

International Journal of Environmental Sciences

(A peer reviewed International Journal)

Tropical Montane Forest Biodiversity in Nigeria – Case Study of Ngel Nyaki Forest Reserve, Mambilla Plateau

International Journal of Environmental Sciences, Vol. 1 No. 2, pp. 95-104, 2277-1948, 2012

ISSN 2277 – 1948

Article type *Full Length Research Article*

Submission date *29 February 2012*

Acceptance date *30 March 2012*

Publication date *15 April 2012*

Article URL <http://www.crdeep.org/category/ijes>

Authors *Temitope I. Borokini,²Fola D. Babalola,³Tajudeen O. Amusa,⁴Samuel T. Ivande,⁴Zingfa J. Wala,⁵Oluwabunmi O. Jegede,⁶Dauda Tanko and ⁷Jerome O. Ihuma*

This peer-reviewed article was published immediately upon acceptance. It can be downloaded, printed and distributed freely for any purposes from CRDEEP website.

Hard copy of Journal is also available on request.

For information about publishing your research in CRDEEP International Journals please visit our website www.crdeep.org

© 2012. All Rights Reserved by CRDEEP



CRDEEP Head Office:
315/10, Kaulagarh Road, Rajendranagar, Indervihar, Dehradun, 248001, Uttarakhand,
India.

Tropical Montane Forest Biodiversity in Nigeria – Case Study of Ngel Nyaki Forest Reserve, Mambilla Plateau

¹Temitope I. Borokini, ²Fola D. Babalola, ³Tajudeen O. Amusa, ⁴Samuel T. Ivande, ⁵Zingfa J. Wala, ⁶Oluwabunmi O. Jegede, ⁷Dauda Tanko and ⁷Jerome O. Ihuma

¹National Centre for Genetic Resources and Biotechnology, P.M.B 5382, Moor Plantation, Ibadan, Nigeria

²Department of Forest Management and Policy, University of Ilorin, Ilorin, Nigeria

³Forestry Research Institute of Nigeria (FRIN), New Bussa, Nigeria

⁴AP Leventis Ornithological Research Institute (APLORI), Jos, Nigeria

⁵Nigeria Conservation Foundation (NCF), Lagos, Nigeria

⁶Ahmadu Bello University (ABU), Zaria,

⁷Department of Biological Sciences, Bingham University, Nigeria

**Corresponding Author: Temitope I. Borokini*

ABSTRACT

In the recent years, attention has been drawn to montane vegetations due to their biodiversity, high level of endemics and very low range of climatic conditions in which they can survive. Ngel Nyaki Forest Reserve is a tropical montane forest located on the Mambilla Plateau, Northeastern Nigeria. It was noted for its biodiversity and the significant number of highly endangered and endemic species. The authors explored the biodiversity of Ngel Nyaki Forest Reserve and other fringing forests in Mambilla Plateau and this paper reported the biodiversity, climate, soil, anthropology, history of botanical collections and conservation status of Mambilla Plateau, with more focus on Ngel Nyaki Forest Reserve. The economic and ecological significance of this forest reserve was also discussed. The success of community forestry through the establishment of Eucalyptus plantations in this area was also noted. The present threats to biodiversity conservation of Ngel Nyaki Forest Reserve were discussed and immediate attention to these threats was advocated.

Keywords: Ngel Nyaki Forest Reserve, Mambilla Plateau, Biodiversity, Montane forest, conservation.

INTRODUCTION

A large fraction of the world's most precious gene pools (for agriculture and medicine) are preserved in mountains (Spehn *et al.* 2010). Major crops (maize, potatoes, barley, sorghum, tomatoes, beans and apples) have been diversified in mountains and an array of domestic animals (sheep, goats, yaks, llama and alpaca) have originated or diversified in mountains (Spehn *et al.* 2010). Other crops such as rye, wheat, rice, oats and grapes have found new homes in the mountains and evolved into many varieties. Coffee and tea, with their roots in Ethiopia and the Himalayan region, are mountain crops as well. Medicinal plants are one of the most valuable resources from high altitudes. Mountains support about one quarter of terrestrial biological diversity, with nearly half of the world's biodiversity hotspots concentrated in mountains (Spehn *et al.* 2010). However, A complete biological inventory of the world's mountains does not exist yet, with a conservative estimate of the world's mountain plant species is 50,000 species of flowering plants (out of total about 260,000) (Spehn *et al.* 2010).

MAMBILLA PLATEAU

Mambilla Plateau is the highest plateau in Nigeria, with a mean altitude of about 1524metres (5000 feet) above the sea level, but some hills are as high as 1828 metres (5997 feet) above the sea level and some mountains are even above 2000m (6562 feet) above sea level (asl), like Chappal Waddi mountain averaging about 2419m (7936 feet) asl, which is the highest mountain in Nigeria. The Plateau covers an area of 9389 square kilometers (3625sq. miles), found in Southeastern part of Taraba state of Nigeria, under Sardauna Local Government Area; sharing border with Cameroon. It contains several afromontane forest fringes scattered spread across the plateau and also harbouring a lot of wild animals. Hepper (1968) have emphasized the international significance of the North Eastern Nigerian montane flora, when he noted a high proportion of endemic species in the montane grassland. Several plant collectors have visited the plateau making a lot of collections, many of which are new to the already established Flora of Nigeria and West Africa. Figure 1 illustrates the location of Mambilla Plateau in Nigeria.

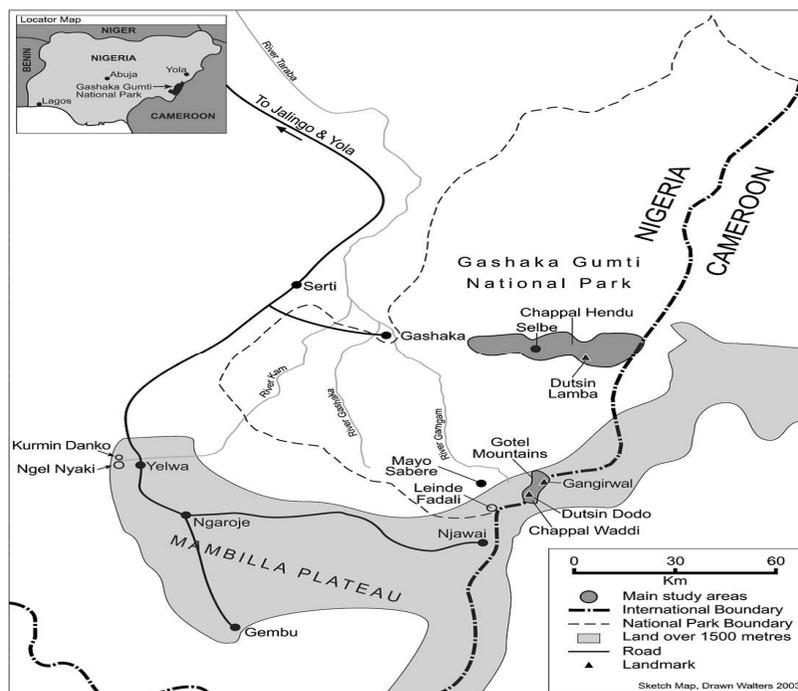


Figure 1. Map of Mambilla Plateau, Taraba State, Nigeria

Climate

Mambilla Plateau has a comparatively cold climate. The climate on this Plateau is of the mountain climate type, which is semi-temperate in nature. Day time temperature on the Mambilla Plateau hardly exceeds 25°C (77°F), making it the coldest Plateau region in Nigeria. Strong winds prevail throughout the day, and the rainy season lasts from the middle of March until close on the end of December. The rainy season on the Mambilla Plateau is associated with heavy and regular rains. This has been attributed to the relative steepness of the southwestern escarpment of the Plateau which comes in direct contact with the southwestern monsoonal winds from the South Atlantic Ocean in southern Nigeria during the rainy season from March to mid-December. The winds are forced to rise on coming in contact with the South Western escarpment of the Plateau which rises from a height of 200 metres (656 feet) in the nearby plains to over 1524 metres (5000 feet) at the top of the Plateau resulting in heavy rainfalls experienced on the Plateau during the rainy season. Rainfall is excess on the plateau and over 3000 mm (118.1 in) is thought to fall in the contiguous Chappal Waddi mountain area part of the Mambilla Plateau mountain chain. Rainy season lasts for an average of 250 days, from March to October (Iyamabo *et al.* 1972). Mean annual rainfall exceeds 1780mm with peaks in June/July and September. The dry season lasts for about three months between November and February.

Ngel Nyaki Forest Reserve shares similar climatic conditions with other areas of the Plateau, having a very cold weather for greater part of the year, often worse in the rainy season. Dry season is characterized by cold morning and evening with mild afternoon sunshine and winds. Rainy season is often characterized by torrential rains, very cold weather and less sunshine.

Soil

The grassland soils of Mambilla are humid ferrisols (Mould 1960). The soils derived from volcanic rocks are mainly silty loams with acidity (pH 5.6 – 6.0, decreasing with depth) from those derived from basement rocks. The soils from the basement rocks are a paler reddish brown with a relatively high quartz content and correspondingly low Base Exchange Capacity and little ability to hold nutrients or moisture. On the contrary, the soils of volcanic rocks have a slightly better nutrient status and higher clay content with a greater ability to retain moisture. The soils are sandy loam in the hills and forest soils in the forest fringes. Furthermore, the topography of the site is characterized by hills covered by montane grasslands and very steep slopes, interlocking spurs and valleys characterized by the forest fringes and fragments. In addition, some large boulders are found on the hills, while some of the hills are rocky.

At Ngel Nyaki Forest Reserve, there are some large rocks inside the forests which are catchment areas for close to ten spring water that run as streams and rivers within the forests and across the valleys. Owing to the cold weather of the place, the spring water is always very cold.

Anthropology of Mambilla Plateau

The area is populated by Mambilla people and Fulani herders. The Mambilla People are primarily farmers. Yelwa village appears to be the closest to the Ngel Nyaki Forest Reserve, a distance of about 40 minutes trekking. They cultivate maize for corn flour meal (tuwo). Mairiga (pers. comm.) stated that ‘Nyaki’ means ‘bean’, suggesting that they might have been cultivating beans in the past. The major agricultural crops here are coffee and tea, which are cultivated and sold in large quantities. Mambilla Plateau is the home to Nigeria and West Africa’s only highland tea plantations. Towns on the Mambilla Plateau are small with populations ranging from 100 to 5,000

people, which include Gembu (the largest town), Dorofi, Nguroje, Ngelforo, Wakili Buba and Maisamari. Other agricultural crops include plantain, a special variety of pepper which when ripe, the flesh is yellowish-orange instead of the common red colored ripe pepper fruits; and a special variety



of yam that resembles cocoyam. The Fulani people are cattle herders settling on the hills where they get grass for their animals. They also sell raw milk, cheese and yoghurt. These few pictures on Figures 2a-b and 3a-b illustrate the cattle herders and the Yelwa community respectively.



Figure 2a-b. Fulani cattle herders, their cattle and their sheds



Figure 3a-b. Section of the Yelwa community

Historical developments of Botanical Collections in Mambilla Plateau

According to Hepper (1966), the first botanical visitor to the Plateau is Mr. & Mrs. Gates in 1947. These were followed by about 50 collections made by the FHI collectors – M.G Latilo and B.O Daramola in January 1955. A more comprehensive collection (355 species) was made by Nigel Hepper in 1958, accompanied by Mr. B.O Daramola, assisted by J.W.F Chapman. Hepper and Daramola made a trek across the Plateau from Mayo Selbe in the north to Nkambe in the West Cameroons. En route, they passed by Ngel Nyaki forest and Hepper commented on its extent and possible rich diversity (Hepper 1966). He also commented on the fact that at Ngel Nyaki village, people were accustomed to hear the roar of lions (Hepper 1962). J.B Hall, Z. Gbile, B.O Daramola, Mrs. Medler and Miss J. Bowden (Kew) made further collections (Hall 1970) between March and April 1970. They made about 314 gatherings, of which 16 were possibly new to Nigeria.

Mr. C.F.A Onochie of Federal Department of Forest Research visited in March 1973. Same year, Dr. I. Colquhoun, the Senior Wildlife Officer visited the Forest, and was impressed by the abundant wildlife. The following year, Ngel Nyaki was

gazetted a game sanctuary. Jim Chapman's collections (over 3,000) were made between 1972 and 1978, comprising a high proportion of woody plants from forest patches throughout the plateau. In 1988, Françoise Dowsett-Lemaire explored the forests on behalf of the Nigeria Conservation Foundation (NCF) and produced a summarized account of the forest structure and species composition (Dowsett-Lemaire 1989). This account highlighted the size and floral diversity of Ngel Nyaki.

In 2001, the University of Canterbury, Christchurch, New Zealand established the Nigeria Montane Forest Project (NMFP) on the Ngel Nyaki Forest Reserve for extensive ecological and field studies. Dr. Hazel Chapman is the Director of the NMFP, being the daughter of Dr. Jim Chapman, who had made several botanical collections in the Forest Reserve in the 1970s. The NMFP is collaborating with NCF and Gombe State University on the management of the Forest Reserve. Researchers and students are welcomed to visit the site for research work.

BIODIVERSITY OF NGEL NYAKI FOREST RESERVE

There are about 15 forest fringes on the Mambilla Plateau, which include Ngel Nyaki Forest Reserve, Leinde Fadali, Sarkaka, Ndum Yaji, and other fringing forests; but Ngel Nyaki Forest Reserve is the most diverse forest (Chapman & Chapman 2001). Ngel Nyaki is located towards the western escarpment of the Mambilla Plateau. It is made up of a main forest and three forest fragments separated by hills covered by montane grasslands. The reserve is situated between latitudes

07° 05'N and longitude 011° 05'E at an altitude of 1,400m – 1,600m asl. The Reserve occupies about 46km² area of land, with about 7.2km² of submontane to mid-altitude forest. It was gazetted a Local Authority Forest Reserve under Gashaka Mambilla Native Authority Forest Reserve Order of 24 April 1969. Figure 4 shows the location of all the protected areas, including Ngel Nyaki Forest Reserve on Mambilla Plateau, while figure 5a-d shows the topography and part of the forests in Ngel Nyaki Forest Reserve.

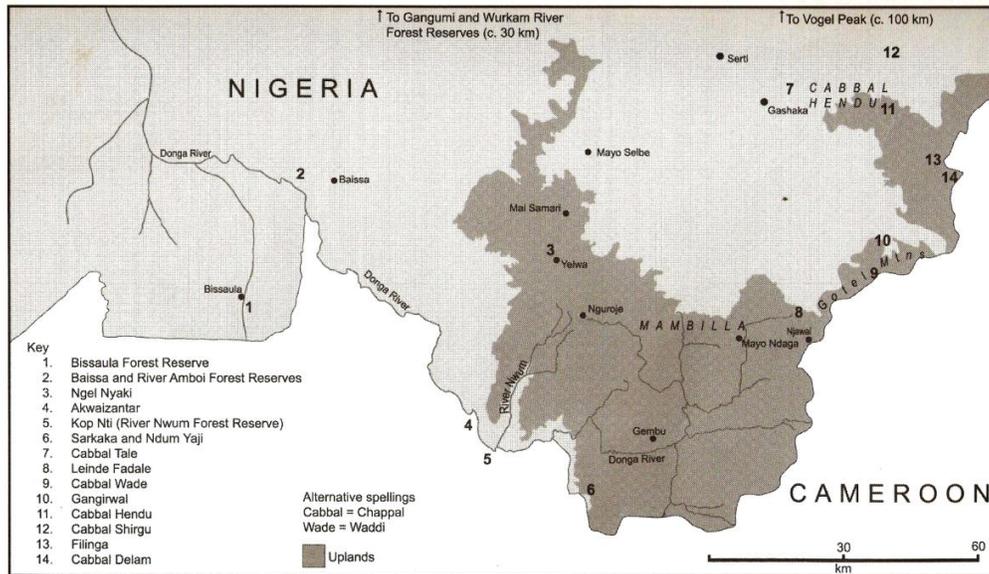


Fig. 4. Map showing Mambilla Plateau, Taraba State, Nigeria (Source: Chapman and Chapman, 2001)



Figure 5a-d illustrates the topography of the forest reserve

Online version is available at: www.crdeep.org

Ngel Nyaki was the most floristically diverse sub-montane forest in Nigeria. It harboured several threatened species and others unknown at that time elsewhere in West Africa (*Anthothena noldeae*, *Apodytes dimidiata* and *Pterygota mildbraedii*) and Nigeria (*Ficus chlamydocarpa* and *Isolona cf. deightonii*) (Dowsett-Lemaire, 1989). This diverse forest flora was reflected in the high number of primates and other animal species, and high bird species diversity (Hall 1976, Ash, Dowsett & Dowsett-Lemaire 1989).

Over 146 vascular plant species have been identified and collected by Dr. J.D Chapman, many of which are trees and are endemic to the Afromontane region. Furthermore, some of them are listed in the IUCN Red Data – *Entandrophragma angolense*, *Lovoa trichiloides*, *Millettia conraui* and *Pouteria altissima* – some others are new additions to the West Africa Flora – *Pterygota mildbraedii*, *Anthothena noldeae* and *Apodytes dimidiata*. Furthermore, plants such as *Isolona cf. deightonii* and *Ficus chlamydocarpa* are new to Nigerian flora. Till date, there are still many plants in the forest that are yet to be identified, and they are suspected to be new plants. There are 3 principal emergents: *Entandrophragma angolense* of 36.6m height, bole of 1.5m diameter and crown spread of 27m and massive surface roots radiating 15-20m; *Pouteria altissima* reaches maximum height of 46m, diameter of 1.8m. *Newtonia buchananii* can reach 38m, but is typically 31m tall (Chapman & Chapman 2001).

Associated with the wide floristic diversity are corresponding faunal diversity of large several herds of tanzania monkeys, duikers, birds, colobus monkeys, mountain gorillas, the Red Data Listed Chimpanzee, *Pan troglodytes* subsp. *vellerosus*,

putty nose monkeys (*Cercopithecus nictitans* cf subspecies *martini*) and black and white colobus monkeys (*Colobus guereza occidentalis*). Oates (2000, pers. comm.) noted that the Chimpanzees in the montane and submontane forests belong to the distinct subspecies *Pan troglodytes vellerosus* listed as ‘endangered’ by the IUCN Primate Specialist Group (IUCN, 2000). He also noted that the putty-nose monkey (*Cercopithecus nictitans*, cf subspecies *martini*) needs taxonomic review and suspects that the Mambilla putty noses may be different from those in the Gashaka lowlands.

Surprisingly, despite the obvious poaching pressures, mammals and birds were still relatively abundant. Primates were not especially shy; we saw a troop of at least 30 putty-nose monkeys *Cercopithecus mona* and a family of chimpanzees *Pan troglodytes vellerosus*, as well as several chimpanzee nests. Black and white colobus monkeys, many baboons and c. 10 buffalo *Syncerus caffer* were also sighted. Ngel Nyaki is also classified as an Important Bird Area (Fishpool & Evans 2001). Snakes are very rare there due to the very cold weather on the plateau which is unfavourable to the poikilothermic nature of the snakes. The table 1 below gives a list of the economic plants found in the area that are listed in the IUCN Red Data List (IUCN 2000).

No doubt, this Forest Reserve has high biological diversity of plants and animals, many of which have great economic significance, and are highly endangered and endemic to that area. The appendices 1 and 2 give full lists of all tree species and the birds in the Forest reserve respectively. Figures 6 a-f depicts the some of the biodiversity of the Ngel Nyaki Forest Reserve.

Table 1. List of Plants in Ngel Nyaki Forest Reserve that are present in the IUCN 2000 Red Data List

S No.	Plant name	Family
1	<i>Peucedanum angustisectum</i> (Engl.) Norman	Apiaceae
2	<i>Lobelia columnaris</i> Hook. f.	Campanulaceae
3	<i>Wahlenbergia ramosissima</i> (Hemsley) Thulin subsp. <i>ramosissima</i>	Campanulaceae
4	<i>Bafutia tenuicaulis</i> C.D Adams	Asteraceae
5	<i>Helichrysum cameroonense</i> Hutch & Dalziel	Asteraceae
6	<i>Vernonia bamendae</i> C.D Adams	Asteraceae
7	<i>Stachys pseudohymifusa sebsebe</i> subsp. <i>saxeri</i> Y.B Harv.	Lamiaceae
8	<i>Crotalaria bamendae</i> Hepper	Leguminosae
9	<i>Crotalaria ledermanii</i> Baker f.	Leguminosae
10	<i>Millettia conraui</i> Harms	Leguminosae
11	<i>Entandrophragma angolense</i> (Welw.) C.DC	Meliaceae
12	<i>Khaya grandifoliola</i> C.DC	Meliaceae
13	<i>Lovoa trichiloides</i> Harms	Meliaceae
14	<i>Eugenia gilgii</i> Engl. & Brehm	Myrtaceae
15	<i>Polygala tenuicaulis</i> Hook f. subsp. Tayloriana J. Paiva	Polygalaceae
16	<i>Prunus africana</i> Hook f.	Rosaceae
17	<i>Chassalia laikomensis</i> Cheek ined.	Rubiaceae
18	<i>Pouteria altissima</i> (A. Chev.) Baehni	Sapotaceae
19	<i>Dombeya</i> cf. <i>ledermanii</i>	Sterculiaceae
20	<i>Carex preusii</i> K. Schum	Cyperaceae
21	<i>Eriocaulon asteroids</i> S.M Phillips	Eriocaulaceae
22	<i>Eriocaulon bamendae</i> S.M Phillips	Eriocaulaceae

23	<i>Raphia mambillensis</i> Otedoh	Araceae
24	<i>Xyris</i> sp.	Xyridaceae
25	<i>Irvingia gabonensis</i>	Irvingiaceae

a. A dominant shrub on the mountains



b. A pack of “shy” tanzalus monkeys



c. Forest escarpment



d. Bryophytes growing on the tree



e. An orchid species



f. A tree fern

**Figure 6a-f.** Pictures illustrating the biodiversity of Ngel Nyaki Forest Reserve***Significance of the Forest Reserve***

African montane forests are of high conservation priority because of their complex origin and evolutionary history (White 1981, 1983). Approximately 50% of the tree species described here are Afromontane endemics or near endemics (Dowsett-Lemaire 1989), and others are mainly confined to the Nigerian/Cameroonian highlands (Hall 1988). The forests

are globally important for their bird fauna (Stattersfield *et al.* 1998), are rich in larger mammalian species, and have a high diversity of smaller mammals, reptiles and amphibians (Dowsett-Lemaire, 1989, Dunn 1999). Caps of montane forest in this region are important for watershed conservation. Without this protection little or no water is available in the dry season in many places (Bawden & Tuley 1966). Several forest

plants are currently used by the local people for food and medicine (Low 1996). The lowland and transitional forests have traditionally been used as a source of food, leaves, beeswax and palm wine. Several timber trees abound. The montane forests have a vital protective function of maintaining year-round stream flow, mitigating erosion and flooding and a refuge to wildlife.

CONSERVATION STATUS OF THE FOREST RESERVE AND MAMBILLA PLATEAU

Before the forest is gazetted as a reserve, several animals have been lost, one of which are the lions. Hunters have dealt a huge blow on the lions, buffalos and other big animals wiping them all from the area in the 1980s (Mairiga pers. comm.). In addition, the Yelwa village was originally located on the hills in the Ngel Nyaki Forest, but they were relocated to their present site about 2km away from the reserve because of incessant poaching.

Chapman *et al* (2004) reportedly observed in 2002, physical damage to the forest in form of slash and burn agriculture was

infringing on the lower slopes of the reserve, there were several abandoned farms of about 1.5 km² within the reserve boundary, and cattle trampling within the forest and along its edge was causing soil erosion. Hunting pressure was higher than in any of the other forests in that area and several leg-hold spring traps and snares were found, some of which contain duiker. Informants (local people from Yelwa village who sometimes patrol the forest for hunters on a volunteer basis), presented us with a further 22 wire snares that they had collected over the previous few months (Chapman *et al.* 2004).

However, the communities on the Mambilla Plateau were encouraged to plant *Eucalyptus* sp. which has now become their main source of timber. Several large Eucalyptus plantations could be observed along the way to the reserve and along the borders of the reserve. Eucalyptus plantations were also observed all along the way up till Gembu, Nguroje and other settlements on the Mambilla Plateau. Figures 7a and 7b below illustrate the Eucalyptus plantations.



Figure 7a-b. Pictures showing the Eucalyptus plantations

It is interesting to note that the plantations are owned by individuals and the community, and there are ready markets in Gembu, Mutum Biyu, Jalingo, Katsina Ala, Makurdi and other areas in the Northeastern Nigeria. The timber from Eucalyptus is used for building and construction purposes, as well as the young boles are used as poles and mainly as firewood. This was observed as a great source of income to the people because Eucalyptus is a fast wood, reaching maturity within 7 to 10 years. Harvesting was done in such a way that the felled tree can regenerate naturally. In this way, no one goes into the forests to fell the trees. One would wish that this kind of arrangement can be adopted in other parts of Nigeria, especially in the Southern parts of Nigeria where deforestation is still very high and illegal felling of trees is notoriously sustained.

It was perceived that the presence of Gashaka-Gumti National Park in that area also helps in protecting Ngel Nyaki Forest Reserve because of the heavy presence of Custom officers, the Nigerian Army and the Park guards. As a result, any unregistered timber transported will be impounded and the offenders would be prosecuted. In addition, there are also some forest patches earmarked as buffer zones to the Forest Reserve for effective protection and management of the

Online version is available at: www.crdeep.org

reserve. The topography of the areas surrounding the Forest Reserve is very difficult for the illegal fellers and their vehicles to penetrate, as the rocky and hilly slopes are very steep. Besides, the NMFP has several employed forest guards who navigate the reserve and arrest any intruder. However, for more effective protection of the forest reserve, the author would like to join the Nigeria Conservation Foundation (NCF) in the call to incorporate Ngel Nyaki Forest Reserve into the Gashaka-Gumti National Park.

The most threatened habitats are lowland rainforests lying outside the Gashaka-Gumti National Park. Some of the forests in the Mambilla Plateau have statutory protection as forest reserves, few are within the Gashaka-Gumti National Park, and a number have no protection other than inaccessibility and local taboos. Baissa Forest Reserve had been logged out by the mid 1980s (Dangpurki pers. comm.) and there is increasing pressure on nearby River Amboi Forest. The taboo which formerly protected the Akwaizantar forest from hunting no longer applies (Hopkins pers. comm.). In addition, there are several other forest fringes on the Mambilla Plateau, as described by Chapman & Chapman (2001) that are yet to be protected as a reserve and are already threatened since the 1970s. There is the need to protect these forest patches too, as

they contain a lot of important endemic and Red Data listed tree species. These areas include Leinde Fadali which is protected by local custom; Sarkaka and Ndum Yaji where slash and burn and agricultural activities are posing great threat to the forests, with many of the trees already felled to serve the Gembu timber market. Some of the economic trees in these areas include *Piper guineense*, *Marantochloa sp.*, *Canarium schweinfurthii*, *Piptadeniastrum africanum*, *Myrianthus arboreus*, *Pycnanthus angolense* etc. Stands of *Hallea stipulosa* which occurred at Mayo Tolori and at Kabri were especially endangered because they have been felled and is much sought after for timber. The Fulani herders are notorious for bush burning on the montane grassland across the Mambilla Plateau (Barnwell, 1993) in the dry season and this greatly affects the survival of the forest tree seedlings and dispersal of the seeds. The human population on Mambilla has grown since then, and so the demands on fringing forests will have increased, their protection is of paramount importance. Kurame and fetish groves are under increasing threat, as superstitions (once responsible for their protection), lose their plausibility; and as the need for wood and food become greater.

By the late 1990s, 850 Fulani were resident on Chappal Hendu (Dunn *et al.* 1998), and in January 2002 there was an influx of more Fulani and their cattle following land rights disputes between the Fulani and Mambilla people living on Mambilla Plateau. This increase in population has accelerated the pressure on the environment (A. Nicholas, pers. com). Forest fragments are now restricted to stream banks, where their survival is precarious because of wood extraction and cattle trampling. None of these fragments has the floristic diversity or tall trees of the 1970s. For example, *Newtonia buchananii*, then common (Chapman & Chapman 2001), was not seen in 2002, and several fragments have been reduced to almost monocultures of *Syzygium guineense* subsp. *guineense*. Especially noticeable was the total destruction of a *Syzygium globulifera* – *Garcinia smeathmannii* forest on the western slopes of Chappal Hendu, which was cleared for farming during the mid- 1980s. Although the farmers were moved out in 1993 (R. Barnwell, pers. com.), cattle still grazed in the area, preventing regeneration. The tussock grass *E. argenteus* has mainly disappeared, and *L. columnaris* is uncommon. *Sporobolus* grass, tolerant of cattle grazing (Bawden & Tuley 1966), has almost totally replaced *Hyparrhenia* and *Loudetia* spp. Everywhere on Chappal Hendu suffers from cattle grazing, trampling and a consequent reduction in regeneration. Erosion is especially severe along tracks.

There have been major changes on Dutsin Lamba. Cattle now graze all along the forest edge, entering it and causing damage, especially along streams. There has been an almost total depletion of grassland species sensitive to grazing. For example, in 2002 no *Erica mannii* or *Gladiolus melleri* were observed and *Sopubia ramosa* was confined to the very top of the highest hill on Dutsin Lamba. *L. columnaris* is now rare. There has likewise been a major depletion in wildlife: only five buffalo and two bushbucks were observed in studies carried out in Dutsin Lamba in 2002.

Furthermore, on the upper reaches of Gangirwal, Fulani herdsmen and their shelters are tolerated by the Park game guards, and we saw evidence of cattle everywhere on the mountain. Patches of grassland are dominated by kikuyu grass, *Pennisetum clandestinum*, an introduced species restricted to cattle holding sites. *E. mannii* and *S. ramosa* are now restricted to steep cattle-free slopes, and bracken, *Pteridium aquilinum*, has spread into the grassland. Cattle-induced soil erosion and compaction is especially pronounced in gullies and along tracks. Fires have continued to encroach along the forest edge, and in some places on Chappal Waddi the shrubby ecotone has been destroyed.

Despite Leinde Fadali being incorporated into Gashaka Gumti National Park in 1991, the most obvious changes to the forest are associated with increased population pressure. Cattle now graze right up to the forest edge and temporary Fulani shelters are within 100 m of the reserve boundaries. Cattle enter the forest, and their trampling has led to soil compaction and erosion, especially along stream banks. The scarcity of wildlife observed in 2002 compared with Chapman's 1970s sightings and the obvious timidity of those seen (only a few warthog *Phacochoerus africanus* and a bushbuck *Tragelaphus scriptus*) are evidence of intense hunting pressure. However in 2002, chimpanzees were heard and several recently used chimpanzee nests were found. The forest flora is still intact, and we collected a previously unknown Acanthaceae from the genus *Metarungia* (K. Vollesen, pers. com). Its closest relatives are in East Africa.

The most obvious changes to the montane environment are the decline in large mammal numbers, soil erosion (especially in the grasslands), and change in grassland floristic composition. While it is unlikely that any forest mammal has become extinct (Dowsett-Lemaire 1989), some species are becoming rare. For example the giant forest hog *Hylochoerus meinertzhageni*, considered 'probably common' in the Gotel Mountains during the 1980s (Dowsett & Dowsett-Lemaire 1989), is not so today. The grassland mountain reedbuck *Redunca fulvorufula*, common in the 1970s (J.D. Chapman, pers. comm.), was rare in 1989 (Dowsett & Dowsett-Lemaire 1989), and we found no evidence of them in 2002.

This dramatic decline in mammal numbers may be very recent on Gangirwal; Saidu Isa reported dramatic declines since his previous visit in 2000. The forests are still rich in bird species (Dunn 1999, Fishpool & Evans 2001) including the great blue tauraco *Corythaeola cristata* and the bar-tailed trogon *Apaloderma vittatum*, in contrast to the Kilum-Ijim forest in Cameroon, where most of the larger mammals and the great blue tauraco are now extinct (Maisels *et al.* 2001). However, the ecology of the smaller fragments and grassland has changed dramatically in response to increased cattle grazing and burning.

The most obvious physical threats facing the forests within Gashaka Gumti National Park, both inside and outside the enclaves, are cattle grazing and fire damage, as on Mt Oku in Cameroon (Cheek *et al.* 2000). A more subtle threat to forest ecology may be reduced recruitment because of declining frugivore numbers (Cordeiro & Howe 2001). 80% of montane

forest trees are animal-dispersed in Malawi (Dowsett-Lemaire 1988) and Cameroon (Maisels *et al.* 2001). Chimpanzees are likely to be important seed dispersers of larger seed, especially as other common monkeys are seed-spitting cercopithecines (Chapman 1995), and because birds with gapes wide enough to ingest large seeds, such as tauracos (*T. persa*, *T. leucolophus* and *Musophaga violacea*) and pigeons (*Columba*



sjostedti) (Dunn 1999), are now less common (J.D Chapman pers. com.). Trees with large fruits dispersed by animals, which may be especially vulnerable to frugivore decline, include the common *S. guineense* subsp. *guineense* and *S. guineense* subsp. *bamendae*, *Carapa grandiflora* and *Mystroxyllum aethiopicum*. Figure 8 presented below illustrate the burning of the montane grasses by the Fulani herders.



Figure 8a-b. Burning of the montane grassland by the Fulani herders

CONCLUSION

In conclusion, the government needs to show more commitment in the conservation of biological resources in Nigeria. On Mambilla Plateau, the visiting Fulani herders seem to be very adamant in the disrespect for the conservation of nature and the associated laws, despite the fact that the “land owners”, that is, the Mambilla people have been comparatively “cooperating”. There is the need for decisive actions to arrest and prosecute the law breakers and possibly drive them away from the Plateau. Furthermore, there is the need to increase the personnel on patrol of the large expanse of protected areas on the Mambilla Plateau.

ACKNOWLEDGEMENT

The study was funded through the 2010 Small Grant Programme of Tropical Biology Association (TBA). We are also grateful to Dr. Hazel Chapman, Director of Nigerian Montane Forest Project, for granting us the permission to conduct the research in Ngel Nyaki Forest Reserve.

REFERENCES

Ash, J.S., Dowsett, R.J. and Dowsett-Lemaire, F. (1989). New ornithological distribution records from eastern Nigeria. In Dowsett, R.J. *Tauraco Research Report 1*. Tauraco Press, Ely, UK.

Barnwall, R. (1993). “WWF/NCF Wildlife Conservation Initiatives in Nigeria”. In *Wildlife Conservation in West Africa*. Proceedings of a biennial Symposium of the Nigeria Field Society (UK Branch) in association with WWF (UK). NFS Occasional Paper No. 1.

Bawden, M. and Tuley P. (1966). The land resources of Southern Sardauna and Southern Adamawa provinces, Northern Nigeria. In *Land Resource Study, No. 2*. Land Resource Division, Directorate of Overseas Surveys, Tolworth, UK.

Chapman, J.D. and Chapman, H.M. (2001). *The Forests of Taraba and Adamawa States, Nigeria. An Ecological Account*

and Plant Species Checklist. University of Canterbury, Christchurch, New Zealand.

Cheek, M., Onana, J. and Pollard, B. (2000). *The Plants of Mount Oku and the Ijim Ridge, Cameroon: A Conservation Checklist*. Royal Botanic Gardens, Kew, UK.

Cordeiro, N. and Howe, H. (2001). Low recruitment of trees dispersed by animals in African forest fragments. *Conservation Biology*, 15, 1733–1741.

Dowsett-Lemaire, F. (1988). Fruit choice and seed dissemination by birds and mammals in the evergreen forests of upland Malawi. *Revue d'Ecologie (Terre et Vie)* 43, 251–285.

Dowsett-Lemaire, F. (1989). Physiography and vegetation of the highland forests of eastern Nigeria. *Tauraco Research Report*, 1, 6–12.

Dowsett, R.J. and Dowsett-Lemaire, F. (1989). Larger mammals observed in the Gotel Mts and on the Mambilla Plateau, eastern Nigeria. In R.J. Dowsett. *Tauraco Research Report 1*. Tauraco Press, Ely, UK.

Dunn, A. (1993). A preliminary survey of the forest animals of Gashaka-Gumti National Park, Nigeria. Unpublished report for WWF-UK and the NCF. Contract reference NG0007 (4686).

Dunn, A. (1998). *Gashaka Gumti National Park: A Management Plan for Developing the Park and its Support Zone*. Draft Unpublished Report. Nigerian Conservation Foundation, Nigeria and WWF.

Dunn, A. (1999). *Gashaka Gumti National Park – A Guide Book*. National Parks Service of Nigeria in collaboration with the Nigerian Conservation Foundation & WWF, Lagos, Nigeria.

Fishpool, L.D.C. and Evans, M.I. (2001). *Important Bird Areas in Africa and Associated Islands*. Pisces Publications, Newbury, UK.

Hall, J.B. (1970). Report on an expedition to Sardauna Province, North Eastern State. 20th March – 10th April, 1970. Ife University Herbarium Bulletin No. 6.

Hall, P. (1976). The birds of Mambilla Plateau. *Bulletin of the Nigerian Ornithological Society*, 12, 67–72.

- Hall, J.B. (1988). "Highlands of Eastern Nigeria: A Re-examination of Conservation Interest". A paper presented at the Nigerian Field Society Symposium on the Conservation of Nigerian Ecosystems, Flora and Fauna, held at Corpus Christi College, Cambridge, 8–9 July 1988.
- Hepper, N. (1966). Outline of the vegetation and flora of Mambilla Plateau, Northern Nigeria. *Bulletin I.F.A.N.T XXVIII, Ser. A, No. 1.*
- Hepper, N. (1968). West Tropical Africa, a regional synthesis. *Acta Phytogeogr. Suec.* 54r:98-105.
- Ihuma, J. (2006) The Influence of Frugivore Community on Forest Fragment Regeneration in Ngel Nyaki Forest Reserve, Taraba State, Nigeria. Unpublished Thesis submitted to the Department Forestry and Wildlife Conservation, Federal University of Technology Yola, Adamawa State, Nigeria.
- IUCN (2000). IUCN Red Data List Categories. IUCN, Gland, Switzerland.
- Low, L. (1996). Non-timber Forest Products: A Study of Their Use and Value to the People of Gashaka Gumti National Park, Nigeria. MSc thesis, University College London, London, UK.
- Maisels, F., Keming, E., Kemei, M. and Toh, C. (2001). The extirpation of large mammals and implications for montane forest conservation: the case of the Kilum-Ijim Forest, North West Province, Cameroon. *Oryx* 35: 322–331.
- Spehn E.M., Rudmann-Maurer, K., Korner, C. and Massali D. (2010). Mountain Biodiversity and Global Change. *GMBA-DIVERSITAS*, Basel.
- Stattersfield, A.J., Crosby, M.J., Long, A.J. and Wedge, D.C. (1998). *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*. BirdLife International. Cambridge, UK.
- White, F. (1981). The history of the Afromontane archipelago and the scientific need for its conservation. *African Journal of Ecology*, 19: 33–54.
- White, F. (1983). *The Vegetation of Africa*. UNESCO, Paris, France.