

VEGETATION STRUCTURE OF FOUR SMALL FOREST FRAGMENTS IN TAITA HILLS, KENYA

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ABSTRACT

The structure of four small forest fragments, Kichuchenyi, Macha, Ndiwenyi and Yale, all situated in the Dabida massif of the Taita Hills, was analyzed. The study was based on sample plots of 400 m² each. Basal area, stratification and disturbance data are presented. All fragments are heavily disturbed. Ndiwenyi and Kichuchenyi forests are structurally very similar. However, the main characteristic of the former is its remarkably large diameter trees in comparison to all the other fragments. Yale is the least disturbed of the four forests and has the highest number of species typical of the primary forest.

INTRODUCTION

The Eastern Arc mountains harbour an unusually high proportion of rare and endemic animals and plants, and together with the coastal forests of Kenya and Tanzania, are recognised as one of the world's 25 biodiversity hot-spots (Myers *et al.*, 2000). The Taita Hills, together with Sagala and Kasigau, form the northernmost part of the Eastern Arc mountains, and are the sole representatives of this ancient geological formation within the Kenyan political boundaries. This chain of mountains continues south into Tanzania and includes North and South Pare, East and West Usambara, Nguru, Nguu, Ukaguru, Rubeho, Uluguru, Udzungwa and Mahenge.

The Taita Hills (3°15'–3°30'S, 38°15'–38°30'E) are located in south-eastern Kenya about 25 km west of Voi. They cover an area of about 250 km² and rise abruptly from the surrounding Tsavo plains at an altitude of 600–700 m, to a series of ridges with Vuria, the highest point, at 2208 m. The Taita Hills form the first large inland barrier for moisture-laden clouds, which come in from the coast, and the precipitation from trapped moisture creates almost permanently humid conditions in the hilltop forests.

Due to human influence, however, the remaining indigenous forest in the Taita Hills is highly fragmented. The biggest forest patch, Mbololo, is about 160 ha but most of the fragments are 5 ha or less (Beentje, 1988). Between 1997 and 2000 the Taita Hills

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Biodiversity Project (THBP) studied the impact of forest fragmentation and degradation on the unique biodiversity of these hills (Bytebier, 2001). In order to quantify the disturbance level for each of the forest fragments included in these investigations, we recorded some basic ecological parameters such as vegetation stratification, plant density and size classes; as well as indicators of destruction such as artificially cut trees and number of human trails. These parameters were published earlier for Sagalla, Ronge, Mbololo, Ngangao, Chawia, Fururu, Vuria and Mwachora (Wilder *et al.*, 1998) but, until now, were lacking for four other forest fragments included in the THBP study namely, Kichuchenyi (sometimes also referred to as Josa) (3°25'S, 38°21'E), 1450 m, 0.5 ha; Macha (3°27'S, 38°22'E), 1550 m, 1 ha; Ndiwenyi (3°26'S, 38°21'E), 1580 m, 1 ha and Yale (3°24'S, 38°18'E), 1900 m, 1 ha.

MATERIAL AND METHODS

The method follows the one used by Wilder *et al.* (1998) in a similar study, and is described in more detail in Bullock (1996). Four 400 m² plots (20 x 20 m) were surveyed between 2 and 7 March 2000. In each of these, five subplots (1x1 m) were also surveyed. In each plot we identified all trees >5 m high and measured their diameter at breast height (dbh at 1.3 m), noted presence of buttresses for trees >15 m tall, measured height and enumerated number of individuals of each species. We also identified and counted all shrubs and saplings 1–5 m tall. We documented plot disturbance by counting the number of artificially cut trees and trails crossing the plot. We then established five (5) 1 x 1 m subplots within the large plot; at the centre and in each corner and estimated % cover of bare ground, herbaceous growth and leaf litter, and measured its depth. We also took half-sight measurements of the shrub layer at 1 and 2 m height and finally estimated % canopy cover. All plants were identified by an experienced botanist (O. Mwangangi) using current literature, such as the Flora of Tropical East Africa, and Kenya Trees, Shrubs and Lianas (Beentje, 1994). Since most species were common, no herbarium specimens were deposited.

RESULTS AND DISCUSSION

Table 1 presents data on stratification, basal area, mean tree height, tree density, leaf litter, and degree of anthropogenic disturbance of the four forests. There are no distinct structural differences among the forests, which show a continuous distribution in a broad range of size classes. Although Ndiwenyi has the lowest tree density, it has the highest basal area. The forest is characterized by very large trees and no intermediates, which indicates poor or no regeneration. The basal area for Kichuchenyi is greatly influenced by a large *Ficus thonningii* Blume tree. Yale has the highest tree density. However, the bulk belongs to the small diameter size class (< 10 cm diameter).

The amount of litter differs considerably in all the forests; those with a closed canopy have more litter compared to forests that are more open. In Yale, where the canopy is closed and the herb layer is less extensive, the percent litter cover is highest. Ndiwenyi and Kichuchenyi have open canopies and a relatively extensive herb layer and proportionately less leaf litter. This can be attributed to a lower tree and shrub density, presence of more trails and the higher proportion of artificially cut trees; an indication of higher human traffic.

The average height of trees is highest in Ndiwenyi (19 m) followed by Kichuchenyi whereas Macha and Yale have approximately the same average height of upper canopy trees.

This could be a result of selective logging of smaller species that are easier to transport in Ndiwenyi and Kichuchenyi. The most frequent and common trees are *Albizia gummifera* (J.F.Gmel) C.A.Sm., *Phoenix reclinata* Jacq. and *Tabernaemontana stapfiana* Britten. *Xymalos monospora* (Harv.) Baill. is common in Yale and Macha forests. Common understorey trees and shrubs include *Psychotria* sp., *Dracaena steudneri* Engl. and *Agelaea pentagyna* (Lam.) Baill.; and common herbs present are *Piper capense* L.f. and *Culcasia falcifolia* Engl.

Table 1. Structural data from 20 x 20 m plots. Standard deviation is given for all means except mean litter depth where values of skewness are given instead.

Parameter	Yale	Macha	Ndiwenyi	Kichuchenyi
Number of strata	3	2	2	2
Basal area.m ⁻² (cm ² .m ⁻²)	65	25	76	48
Mean height canopy trees	12	11	19	16
Number of trees/ha	1000	825	325	875
Buttressed trees/ha	50	0	0	0
Mean litter depth (mm)	15(2.1)	18(1)	18(0.5)	4(-0.4)
Mean litter cover (%)	78±10	73±19	35±29	17±10
Mean herb layer (%)	14±13	15±12	59±31	30±16
Mean half-sight: 1m	10±12	23±3	19±8	8±10
Mean half-sight: 2m	4±8	11±8	16±12	5±10
Dead trees (%)	3	0	7	0
Artificially cut trees (%)	0	0	3	12
Number of trails/ha	0	25	50	100

The vegetation of these forests has been greatly influenced by man. We observed very recent tree-poaching. For instance in Ndiwenyi we encountered a fresh saw pit and in Kichuchenyi there were recently cut stumps of *Maesa lanceolata* Forssk. trees. The effect of earlier selective logging is clearly evidenced by the dominance of secondary successional species such as *Maesa lanceolata*, *Phoenix reclinata* and *Tabernaemontana stapfiana*. Yale, the least disturbed of the four forests contains many primary forest species such as *Xymalos monospora*, *Aphloia theiformis* (Vahl) Benn., *Rapanea melanophloeos* (L.) Mez., *Syzygium guineense* (Willd.) DC. and *Cyathea manniana* Hook.

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