	+	+	-	2
Belonophora hypoglauca	later seconady	+	-	5	+	-	-
Celtis brownii	Wide range of forest types	2	+	+	4	-	5
C. mildbraedii	Wide range of forest types	1	1	2	+	3	+
C. zenkeri	Wide range of forest types	+	+	+	5	6	+
Chrysophyllum albidum	Primary	+	-	+	+	-	6
C. perpulchrum	Primary	+	5	+	-	-	-
Chrysophyllum spp.	Primary	+	2	+	+	-	+
Crossonephelis africanus	Understorey	3	+	+	+	-	-
Cynometra alexandri	Primary	+	3	4	3	2	1
Funtumia elastica	Later secondary	4	+	6	6	+	-
Khaya anthotheca	Primary and used for enrichment	+	6	+	-	-	-
Lasiodiscus mildbraedii	Primary	-	-	1	1	1	-
Maerua duchesnei	Wide rande of forest types	-	+	+	+	+	3
Rinorea ardisiaeflora	Understorey	+	+	3	2	4	+
Strychnos mitis	Middle storey	-	-	+	-	5	+
Tapura fischeri	Later secondary	+	-	+	+	+	4
Trichilia prieureana	Understorey	5	+	+	-	-	-
Trilepisium madagascariense	Later secondary	+	4	+	-	-	+

1 - 6 = level of presence of species in plot with 1 best represented
+ = Presence of the species in the plot after level 6
- = absence of the species in the plot
The eleventh plot was located in a swamp
Source: Eggeling (1947)

Table 8. Budongo Forest, Uganda: the best six represented species enumerated during 1995 for the greater than 20 cm dbh in the four compartments (W21, N4, B4 and N15) shown by ranks

Species	Category	Individuals			
		W21	N4	B4	N15
Celtis gomphophylla	Secondary	5	1	+	+
C. mildbraedii	Wide range of forest types	2	4	1	1
C. zenkeri	Wide range of forest types	+	+	+	5
Chrysophyllum albidum	Primary	+	+	4	+
Cola gigantea	Late secondary	-	-	4	+
Croton macrostachyus	late secondary	1	6	6	+
Cynometra alexandri	Primary	4	5	+	2
Khaya anthotheca	Primary and used for enrichment	+	+	2	5
Funtumia elastica	Later secondary	3	2	2	4
Lasiodiscus mildbraedii	Primary	+	+	-	3
Maesopsis eminii	Colonising	+	3	+	+
Margaritaria discoidea	Late secondary	6	+	+	-

1 - 6 = level of presence of species in plot with 1 best represented
+ = Presence of the species in the plot after level 6
- = absence of the species in the plot

This is an ecologically important species at Budongo although it has never been studied in detail.

Secondary species of importance in Budongo forest included *Maesopsis eminii, Cola gigantea, Croton macrostachyus, Celtis gomphphylla* and *Margaritaria discoidea* all of which were mainly recorded in the larger sizes indicating that a single generation became established in quantity when logging/arboricide treatments had created opportunities for establishment. Subsequently, the amount of regeneration has declined. As these are colonising species a further canopy opening would be needed to stimulate a new pulse of regeneration (Eggeling 1947; Synnott, 1985). Numbers of *Celtis zenkeri, C. brownii* and *C. gomphophylla* were variable, a factor that may be associated with field identification problems. *Chrysophyllum albidum* (a primary species) was represented in B4 and plot 6 an indication that it is a species well suited to a mixed forest condition. *Strombosia scheffleri* was less in compartment N15 and more represented in the compartments that were disturbed. This suggests that the species is successional, though not colonising. In summary, the main contrast between the compartments in the upper storey species are the differences of N15 from the others. In N15, the typical secondary species, *Croton macrostachyus, Maesopsis eminii* and *Margaritaria discoidea* are all relatively rare. In contrast, the primary species, *Aningeria altissima* and *Cynometra alexandri* are both more abundant there. *Strombosia scheffleri, Funtumia elastica* are also important in N15 than elsewhere and it may be that these are late secondary species.

From the stocking recorded in this study an increase in numbers especially in the small size classes (5-13.9) in the disturbed compartments (B4, N4, W21) compared with the undisturbed compartment (N15) is evident. However, this did not extend to the 2.5-4.9 cm dbh class. Previous management events do not appear to have over-ridden the mixed-forest character of N4 and W21.

The time span since the disturbance, has not led to a marked increase in the regeneration of the economically most desirable species: *Entandrophragma angolense, E. cylindricum, E. utile and Lovoa trichilioides* although this may be a feature difficult to detect. This is because these species tend to be thinly dispersed and the present level of sampling, and its restriction to three treated compartments, was on too small a scale. Silvicultural treatments similar to those that were carried out on *Khaya anthotheca* such as enrichment planting and direct seeding however, could benefit them if management opted for such action (Synnott, 1975). The poorer quality of forest in terms of the prominence of top quality timber species in the compartments towards the reserve boundary may be due to lack of seed and possibly inadequate soil moisture.

Conclusions

1. The four compartments studied differ in structure (notably the stocking of individuals in 5-13.9 cm dbh class - which is low in N15 and W21) and floristic composition to some extent. N15 (unlogged) and B4 (logged 1941-42) are the most distinct because at the time of logging B4 was colonising forest and has not developed into a typical mixed forest. Compartments N4 and W21, despite thediffering density of individuals 5-13.9 cm dbh, are relatively similar. There is good representation of mixed forest species despite logging and poisoning 30 years (W21) and 40 years (N4) ago.

2. Both treated compartments (B4, N4, W21) and the untreated one (N15) at Budongo have diverse tree flora in which the species that are well represented include *Celtis* spp., *Alchornea laxiflora, Lasiodiscus mildbraedii, Rinoreaardisiiflora, Funtumia elastica, Cynometra alexandri,* and *Trichilia rubescens*. *Khaya anthotheca* is present in greater numbers than any other equally valuable timber species but it is unclear how much of this has arisen from enrichment planting and how much has resulted from the regeneration stimulated by partmanagement treatments.

Recommendations

1. Species - focused research should be carried out to develop a better understanding of the roles of the most abundant species such as *Crototon, Celtis* spp. And *Aningeria* (Upper storey); *Lasiodiscus, Strambosia, Funtumia* (Middle storey), and *Rinorea, Alchornea, Trichilia rubescens* (Undersorey) This would strengthen the capability to manipulate regeneration and growth conditions at the sapling pole and mature stages.

2. There is a need to carry out a study of soil seed bank in Budongo forest in order to understand tha pulse of germination of pioneer species. Large size individuals such as *Croton, Cordia milenii* and *Chrsophyllum* spp should also be investigated, especially how they are reduced by natural factors or human management, and how they maintain their potential to germinate after disturbance.

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