

Montane forest fragmentation

and its effect on tree and diurnal frugivore composition in North East Nigeria.

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Nigerian montane forests are:

- satellite populations of many Afrotropical endemics.
- of a rare dry type, and harbour many threatened plant and animal species.
- fall within the Cameroon Mountains Endemic Bird Area.
- Forests range in altitude from ca. 1500 m to 2420 m on Gangirwal, Nigeria's highest mountain.
- vary in size from small fragments of less than one hectare, to riverine strips and impressive stands of over 20 km² [1,2].



Figure 1. View over Dutsin Lamba in Gashaka Gumti National Park.

Most of these forests are within Gashaka Gumti National Park, and only one forest – Ngel Nyaki, remains on Mambilla Plateau, where there once was good forest cover. All over Mambilla forest patches are disappearing through wood chopping, burning and cattle trampling [2].

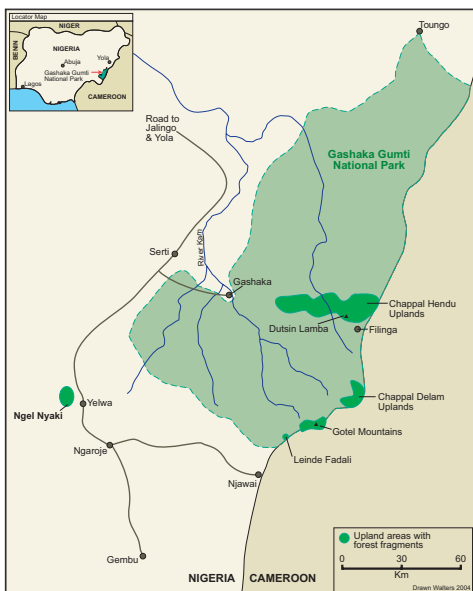


Figure 2. Map showing areas with upland forest fragments.

Ngel Nyaki Forest Reserve is 46 km² in area, comprising 8 km² of montane / sub-montane forest, the rest being grazed and burnt savanna woodland and grassland. Outside the reserve, but within what was the unofficial 'buffer zone', are streamside forest fragments in varying stages of degradation.



Figure 3. Fragment B.

The aim of this research [3] was to investigate the effect of fragmentation / degradation on tree, tree seedling, and diurnal frugivore species composition, in order to:

1. Predict which frugivores might best promote natural regeneration (if forests are given protection from grazing and burning).
2. Identify species which are unique to the fragments so that a case can be made for their inclusion within Ngel Nyaki Reserve.

Methods

The tree species, tree seedlings, and diurnal frugivore community was described for Ngel Nyaki forest (NN) and three forest fragments, A, B and C. The fragments were at increasing distances away from NN, with corresponding increase in degradation and decrease in fragment size (Table 1).

	NN	A	B	C
Distance from NN (km)	0	0.3	1	1.6
Area (ha)	80	2	1.4	0.2
State of degradation*	0	1	2	3

* 0 = none, 3 = burnt and cut over.

Information on woody species composition in terms of relative frequency, relative density, dominance and 'importance' in NN and fragments A, B and C was determined using a plotless sampling technique P.C.Q. [4].

All tree seedlings within twenty 1m² quadrats per site were measured and recorded.

Frugivore species feeding within each site were identified [5] from records taken over a total of 5, 12 hour day, observation per site. On each of the 5 days each frugivore seen was recorded the first time only it was observed.

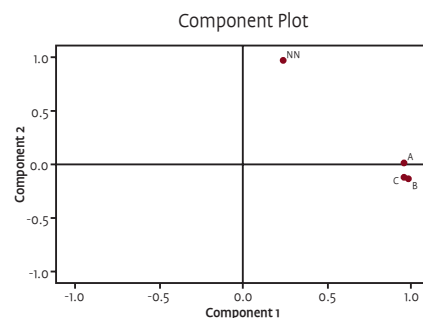
Data Analysis

Principal Component Analysis (PCA), Cluster analysis, and paired t tests were used to analyse the differences in tree and diurnal frugivores species composition between NN and fragments A, B and C.

Results

Frugivore communities

The first two components of the PCA explained 95% of the variation.



There is a clear difference between NN and fragments A, B & C in terms of frugivores composition. However fragments A, B & C are not statistically different from each other as confirmed by t-tests.

Six diurnal frugivore species were observed in all four sites on every sampling day: the red-eyed dove (*Streptopelia semitorquata*), double-toothed barbet (*Lybius bidentatus*), willow warbler (*Phylloscopus trochilus*), garden warbler (*Sylvia borin*), common bulbul (*Pycnonotus barbatus*) and the tree squirrel (*Funisciurus anerythrus*). These frugivores can potentially disperse seed among the sites.

Thirteen species of frugivores, 5 of which were primates, were only recorded from NN: slender billed greenbul, *Andropadus gracilirostris*; Naked-faced barbet, *Gymnobucco calvus*; Yellow-rumped tinkerbird, *Pogoniulus bilineatus*; Yellow spotted barbet, *Buccanodon duchallui*; Great blue turaco, *Corythaes cristata*; Green turaco, *Tauraco persa*; piping hornbill, *Ceratogymna fistulator*; blue duiker, *Cephalophus monticola*; Olive baboon, *Papio anubis*; Putty nose monkey *Cercopithecus nictans*; Mona monkey *Cercopithecus mona*; Black and White colobus, *Colobus guereza*, West African chimpanzee, *Pan troglodytes vellerosus*.

Seven species of avian frugivores were recorded more frequently in the fragments than in NN: Double-spurred francolin, *Fracolinus bicalcaratus*; African thrush, *Turdus pelios*; White crested turaco, *Tauraco leucolophus*; Bannerman's weaver, *Ploceus bannermani*; Simple leaflove, *Chlorocichla simplex*; Baglaffeicht weaver, *Ploceus baglaffeicht* and the western grey plantain eater *Crinifer piscator*. The latter two species were never recorded in NN, but were confined to the fragments and *T. leucolophus* was only ever found on the forest edge, it roosts in the fragments.

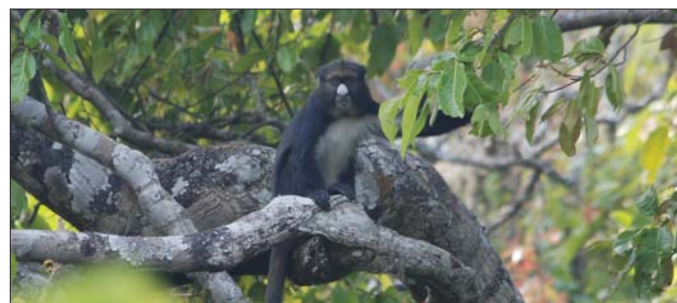
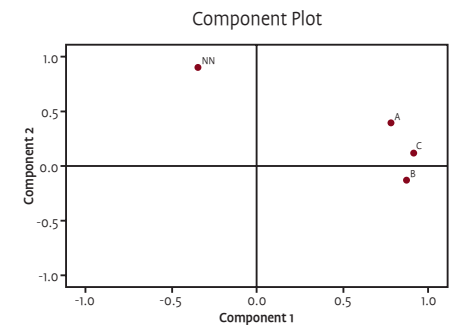


Figure 4. Putty nose monkey (*Cercopithecus nictans*), a frugivore found in Ngel Nyaki forest.

Vegetation Analysis

The first two components of the PCA explained 85% of the variation, and as with the frugivore communities, NN stood apart from each of the three fragments in terms of tree species composition.



With the cluster analysis set at 3 clusters, cluster 1 comprised 19 tree species which were almost exclusively confined to NN: *Beilschmiedia mannii*; *Anthonotha noldii*; *Campylospermum flavum*; *Carapa grandiflora*; *Chrysophyllum albidum*; *Deinbollia pinnata*; *Garcinia smeathmannii*; *Hannoa klaineana*; *Isolona deightonii*; *Newtonia buchananii*; *Pouteria altissima*; *Rothmannia urcelliformis*; *Strombosia scheffleri*; *Synsepalum sp*; *Tabernaemontana contorta*; *Voacanga bracteata*; *Xymalos manspota*; *Zanthoxylum lepreurii*.

Cluster 2 comprises species which are most common in fragments A and B, and NEVER occur in NN. Some of them are typical montane forest species: *Albizia gummifera*; *Anthocleista vogelii*; *Clausena anisata*; *Dombeya ledermanii*; *Entada abyssinica*; *Ilex mitis*; *Nuxia congesta*; *Pittosporum viridiflorum*; *Rauvolfia vomitoria*; *Rubiaceae*; *Symphonia globulifera*.

Cluster 3 comprises species which tend to be most common in the extremely degraded fragment C, and never, or only rarely, in NN: They are widespread, pioneer species. *Allophylus africanus*; *Bridelia micrantha*; *Canthium vulgare*; *Croton macrostachyus*; *Maesa lanceolata*; *Psorospermum corymbiferum*; *Syzygium guineense*; *Trema orientalis*.

Seedling regeneration

No seedlings of tree species restricted as adults in NN (see above) were found in any of the fragments A, B or C. Almost all the seedlings in the fragments were of pioneer species such as *Canthium vulgare* and *Trema orientalis*.

Conclusions

- Both tree species composition and frugivore communities are significantly different between Ngel Nyaki forest and the three forest fragments A, B & C. However the fragments, despite differing in area and state of degradation, are not significantly different to each other in terms of tree species composition or diurnal frugivore community.
- Six species of avian frugivores (see above) feed within NN and in the fragments, and were observed flying between the sites. These are the most likely potential dispersers of small fruited forest species between NN and the fragments A, B and C.
- No evidence of seed dispersed from NN into fragments A, B and C in terms of seedling regeneration was found. All tree seedlings in the fragments were of pioneer species already present as adults in the fragments.
- The fragments are home to taxa which do not occur within NN forest: Especially noticeable for conservation reasons are the white-crested turaco (*Tauraco leucolophus*) and montane forest woody species *Pittosporum viridiflorum*, *Ilex mitis* and the RDL *Eugenia gilgii*.
- If these fragments continue to be destroyed by wood chopping, burning and cattle grazing, the white crested turaco and at least one RDL montane forest tree species will become locally extinct.

Acknowledgements

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