

Nigerian Montane Forest Project
Montane Forest Conservation Initiative Nigeria



Annual Report



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Introduction



Anastasios (Tasso) Paul Leventis - Patron



Phil Hall (Chair)



John Adeyemi Adeleke



Roger Wilkinson



Danladi Umar



Hazel Chapman

This year's annual report features our research, capacity building, forest conservation and community initiatives. This diversity of activities reflects the energy and dedication of our staff and students. Manager Misa Zubairu and his deputy, Usman Abubakar take ideas and make them happen; the management committee go out of their way to ensure accountability and all staff strive to make their personal contribution matter.

As always our Advisory Board provide the guidance, connections and support that are so important. Their hands on influence spans student support to community initiatives.

This year the Project has benefited from the support and dedication of the Forest Management Committee of community leaders. The committee liaises on our behalf with the Local and State government over challenges faced by the forest reserve.

Matt Walters from UC works behind the scenes to promote the Project, this annual report being only one example of his work. Matt also maintains the NMFP website, Facebook and Twitter sites.

I am grateful to Dr's Danladi Umar, Kennedy Poloma and Babale Aliyu, all lecturers at Gombe State University who liaise with Misa to offer advice and help resolve issues to ensure the smooth running of the Project while I am in New Zealand.

People outside the Project also make a difference. For example, Chris Newsom based in Port Harcourt with Stakeholder Democracy Network but from Christchurch, NZ, linked the Project into meetings in Abuja with USAid, the Canadian and British High Commissions and other forest NGO's. This grows the Project's profile in Nigeria and opens possibilities for more local community initiatives.

Of course without our funders none of this could happen and we are eternally grateful to you all.

T.Y. Danjuma



Taraba State Government

Hazel Chapman

Director, Nigerian Montane Forest Project

Our values

Mission Statement

To promote national and international commitment to the conservation of Nigeria's montane forests by inspiring excellence in research by postgraduate students and empowering local communities through employment and education.

Aims

1. To combine scientific research with education at both tertiary and local community level in order to develop long term sustainable management of Nigeria's montane forests.
2. To facilitate the involvement of national and international researchers in Nigerian montane forest research.
3. To involve the community in the management of montane forest ecosystems.
4. To work with the community in other ways, such as developing small businesses and working with schools to develop conservation awareness.

Our networks

Project Partners / Collaborators

A.P. Leventis Ornithological Research Institute (APLORI), Jos, Nigeria
Chester Zoo, England
Federal University of Kashere (FUK), Nigeria
Gashaka Biodiversity Project, England/Nigeria
Gombe State University (GSU), Nigeria
Mayfield Community Ecology Laboratory, The University of Queensland, Australia
Nigerian Conservation Foundation (NCF), Nigeria
Nigerian National Parks (NNP), Nigeria
Professor Pierre-Michel Forget, Natural History Museum, Paris, France
Royal Botanic Gardens, Kew, England
Smithsonian Tropical Research Institute-ForestGEO, USA
Taraba State Government, Nigeria
Taraba State University (TSU), Nigeria
University of Canterbury (UC), New Zealand

Project Funders

A.G. Leventis Foundation
A.P. Leventis
Chester Zoo
Direct Aid Program (DAP) – Australian High Commission, Nigeria
Ministry of Foreign Affairs and Trade New Zealand
Nexen, a wholly-owned subsidiary of CNOOC Limited
Smithsonian Institute
Taraba State Government
Retired General T.Y. Danjuma

Academic Supervisors

Assoc Prof Hazel Chapman (UC)
Dr Alexander Christianini (Federal University São Carlos, Brazil)
Prof Will Creswell (University of St Andrews, UK)
Dr Matthius Deling (UC)
Prof Pierre-Michel Forget (Natural History Museum, Paris, France)
Dr Daniel Gerhard (UC)
Dr William Godsoe (Bio-Protection, Lincoln University, NZ)
Dr Marie Hale (UC)
Assoc Prof Alex James (UC)
Dr David Kenfack (Smithsonian Institute, Washington D.C. USA)
Dr Shiiwua Manu (APLORI)
Dr Roger Pech (Landcare Research, Lincoln, NZ)
Dr Mike Plank (UC)

Research Highlight:

Establishing the value of a planted seedling



Figure 1 Augustine Ntim measuring *Pouteria altissima* seedlings in the nursery before they are planted into the grassland.

The value of planted tree seedlings in attracting natural seed dispersers:

This year George Godson (recent graduate of Taraba State University and ex NMFP IT student) and Augustine Ntim (NMFP field assistant) undertook a census of all the seedlings the NMFP has planted into grassland since 2006 in a forest restoration initiative. The aim of the census was to determine which species of forest trees are most useful to plant into grassland in order to attract frugivores (birds, bats and monkeys). Frugivores mainly use the planted trees as perches (most of the trees are too young to produce fruit) - the more time the frugivores spend in the trees, the more seeds they poop out under the crown, thereby speeding up the establishment of a new forest.

George and Augustine, with the help of Gombe State and Taraba State University IT students, recorded species, height, crown diameter, diameter at breast height (DBH) and nearest neighbour of all seedlings planted between 2006–2016. In addition they have counted and recorded the species name of every tree seedling below the crown of each tree. This has produced a data file with over 2000 'trees' – the planted seedlings and 4545 seedlings.



Figure 2 Shedrach Kongvong (left) and Ridwan Jafar setting up seed traps below a small tree, planted in 2007. The seed trap shows us what seeds are being brought into the grassland by frugivores.



Figure 3 The field station in 2005 and 2016. Note the *Albizia gummifera* tree in the 2005 photo has since died. Much of the forest restoration has been funded by the Australian Direct Aid Program (DAP).

These data are being analysed back at UC by Keely Carter, a student volunteer in her second year of a BSc degree majoring in math/biology.

Building on this data set, a Taraba State University IT student Ridwan Abdullahi is working with Shedrach Konvong (Tasso Leventis science coordinator) to determine which functional traits of the trees are responsible for attracting which bird species. Ridwan and Shedrach are also matching up tree functional traits with bird functional traits. For example, regardless of species, it may be that planting a tree which has dark, thick foliage is more attractive to frugivores than a more open crown. Alternatively, tree height may be more important than crown type, so that in that case, planting fast growing tree species may be best. Looking at functional traits rather than species makes our findings more applicable to a wider range of forest types.

More than this, by setting up seed traps under the tree crowns the research group are finding out which seed species are deposited below the regenerating canopy.

This type of information is extremely valuable in improving forest restoration; by initially planting the most attractive species to frugivores, passive restoration will follow and a species rich forest, with fully functional ecosystem services can develop.



Figure 4 IT students help in the census of planted seedlings.

A snapshot of our science



Figure 5 A chimpanzee caught in one of Biplang's camera traps. It was really 10.32 AM Nigeria time.

Every year our team uncover interesting and sometimes unexpected findings, all of which add to the knowledge we have of this unique forest reserve. Here we share a few of the latest research findings.

Ngel Nyaki chimpanzees prefer to nest in *Anthanatha noldea* trees

Dr Paul Dutton has recently published a paper in *Folia Primatologica* titled 'Nesting ecology of a small montane population of the Nigerian/Cameroon Chimpanzee (*Pan troglodytes ellioti*) in Nigeria'. Based on his PhD research at Ngel Nyaki, Paul and field assistant Alfred Christopher have shown that the Ngel Nyaki population of chimps is very particular when it comes to choosing a nest site—nests are always in one of just 35 tree species (28% of all available species in Ngel Nyaki forest)—and *A. noldea* is the most popular tree species. More than that, nest sites are on steep slopes and nests are in smaller than average trees. Why this behaviour has evolved is another question and one that needs addressing; understanding nest site choice by chimpanzees has implications for ecology, anthropology and in the collection of census data, yet it remains controversial.

***Anthanatha* seeds germinate and thrive when sown directly into the grassland**

During 2015 as part of the Australian High Commission, Nigeria, Direct Aid Program (DAP) restoration project over 2,000 seeds of the light loving forest tree species *Anthanatha noldea* were sown directly into grassland, instead of growing the seedlings in the nursery first. *Anthanatha* has a large seed, and we were unsure if the seeds would (1) survive predation by the African Giant Pouched Rat and/or porcupines (2) germinate in the dense grassland where competition is high and 3) survive the extremely dry conditions of the dry season. So far, so good, and after the first dry season healthy *Anthanatha* seedlings are currently thriving in dense grassland. We shall continue to monitor and experiment with this technique with other species.



Figure 6 Iveren with Helen and Ali, double entering data from the Smithsonian Plot.

Ants play less of a role in seed dispersal than we expected

Research by PhD candidate Jennifer Agaldo and her field assistants Thomas Patrick and Musa Bawuro has shown that despite the high density of ants within Ngel Nyaki forest, the forest-edge and surrounding grasslands, ants interact with very few seed species (see Jennifer's report on page 14). This is an important finding and quite unexpected. Most previous tropical studies on ant dispersal are from Australia or the Neotropics where ants play a major role in the dispersal of small seeds. An explanation may be that birds disperse more seeds in montane forest—the proportion of birds relative to primates certainly increases with altitude in the tropics and there is some evidence that ants become less diverse.

Over 40,000 trees mapped, labelled and measured in the TY Danjuma Smithsonian CTFE ForestGeo plot

The first census of the TY Danjuma Smithsonian CTFE ForestGeo plot is now complete. 41,033 stems from 137 tree species have now been labelled, measured, mapped and the data is ready to be entered into the Smithsonian database. Two people enter the data independently. The database software then compares both entries, so that discrepancies can readily be picked up and corrected. When it is complete the data from the first Ngel Nyaki census will be added to the Smithsonian data base in Washington DC.

The rest of the TY Danjuma field assistants are continuing to work on the Plot, replacing labels removed by baboons, carrying out a 'dead tree' census and replacing plastic piping plot markers along the streams with more solid concrete ones.

The Plot needs vigilance, three fulltime watchmen ensure that no cattle ever enter the grassland adjacent to the plot. It is important work and we hope that in the future a live fence post of *Ficus* and an extremely thorny *Solanum* species will keep cattle out.

Tinkerbirds are frequent visitors to all mistletoes

Daniel Andrawus of Gombe State University worked with field assistants Yakubu Vugeh and Hamadu Usman to investigate which frugivore species are responsible for seed dispersal in the local mistletoes - *Globimetula braunii*, *G. oreophila*, *Agelanthus brunneus*, *A. oreophila*. An interesting finding was that all mistletoes in Ngel Nyaki are visited (and therefore presumably dispersed) mostly by two species of birds- the yellow-rumped tinkerbird (*Pogoniulus bilineatus*) and Western tinkerbird (*Pogoniulus coryphaea*). Tinkerbirds on the other hand appear to be generalists, feeding off a wide variety of fruit species. This is not a surprise, as tinkerbirds are well known for their mutualistic relationship with mistletoes- however the detail of this mutualism has never been investigated in a West African montane forest.

Visitors



Figure 7 Visit from Chester Zoo (Stuart and Ben) with Hazel, Umar and Shedrach.

Ngel Nyaki continues to attract a steady stream of national and international visitors. The research teams are attracted to this rare and biodiverse forest reserve in large part because of the high quality facilities we operate and the long term stability of the Project.

Chester Zoo

Stuart Nixon (Field Programmes Coordinator) and Ben Buckley (Primatologist, University of Cambridge) accompanied by Buba Umar Nformi (Gashaka Biodiversity Project) visited Ngel Nyaki in April to see how the Project was going and discuss potential collaborations. Areas of scientific expertise complement each other; Chester Zoo scientists are experts in wildlife conservation while the NMFP has a greater focus on plants and plant-animal interactions. One possibility is to use the relatively easy

accessibility of Ngel Nyaki chimpanzees compared to their Gashaka neighbours to better understand aspects of their behaviour.

Royal Botanic Gardens, Kew and National Centre for Genetic Resources and Biotechnology, Ibadan

Sina Omosowon and Alexander Giwa visited Ngel Nyaki during the rainy season to collect genetic material of *Dioscorea*. This is in order to aid in the development of better yam cultivars for Nigeria in a time of changing climate and food insecurity, see their report on page 12.

University of Ibadan

Two academics from the Department of Botany, Drs Oso Oluwatobi and Okanume Esther visited with Sina Omosowon to collect species of *Solanum* from Ngel Nyaki forest and surrounds. As with Sina's *Dioscorea*, this was part of a larger project into the biodiversity of Nigerian *Solanum*.

University of Benin

Professor Chris Oke, a zoologist with a specialization in mollusc ecology spent time with the NMFP while collecting snails for a taxonomic study of the area. Again, the NMFP provided

logistical support (see Professor Oke's report page 13).

Nigerian Conservation Foundation (NCF)

Our collaborators Luka Joseph and Mohammed Garba Boy from NCF visited during a trip to the Plateau to talk with the local community about the impacts of logging on the environment.

University of Exeter UK

Internationally, interest in Ngel Nyaki has increased considerably, primarily because of the CTFS-ForestGeo plot (www.ctfs.si.edu/site/Ngel+Nyaki), of which Chester Zoo is a partner. The first official collaboration is with Drs Tim Hill and Ted Feldpausch (University of Exeter) and Dr Edward Mitchard (University Edinburgh) in a grant funded through the UK Research Council, looking at the mechanism and extent of lightning mortality of trees.

We are also collaborating with several other CTFS ForestGeo plots in a study, headed by Professor Simon Lewis from the University of Leeds, into the influence of El Niño on tree mortality.



Figure 8 Sina Omosowan (centre) RBG Kew with colleagues from the University of Ibadan and the National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan.



Figure 9 Professor Chris Oke's visit with his students and NMFP staff and students.



Figure 10 Visitors from Gashaka gumti national park



Figure 11 With Misa are NCF visitors Boyi Garba, Northern Coordinator; Solomon Adefolu, Climate Change Officer, and Luka Joseph, a local guide.

University of Technology, Yola

Meer Bernad Bunde from Modibbo Adama University of Technology, Yola, visited the NMFP to investigate the diversity of woody species in the forest. This was part of a wider study determining forest structure in three different ecological zones within Taraba State.

Nigerian Minister of State for the Environment visits New Zealand

The Minister of State for the Environment Mallam Ibrahim Usman Jibril was in Christchurch New Zealand in June, to attend a research conference. This provided him with an opportunity to meet the Nigerian NMFP PhD students studying at UC.



Figure 12 The Minister of State for the Environment Mallam Ibrahim Usman Jibril in Christchurch, NZ where he met with NMFP UC students Auwal Abdullahi, Murna Tela, and Jennifer Agaldo.



Figure 13 Looking for *Dioscorea* in the grasslands with the help of Diaru, Nigerian Montane Forest Project field assistant.

Royal Botanical Gardens, Kew *Dioscorea* expedition to Mambilla Plateau

Sina Omosowon, a PhD student of Imperial College London working through Royal Botanic Gardens, Kew, London, under the supervision of Drs Paul Wilkin and Felix Forest and Prof Timothy Barraclough, was able to use the NMFP as a base for collecting material of *Dioscorea* spp. (yam) on Mambilla. This was part of a NERC funded project into the Phylogenomics of Guinea yams and their wild relatives, with a focus on *Dioscorea rotundata* and *Dioscorea cayennensis*. The NMFP provided a base, field assistants and other logistical support.

Sina was accompanied by Alexander Giwa from the National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan and Oso Oluwatobi and Okanume Esther, Department of Botany, University of Ibadan, who were carrying out a similar inventory of *Solanum* species.

Sina's study had three objectives

1. Study the phylogenetic relationships within Enantiophyllum clade species of *Dioscorea* with a principal focus on Africa.
2. Trace the wild progenitors of the Guinea yams using the phylogenies developed in order to help yam breeders in getting information to produce improved yam varieties.
3. Identify genes controlling key traits (e.g. flowering) in the wild species.

Sina reports:

After three days in Ngel Nyaki forest, several accessions of wild yams which are reservoirs of important key traits that can be used to improve the cultivated species were collected from the forest. *Dioscorea schimperiana* and *D. hirtiflora* were collected. I also come in contact with *D. dumetorum* and *D. bulbifera* which are also important but are not within my target species.

We couldn't explore further down the forest due to the thickness of the forest but we suspect that other species of wild yams are in the forest and a trip in the future will be very important for my research.



Figure 14 Collecting a specimen of an Ngel Nyaki *Dioscorea*.



Figure 15 A student of Prof Oke collecting molluscs from the forest floor for taxonomic analysis.

University of Benin Mollusc diversity survey

Professor Chris Oke, *University of Benin*

I went to the Nigerian Montane Forest Project site with five postgraduate students in June to look at the possibility of studying the land and fluviatile mollusc composition. We were well received by the members of staff of the Montane Forest Project. We saw the great work that is going on there with respect to the re-planting of trees to revive some parts of the montane forest. Three of the students went back in September to study the molluscan composition.

A preliminary look at the specimens revealed the presence of at least 20 species with some possible new species and new records for Nigeria. There is a plethora of slugs (*Veronicellidae*) and semi-slugs (*Urocyclidae*) in the area and there is also the presence of some unique and rare *Streptaxidae* (carnivorous snails) in the region.



Semi-slug Gymnarion sp. (Urocyclidae)

Streptostele sp.1 (Streptaxidae)

Figure 16 Two of the molluscs collected during the trip.

Postgraduate students



Figure 17 Biplang setting up his GUD (giving up density) trays for the rats. GUD is a way of determining how safe vs risky a microhabitat feels to a foraging animal. If safe, all the food in the GUD tray will be removed, if risky, less will be taken. The black ink pads are to detect rodent foot prints.

TY Danjuma Scholars

Jennifer Agaldo,
Field assistants: Thomas Patrick
and Musa Bawuro

Ants are known to interact with seeds that they find on the forest floor. In some cases this may be harmful to the seeds, hindering forest regeneration. Alternatively ants may move seeds into safe sites for germination, in which case they help forest regeneration.

It is important that we understand the role ants play in the forest ecology, especially as their ability to move seeds may become more important as larger, primary seed dispersers decline in numbers through habitat loss and hunting.

My aim is to explore the nature of ant-seed interactions in Ngel Nyaki Forest Reserve where ants are abundant in both the forest and grassland. Specifically I want to determine if ant-seed interactions are antagonistic or mutualistic.

Since last year I have continued to carry out field work and identify ant species.

Key findings this year:

- two ant species out of 12 occurring in the area, moved seeds of only three of the seven species I experimented with
- Removal distance did not differ between ant species but did differ between plant species.
- Almost half of seeds taken were deposited into ant nests. So far, five seedlings of *T. orientalis* have germinated within three ant nest locations.
- two of the most common ant species (*Pheidole* sp. and *Myrmicaria* sp.) in Ngel Nyaki Forest Reserve affect soil physical properties by improving the porosity.

Biplang Yadock

Nigeria has many diverse forests, harbouring nearly 5,000 species of plants. However Nigeria's forests are some of the most threatened on Earth. Between 1990–2005 it lost 80% of its old growth forests. This is serious because the high human population in Nigeria depend on natural resources for survival; forests provide water for the rivers, they help maintain rainfall and they offer services such as pollinators and pest control. It is vitally important that forests are conserved, managed well and regenerated.

At the same time that forests are being cleared, the animals that disperse seeds of forest trees are

being hunted to extinction. No dispersal means no regeneration and forests will fail.

My thesis is about the need for substitute dispersers –ie animals that move seeds away from where they have been dropped, undispersed, onto the forest floor.

In the Neotropics, where all the large animal dispersers have long gone, scatter hoarding rodents move seeds and the forest survives. Scatter hoarding is a behaviour whereby food is stored in times of surplus for use when food is scarce. Luckily rodents often forget where they have stored their food, and seeds have then effectively been planted—and can germinate and grow.

Key findings this year:

1. Rat density is at around 6 rats per hectare
2. Rats disperse seeds of 7 large seeded tree species
3. Seeds are moved up to 50 metres
4. Seed size does not affect distance moved

I have also observed that the African pouched rats seem to prefer some seeds compared to others and generally, these rats interact more with larger seeds than smaller seeds. This means there is potential for larger seeds to be dispersed by these rats.



Figure 18 Murna Tela with field assistants Hammadu Usman and Yakubu Vaugh recording bird visits to farmland.

Modelling seed fate

Auwal Abdullahi, PhD UC

Auwal is continuing to work with mathematicians to model seed removal rates and seed fate. This work will be extremely useful in predicting dispersal kernels over time with land use change. We are especially interested in the potential for dispersal rates to increase following the loss of large frugivores.

Investigating ecosystem services

Murna Tela, NZ Development PhD Scholarship

Murna will investigate the ecosystem services provided by bird species to subsistence farming on the Mambilla Plateau and determine the role of native forest fragments in maintaining these bird populations.

Her objectives include identifying the birds associated with farmlands and forest fragments; assess the diversity, species richness and composition of bird communities and vegetation types; identify the functional traits of bird and crops; assess the ecosystem services to farmers provided by birds, and assess their contribution to agriculture productivity.

Understanding montane forest dispersal ecology

Iveren Abiem, University of Jos

Iveren is currently waiting for her visa to enter New Zealand and begin writing her UC PhD project proposal. However Iveren is already planning her research and has set up seed traps in the CTFS-ForestGEO plot at Ngel Nyaki.

Her research will address some questions about seed dispersal and forest regeneration in Ngel Nyaki forest. This will be in collaboration with Dr David Kenfak of the Smithsonian Institute and Assoc Prof Hazel Chapman.

While a large body of literature exists around seed dispersal ecology in lowland tropical forests critical gaps exist in our knowledge of tropical montane forest dispersal ecology. Seed dispersal ecology is a vital process for plant reproduction and recruitment and underpins plant population and community dynamics. A knowledge of dispersal ecology is integral to successful forest management/conservation as it is considered a major driver in the maintenance of tree species diversity.

Measuring ecophysiological responses of seedlings

Susinya Habila, Gombe State University

Susinya has been granted admission to UC for a PhD and is waiting on his New Zealand visa.

His topic will be Ecophysiology of light and shade tolerant seedlings in Ngel Nyaki forest in collaboration with Prof Matthew Turnbull of the University of Canterbury (UC).

Determining levels of gene flow in trees between forest fragments

Lily Brailsford, MSc UC

Deforestation and habitat fragmentation has led to reduction of population sizes of many Nigerian species. This project will investigate the levels of gene flow among the remaining forest fragments on the Mambilla Plateau. Lily is using microsatellites to determine population genetic structure and gene flow of *Albizia gummifera* (wind dispersed) and *Clausena anisata* (bird dispersed). Collections of leaf material were made across the Mambilla Plateau, including crossing the Donga River to Mbanmgar and Tamnya, and visiting Yana and Kuma forests, close to the Cameroon border.

Industrial Training students



Figure 19 Taraba State University IT students majoring in botany and zoology, in Jalingo before leaving for Mambilla

This year the Project hosted 18 Industrial Training students, undergraduates who spend six months with the Project as part of their degree. The students benefit from hands-on training in many aspects of science and also conduct a piece of research. These practical internships help build capacity in science across Nigeria. A range of their projects are outlined here.

Fruit removal of *Eugenia gillgii*

Elizabeth Peter Gapkong

Seed dispersal is an important phenomenon in forest regeneration and restoration. This process is facilitated by frugivores which remove fruits from parent trees and disperse them. Focal observation of fruit removal by different frugivores (mainly birds and mammals affect) was carried out on *Eugenia* plants around Ngel Nyaki Forest Reserve. Birds removed fruit more often, but the mammals remove a lot more fruits when they visit. There was no difference in fruit handling method among individuals that removed fruits during the period of the study. This means mammals deposit more seeds through their faeces which may be clustered in one spot but the birds will likely move the seeds further away from the parent plants and deposit them at greater distances from each other so there is a lower risk of competitive mortality when the seeds germinate.

Mistletoe species distribution and host preference in Ngel Nyaki Forest Reserve

Nelly Azege

Data were collected for mistletoes and their host plants including the level of infection on every host plant by species of mistletoe. There

was a significantly more mistletoe on plants of the family Moraceae. This is not because plants belonging to this family are more abundant but it may be because birds (main dispersers of mistletoe seeds) also feed on the fruits of the figs and so are more likely to leave seed of mistletoe on the trees. However, the severity of infection was evenly spread among mistletoe and plant host species.

Flower visitors and fruit set of *Clausena anisata*

Dayebga Kokina

Pollination is an important process in the reproductive cycle of plants. This process is facilitated by flower-visiting insects and birds whose roles in pollination can affect fruit set. Flowering *Clausena* plants were observed in the morning and evening to investigate which insect and/or bird potential pollinators visit the flowers. To determine the importance of different flower visitors in pollination and fruit yield, some flowers were bagged (complete exclusion), some meshed (allowing only insects) while others were left open to all visitors as a control. Number of flowers visited differed among the flower visitors with honeybees visiting the highest number of flowers. Visitation rate also differed by the time of day. Fruit yield differed among the treatments with complete exclusion having a significantly



Figure 20 Gombe State Industrial Training (IT) students for 2016.

lower fruit yield than partial exclusion and control. The results show the importance of flower visitors in successful pollination and fruit yield of plants and the need to conserve such agents of pollination.

Foraging patch choice of habituated village weaver birds at the field station

David Jonah

Several factors affect patch choice of birds including predation risk, patch quality and flock size of foraging birds. But one factor that can determine how birds respond to the above-mentioned factors is how habituated the birds are to humans and disturbance in the environment. Artificial feeding patches of different qualities (control and poor) were placed at varying distances from people, where village weavers could feed on them. The control contains only millet while the poor patch has 70% sand and 30% millet. Parameters such as flock size, distance from people (disturbance/predation risk), patch quality and amount of time spent feeding in a patch were recorded as indices of patch choice. Feeding rate was significantly higher in control patches (regardless of distance from humans). Number of individuals feeding in a patch at a time was also higher in the control patches. This suggests that habituation

has made the birds more concerned with the quality of their feeding patches than with risk of predation. This could expose them to real predation risk since they are unsuspecting most of the time due to habituation over time.

Fruit fate of *Psychotria umbellata* in Ngel Nyaki Forest Reserve

Oladeinde Taofeek

Birds and mammals are the major agents of seed dispersal for fleshy-fruited species. Most studies on fruit removal have only considered fruit removal of birds with those of diurnal mammals. In this study, fruit removal of birds and other diurnal mammals were compared with those of the nocturnal frugivores. Fruits on the crown were counted at 6 am and 6 pm daily to account from the number of fruit taken in the night and during the day respectively. A net was used to trap fruits falling from the plants at these times as well and they were also counted. Fruits were taken and more fruits fall at night than during the day. This shows a strong relationship between fruits taken and fruits falling to the ground and suggest that nocturnal frugivores are more important in primary seed dispersal of *Psychotria umbellata* and the secondary dispersers are dependent on them

Flower visitors and their effect on fruit set of *Syzigium guineense* subsp. *guineense*

Abdulwahab Yusuf

Organisms visit flowers for benefits such as nectar and pollen which they feed on. In the process of removing these, they move pollen grains that result in pollination of flowers. But how much this role of flower visitors affects fruit set of *Syzigium guineense* subsp. *guineense* has not been studied. Focal observations were carried out and flower visitors were recorded in the morning and evening. Treatments were also administered on some flowers to determine the presence or absence of flower visitors on fruit set. Visitors were completely excluded from some flowers, only insects were allowed access to some flowers while some flowers were left open as control. There was a significantly higher flower visitation rate by bees compared to other insects. However, no difference was detected in visitation rate by time of day. Fruit yield was significantly lower for complete exclusion treatment but was not significantly different between partial exclusion and control treatment.

Undergraduate field trips



Figure 21 Undergraduate students from Gomebe State University learning about forest conservation.

This past year the Project's field station has hosted over 300 Nigerian undergraduate students and their professors on multi-day field trips.

Federal University of Kashere

In July, three biology lecturers, Ahmad Ibrahim Galadima, Kolawole Opeyemi Saheed and Umar I. Galadima visited the Project with 37 undergraduate students of 300- and 400-level. They stayed two nights at the field station.

Taraba State University

Also in July, Dr Delphine, HOD of Biology at Taraba State University and additional staff of the department with two staff from the Gashaka-Gumti National Park (GGNP) visited the Project with about 130 students and stayed two nights at the field station. The student were given lectures and orientation on the research and conservation and were taken to the field to experience the activities in the reserve. The staff of GGNP were happy with the Project and suggested that tourism potentials on the Mambilla Plateau be explored.



Figure 22 Shedrach (Science Coordinator) teaching education students about montane habitats.

Gombe State University

Over 100 GSU biology students visited Ngel Nyaki with Professor Ezra (HOD biology) for a field trip in March. The students stayed two nights and during their time with the Project they saw the research going on and learnt more about forest conservation both in lectures and in the field.

Federal College of Education, Gombe

Zainab D. Thomas (HOD Biology), along with Samuel John and Enock John from the Federal College of Education visited with about 30 students. This group were very interested in the conservation biology issues and hope to be sending some Industrial Training students to the Project next year.

Outputs

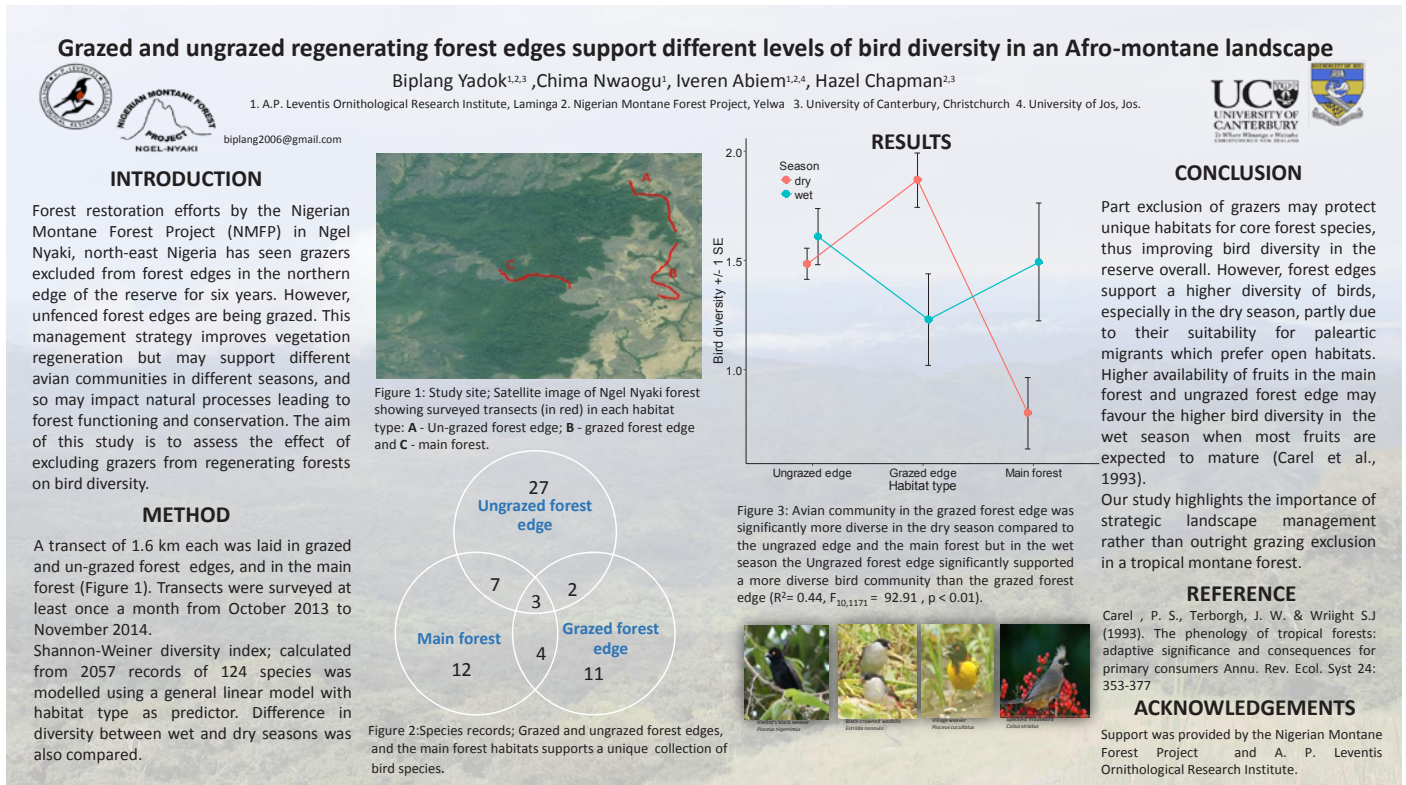


Figure 23 Poster for the Pan African Ornithological Congress in Senegal.

Peer-reviewed articles

- Chapman, H.M., Cordeiro, N.J., Dutton, Wenny, D., Kitamura, S., Kaplin, B., Melo, F., Lawes, and M. (2016) Seed Dispersal Ecology of Tropical Montane Forests. *Journal of Tropical Ecology* 32:437-454
- Knight, A., Chapman, H.M. and Hale, M. (2016) Habitat fragmentation and its implications for Endangered chimpanzee *Pan troglodytes* conservation. *Oryx* 50(3): 533-536.
- Olayemi A., Obadare A., Oyeyiola A., Igbokwe J., Fasogbon A. et al. (2016) Arenavirus Diversity and Phylogeography of *Mastomys natalensis* Rodents, Nigeria. *Emerging Infectious Diseases* 22(4) 694-697
- Thia, J.A., Hale, M.L. and Chapman, H.M. (2016) Interspecific comparisons with chloroplast SSR loci reveal limited genetic variation in Nigerian montane forests: A study on *Cordia millenii* (West African cordia), *Entandrophragma angolense* (tiama mahogany), and *Lovoa trichilioides* (African walnut). *Tropical Conservation Science* 9(1): 321-337.
- Thia, J.A., Hale, M.L., Stouffer, D.B. and Chapman, H.M. (2016) Limited dispersal into appropriate microhabitats likely explains recruitment failure in a chimpanzee-dependent tree species. *African Journal of Ecology* 54(1): 121-124.

In Press:

- Folia Primatologia* Dutton, P; Moltchanova E; Chapman, H.M. Nesting ecology of a small montane population of the Nigerian/ Cameroon Chimpanzee (*Pan troglodytes ellioti*) in Nigeria.

Submitted

accepted pending revision :

- Nsor, C.A.; Chapman, H. M. Godsoe, W. Differential contribution of sunbird species to a sunbird -tree visitation network supports network stability. *PlosONE*

Conference presentations

- Shedrach Konvong (Science coordinator Ngel Nyaki): Pollination and fruit set of two plant species at Ngel Nyaki Forest Reserve. Joint Biodiversity Conservation Conference of Nigeria Tropical Biology Association (NTBA) and Nigerian Chapter of Society for Conservation Biology (NSCB). Ilorin June 2016.
- Biplang Yadok: Seed dispersal dynamics: the role of African giant pouched rats (*Cricetomys* sp. nov) in dispersing seeds within Ngel Nyaki forest. Taraba State University, 12th January, 2016

- Biplang Yadok African giant pouched rats (*Cricetomys* sp. nov), seed removal and seed removal and seed dispersal in an Afromontane forest landscape. APLORI, 26th August, 2016
- Biplang Yadok: ATBC, 18-23 June, 2016 Montpellier, France (presented by Professor Pierre Michel Forget)
- Jennifer Agaldo: Ant dispersal in an Afromontane forest September 2016 APLORI.
- Dr Danladi Umar: Introduction to the Nigerian Montane Forest Project Tropical Biology Association (NTBA) and Nigeria Chapter of Society for Conservation Biology (NSCB). Ilorin June 2016

Posters

- Antagonistic or mutualistic? Ant-diaspore interactions in Nigerian montane forest. Agaldo, Jennifer Arubemii., Chapman, Hazel and Christiannini Alexander School of Biological Science, University of Canterbury New Zealand, 2 Ambientais Sciences Department, Federal University of São Carlos, State of Sao Paulo, Brazil.
- Biplang Yadok: Pan-African Ornithological Congress, PAOC, 16-21st October

Project news



Figure 24 Videographer/Director Ben Elekwachi (standing) and sound operator Abeeb Adebayo

The wide range of developments shown here highlight the breadth of the Nigerian Montane Forest Project initiatives, a reflection of the combined efforts of the entire team.



Figure 25 Honourable Minister of the Environment, Amina J. Mohammed meets with Assoc Prof Hazel Chapman (Director NMFP) in Abuja to discuss conservation issues.

New outreach centre and arboretum funded

This year the New Zealand Ministry of Foreign Affairs and Trade (MFAT) is supporting the NMFP by providing funding for a science outreach centre which includes an arboretum. This initiative is greatly appreciated- it will add value to the experience and learning gained by all students and researchers during their time with the NMFP. The arboretum will comprise the planting of trees of different forest species close to the field station. The trees will be labelled which will allow students to photograph both the tree and its name. In addition to taxonomy the arboretum will help teach students about

pollination and seed dispersal (ecosystem services).

The outreach centre will be an attractive space to host visitors and students of all levels. It will be equipped with a library, multimedia facilities and other educational resources.

Ministry meetings

Hazel met with the Honourable Minister of the Environment, Amina J. Mohammed and her forestry advisors in Abuja. This was an opportunity to ensure that the Minister is aware of the NMFP and the ongoing issues faced by Ngel Nyaki Forest Reserve.



**NEW ZEALAND
FOREIGN AFFAIRS & TRADE**



Figure 26 Selling local honey by the roadside on Mambilla.



Figure 27 Nicky Glenjarman with Warren and Elspeth Thompson in their honey extracting room.

Conference sponsorship

This year the Project sponsored the Joint Biodiversity Conservation Conference jointly organised by Nigeria Chapter of Society for Conservation Biology (NSCB) and Nigeria Tropical Association (NTBA) alumni group. The aim of the conference was to explore the crucial roles that biodiversity play in sustainable development. With the new Sustainable Development Goals (SDGs) in motion, the conference engaged students, researchers and conservation practitioners in discussion on emerging issues and strategy to improving conservation of biological diversity in Nigeria. The conference, held in Ilorin, the Project was represented by Dr Danladi Umar and Shedrach Kongvong.

Project videos

The Smithsonian Institute employed a documentary maker Ben Elekwachi to film the TY Danjuma CTFS ForestGEO Plot for CTFS ForestGEO website. Ben used a drone to capture amazing aerial images of the forest and neighbouring grassland and at the same time made us a promotional video. Retired General T.Y. Danjuma, who financed the Plot, was included in both videos.

Project update 2016

www.youtube.com/watch?v=byUxC6H5J6I

Retired General T.Y. Danjuma explains his passion for conservation

www.youtube.com/watch?v=IvEbWshsu70

Beyond bees

The Project is continuing to work with the local bee keepers to access funds for a bee keeping industry based at Ngel Nyaki forest. The bee keepers have undergone training in new techniques, funded through a Leventis grant.

Nicky Glenjarman, a UC Biology postgraduate student with experience and a bachelor's degree in business majoring in innovation and entrepreneurship, has taken up the challenge to raise funds for an extractor to underpin a honey production business run out of Yelwa village.

The current owners of the extractor Warren and Elspeth Thompson are keen to visit Ngel Nyaki and set up the plant and provide training.

If we are successful in fundraising, Nicky has arranged for a shipping container to be converted to a production facility, meeting NZ hygiene standards and transported to Yelwa.

The aim is that the facility will predominantly employ local women to process and package the bee products.

As mentioned in last year's report, once we have the honey processed we shall truck it to Lagos where it will be bottled and sold through ShopRite. While all of this organisation is taking time, we are actively engaged with the bee keepers in making it happen.

Investigating gene flow among forests



Figure 28 Crossing the Donga River to reach Mbamnga and Tamnya.

As part of an adventurous collecting trip, with the aim of determining levels of gene flow among forest patches on the Mambilla Plateau (see Lily Brailsford's project on page 15), we visited three village kurmi's on the Plateau, Yana, Kuma and Mbamnga.

These small forest fragments are of spiritual significance to the local community and are consequently protected. As far as we know the last time these kurmis were visited by botanists was in the 1970s when J.D. Chapman recorded their species composition and ecology.

Comparing old 1970s photos with how the forests look today suggests that these kurmi's are still protected and important to the local communities.



Figure 29 Meeting with the Jaurao of Mbamnga and his advisors.

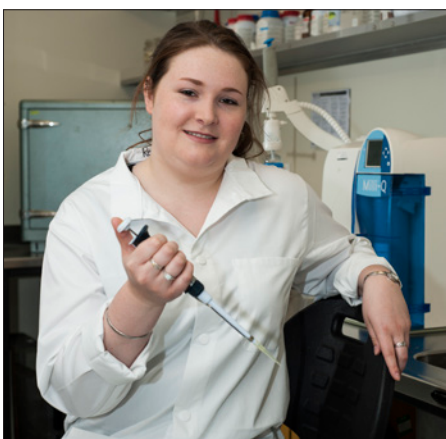


Figure 30 Lily Brailsford is analysing the samples at UC to determine levels of gene flow.



Figure 31 Yana Kurmi is valued and protected by the local communities.

Forest reserve issues



Figure 32 Early burning of the fire breaks prevents incursion of grass fires into the reserve.

With the increasing threats to biodiversity on the Mambilla Plateau conserving and restoring Ngel Nyaki Forest Reserve is more important now than it has ever been. Yet despite its Forest Reserve Status the forest continues to be seriously threatened by cattle grazing, burning and other illegal activities.

To try and reduce these threats the Forest Management Committee comprising 11 Fulani and Mambilla community leaders (Alhaji Abubakar Mohammed, Abdulkadir Usman, David Garba, Alhaji Abdul Malik, Joshua Abriham, Aliyu Mohammed, Alhaji Suleiman, Alhaji Babaji, Barnabas Sunday, Alhaji Salihu Njobdi and Alhaji Ibrahim Yahya Muri) have acted in a liaison role between the NMFP and the State and Local Governments.

The committee work with the Jauro of Yelwa, Jauro Patel and NMFP managers to identify issues and report to the Taraba State Commissioner of the Environment Rebecca Manasseh who has shown great support to the Project.

3 key issues for the forest reserve

The committee has identified three key issues faced by Ngel Nyaki Forest Reserve which could be improved with more financial support:

1. The Reserve boundary is ambiguous to some. The boundary needs demarcating with solid beacons which are indestructible. In Gashaka Gumti National Park oil drums filled with cement have worked. Following this, the beacons need to be maintained.

2. The forestry patrollers need more recognition.

They need more support in terms of gear- such as GPS devices, good boots, binoculars, radios and allowances. Without this - motivation cannot be expected to be high.

3. The reserve needs patrol posts so that rangers can stay overnight in more remote parts of the reserve.

Long grass and forest restoration

With the fencing-off of several kilometres of grassland along the forest edge (see Figure 32) has come a huge biomass of tall grasses. This is now a management issue of real concern- and currently we are managing it by creating a network of fire breaks.

At the same time we are planting trees into the grassland to stimulate forest restoration. A grant from the Australian High Commission in Abuja has helped greatly in this restoration initiative. In fact, we may now be well placed to commit to the Bonn Challenge—a global challenge to restore 150 million hectares of the world's deforested and degraded land by 2020 and 350 million hectares by 2030. If we are able to take part we will be the first Nigerian forest restoration initiative to be involved.

Underlying the Bonn Challenge is the forest landscape restoration approach, which aims to restore ecological integrity. We are working towards creating this integrity by planting locally sourced trees into the grassland to act as catalysts for natural 'passive' restoration.

Bee Keeping

We are hoping that the forest will benefit from bee hives placed along the forest edge. This should stimulate pollination and at the same time increase the realisation within the community as to the importance of Ngel Nyaki forest to human welfare .



Figure 33 Rebecca Manasseh, Taraba State Commissioner of the Environment.

Community initiatives



Figure 34 Charles Nsor gives out doses of de-worming medication to the nursery school pupils.

The Project team continue to work on a number of community activities with a core focus on health and education.

Supporting healthy children

Thanks to the initiative of Dr Charles Nsor, PhD graduate and currently lecturer at Gombe State University, the Project was able to organise and co-fund with Osowo-Sama Nigeria Limited a de-worming of school pupils and children in the Yelwa and wider Mambilla area. The medicine was administered first by Osowa-Sama and subsequently by the Project. This initiative was much appreciated by the community and the NMFP will strive to repeat in the future- it is of course a programme that to be worthwhile needs to be carried out biannually.

Conservation Club

Students in the conservation club are from: Esso/ NMFP Nursery school Yelwa, Primary school Yelwa, Community Secondary School Yelwa, Ngabuli Primary School Hainare and Maisamari Government Secondary School.



Figure 35 George Gosden, Ex Taraba State IT student teaching biology to secondary school students from Yelwa village. The students regularly attend tutorials at the NMFP campus.

Members from these school regularly visit the NMFP. Each visit is enjoyable, the students learn about the value of the forest. They learn from the Project members about forest regeneration, how to run a nursery and lots more about what goes on at the NMFP.

Science tutorials

Project alumni and current IT students have begun offering free tutorials to secondary school

students from Yelwa village. The students visit the field station for extra tuition in biological sciences. Teachers include Shedrach Kongvong, our Science Coordinator, George Godson and Prince Umar (past IT students). The teachers help school pupils with parts of the curriculum in which they need additional clarification. The pupils can also use our library and watch educational videos.

Celebrating our people

Many people help make the Project run, often times they are behind the scenes. Here we celebrate some of our staff who contribute to the success of the team.



Faith Febzir, Smithsonian assistant and part-time cook.



Manu Abubakar, maigadi (watchman).



Jafar Bapetel, Adamu Hassan, Yusuf Tongbuin, field assistants.



Evelyn, teacher and conservation club leader, with nursery school students.



Augustine Tayo, Smithsonian watchman.



Ali Buba, Medicinal plant expert, Bobbo Zubairu, maigadi (watchman), Dauda Baduku, Joshua Fabzir, Abdullahi Buba, Smithsonian watchmen.

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