

Nigerian Montane Forest Project
Montane Forest Conservation Initiative Nigeria



Annual Report 2025



Biological Sciences
Pūtaiao Koiora



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Introduction



Anastasios (Tasso) Paul Leventis - Patron



Phil Hall (Chair)



John Adeyemi Adeleke



Danladi Umar



Hazel Chapman

I am pleased to present a foreword to the 2025 NMFP Annual Report which highlights advances across all our pillars: Education and Research, Community Stewardship, National and International Partnerships, and Biodiversity Conservation.

In producing the report, it occurred to me that good things come to those who wait. There are three clear examples here.

First comes from our ethos of collecting long term data. Over twenty years our phenology team, led by Hammasumo Ibrahim, has collected weekly data on timing and intensity of flowering, fruiting, leaf fall, and new leaf production from nearly 2,000 trees across Ngel Nyaki forest. This effort has revealed strong signals of climate change in the forest ecosystem. The work translates into practical guidance for conservation management, from anticipating altered flowering and fruiting windows to informing restoration timing and species selection. Our findings are documented in the prestigious *Journal of Ecology*.

The second is from lost specimens being found. After 12 years, samples of reptiles and amphibians collected from Ngel Nyaki by then PhD student Denise Arroyo-Lambaer were forwarded from Abuja to herpetologist Dr David Blackburn of Florida Natural History Museum. Together we have at last published a ‘herp’ checklist for Ngel Nyaki forest reserve—the first of its kind for this part of Nigeria.

Thirdly, our 11-year search for a partner for the NMFP’s honey enterprise ‘Beyond Bees’ has succeeded. Prof. Shehu Hassan is providing honey processing infrastructure, packaging equipment, and market access, helping to establish a conservation-linked business creating sustainable income opportunities for local beekeeping communities while supporting NMFP’s long-term conservation and community development work.

Serendipitously this year was the reuniting with Ridwan Jaafar when we were both in Nigeria. Ridwan is a NMFP alumnus, currently completing his PhD thesis at Vrije Universiteit Brussels. As you read the report you will appreciate the energy and direction Ridwan is contributing towards our meeting our goals.

I am pleased to welcome Bashir Mijinyawa to our science team. Bashir is a Yelwa indigen and NMFP alumnus, currently completing his MSc at Ahmadu Bello University, investigating how forest edges affect seed predation in Ngel Nyaki forest.

Kudos to our exceptional leadership team on Mambilla; Istifanus Jesse, Misa Zubairu, Gabriel Dabo, Hammasumo Ibrahim and Alfred Christopher who keep the work moving forward. From Lagos, Opeyeme Abimbola is demonstrating exemplary oversight of our accounts and HR, and from Jos / Harvard, Ivy Abiem continues to efficiently lead the ForestGeo team.

Despite all the progress we have made in 2025 there have been some major challenges, and I want to thank our Board Chairman, Phil Hall for his unwavering support, time and commitment in helping us to navigate our way forward.

Many thanks as always to Matt Walters for his broad support, including his pivotal role in creating this Annual Report and other promotional material.

Finally, on behalf of the NMFP, I would like to thank our Board, our funders, all our partners, field teams, students, and community members who contribute to this shared endeavour. Your dedication drives science that informs stewardship and ensures that Nigeria’s montane forests will endure for future generations.

A handwritten signature in black ink that reads "Hazel Chapman".

Hazel Chapman

Executive 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.



The image shows the Sustainable Development Goals logo at the top, featuring the United Nations emblem and the text "SUSTAINABLE DEVELOPMENT GOALS". Below the logo is a grid of 17 icons, each representing a goal: 1. No Poverty, 2. Zero Hunger, 3. Good Health and Well-being, 4. Quality Education, 5. Gender Equality, 6. Clean Water and Sanitation, 7. Affordable and Clean Energy, 8. Decent Work and Economic Growth, 9. Industry, Innovation and Infrastructure, 10. Reduced Inequalities, 11. Sustainable Cities and Communities, 12. Responsible Consumption and Production, 13. Climate Action, 14. Life Below Water, 15. Life on Land, 16. Peace, Justice and Strong Institutions, 17. Partnerships for Development.

We are committed to biodiversity conservation through working hand in hand with local communities.

We actively pursue our four primary aims above, all of which can be linked to the United Nation's Sustainable Development Goals.

Our networks

Project Partners / Collaborators

Africa Nature Investors Foundation (ANI), Nigeria
A.P. Leventis Ornithological Research Institute (APLORI), Jos, Nigeria
Dr Andrew Hacket-Pain, University of Liverpool UK
Dr. Brian Sedio, University of Texas, Austin, USA
Embrace the Earth, Belgium
Gombe State University (GSU), Nigeria
Nigerian Conservation Foundation (NCF), Nigeria
Royal Botanic Gardens, Kew, England
Smithsonian Tropical Research Institute-ForestGEO, USA
Taraba State University (TSU), Nigeria
University of Canterbury (UC), New Zealand
University of Exeter, United Kingdom
University of Jos, Nigeria

Project Funders

Africa Finance Corporation (AFC)
A.G. Leventis Foundation
A.P. (Tasso) Leventis
Retired General T.Y. Danjuma
Taraba State Government
University of Canterbury, NZ



Scientific highlights



Hammasumo and his team recording flowering of one of the 2000 tagged trees along the phenology transects.

Climate change is altering Ngel Nyaki forest

This year we published the findings of 20 years of weekly phenology data collection in the prestigious *Journal of Ecology*. Our data, on nearly 2,000 trees across Ngel Nyaki forest, documents the timing and intensity of flowering, fruiting, leaf fall, and new leaf production. We have explored how phenology is changing with increased temperatures and changed rainfall patterns. We have found that climate change is affecting both timing and intensity of all parameters. Some species are flowering more, others less. Overall, fruit production is dropping and more leaves are falling. This will have major implications for the entire Ngel Nyaki ecosystem, as tree phenology dictates the flow of food and symbiotic relationships, as well as the soil nutrient status.

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RESEARCH ARTICLE

Journal of Ecology

Changes in quantity and timing of foliar and reproductive phenology of tropical dry-forest trees under a warming and drying climate

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Funding Information: Singapore Research Centre of Research Excellence, T1-Darwin, The North of England Ecological Society, Mervin Paul, Grant Award Number: MFP-UOCC2022-A1, Scientific Foundation

Handling Editor: Anthony Yeo

Abstract

1. Plant phenology drives population dynamics and forest productivity; it is also impacted by shifting environmental cues under climate change such as more prevalent drought. It is imperative to better understand how species and community phenology respond to climate change in leaf turnover and reproduction, both of which are required to integrate phenology into full life-cycle assessments.

2. However, relatively few studies to date examined the quantity and timing of phenology simultaneously. We demonstrate that the simultaneous assessment of phenological quantity and timing across multiple organs reveals more nuanced and holistic insights into the consequences of climate change.

3. Extending a regression approach based on Fourier series, we decomposed the long-term (2004–2020) monthly leaf shedding, leaf flush, flowering and fruiting of 617 trees across 94 taxa at a Nigerian seasonally dry tropical forest into three periodic components—mean intensity, amplitude and phase—which respectively represent the total quantity, pulse concentration and peak timing of phenology. We then related each periodic component to warming minimum temperature and drying wet season rainfall.

4. We found that climate explained more variation in phenological amplitudes (14%–65%) compared to mean intensity and timing (5%–49%). In drier years, more species (18%) shed leaves earlier (changing timing), or in more concentrated pulses (changing amplitude), while only a few (2%) shed leaves in greater total amounts (changing mean intensity). This, combined with the decreased mean intensity of leaf flush, implies a lower primary productivity as trees deployed fewer leaves for a shorter period. Some species (20%) produced fewer fruits despite no change or even an increase in flowering; in a few species, this could be explained by a shortened flowering period that limited pollination. At the community level, reproduction became more synchronous, potentially creating periods of scarcity for consumers.

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Vine by Colleen Wilson from Noun Project (CC BY 3.0)

The ForestGEO team measuring liana stems within the 20.28ha ForestGeo plot.

Liana diversity and abundance in an Afromontane forest

The NMFP ForestGeo team concluded the Liana census within the ForestGEO plot in the reserve. Over 19,000 rooted lianas from 36 species were tagged, mapped, and measured. This research highlights the contribution of lianas to the overall woody species diversity, and their role in shaping the dynamics of the Ngel Nyaki Forest.

Check for updates

WILEY

biOTROPICA

NATURAL HISTORY FIELD NOTE

The Search for Champion Lianas: The Largest Lianas on Six Continents

Shafiq A. Schatzler¹ | Begüm Kaşamak² | Isaac Zumbo³ | Vivek Pandi⁴ | Patrick Adfo-Ponfou⁵ | Yu-Jen Chen⁶ | Alfredo De Filippis⁷ | Warren V. Brocklebank⁸ | Annette Natchaling⁹ | Ernesto Cisneros¹⁰ | María M. García-Londo¹¹ | Boris Borsari¹² | Emma Mackintosh¹³ | Geertje van der Heijden¹⁴ | Hiroaki Mori¹⁵ | Christopher J. Davis¹⁶ | Jacob D. J. Peters¹⁷ | Rabih M. Zakaria¹⁸ | Guillermo Torres-Muniz¹⁹ | Santiago Sotoca-Cordero²⁰ | Wiyong Chaithong²¹ | Gabriel A. Duhon²² | Francis E. Putz^{23,24} | Andrew B. Marshall^{25,26} | David M. Desfilippi²⁷ | Felipe Melis²⁸ | Alanik Schatzler²⁹ | Christian Domestica³⁰ | Nurvez-Rahm Kaidah^{31,32} | Nityajanyawaty Permalatharath³³ | Willem P. T. De Winter³⁴

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Key words: climbing plants | maximum size | temperate forests | tropical forests | woody vines

ABSTRACT
Determining species' maximum sizes provides valuable insights into their ecology, natural history, and potential ecosystem contributions. Using both plot-based and forest-wide surveys on six continents, we document the largest 'Champion' liana ever recorded (86 mm diameter) from an African forest, as well as continental Champion Lianas from around the world.

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1 of 6



A *Garcinia smeathmanii* sapling in Ngel Nyaki forest.

Evidence for positive plant-soil feedbacks in Afromontane forests

Plant-soil microbial interactions influence biodiversity and species coexistence in terrestrial ecosystems, but the strength and scope of plant-soil feedbacks (PSFs) in tropical Afromontane forests are not fully understood. Our study, published in the *Journal of Tropical Ecology* measured PSFs in six tree species. The only species showing a positive PSF was *Garcinia smeathmanii*, which showed a significant seedling-growth advantage when grown in conspecific soil inocula. These results suggest that PSFs may play a limited role for most species in this ecosystem. The notable exception, *G. smeathmanii*, highlights a nuanced ecological dynamic that warrants further investigation. Ongoing work aims to unravel the mechanisms behind species-specific PSFs and their implications for forest composition, resilience, and management.



Journal of Tropical Ecology Investigating plant-soil feedbacks in tropical montane forest trees
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Short Communication
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Abstract
 Plant-soil microbial interactions play a central role in maintaining biodiversity and coexistence in terrestrial ecosystems. However, to what extent plant-soil feedbacks (PSFs) operate in tropical Afromontane forests remains unclear. In this study, we conducted a PSF shade house experiment using six tree species exhibiting diverse life history strategies and abundance in a sub-tropical montane forest in Nigeria. Seedlings were grown under controlled conditions in inoculated soil with or without soil microbes collected under mature trees of each of the six species. We assessed whether conspecific soil seedling performance was altered in comparison to heterospecific seedlings when grown in the soil of their adult trees. Seedling growth rate and survival significantly differ between inocula from conspecific and heterospecific adults for five of the six species tested, indicating no evidence of PSFs. In *Garcinia smeathmanii*, we found a significant increase in seedling growth when grown in conspecific soil inocula. Given that no PSFs were observed in five out of six species, our study suggests that PSFs may play a limited role in the performance of some species in the Afromontane ecosystem. Nevertheless, the facilitative interaction noted in *Garcinia smeathmanii* indicates a nuanced ecological dynamic worth further exploration.

Introduction
 Increasing evidence suggests that interactions between plants and their soil are important determinants of the structure of plant communities through plant-soil feedbacks (PSFs). PSFs arise through plants changing the biotic and abiotic properties of the soils they inhabit, which may then influence plant growth (Drew 2001; Van Der Putten et al. 2013). A plant species may influence soil conditions in a way that supports its growth (positive feedback) or hinders its development (negative feedback). Positive PSFs arise through the accumulation of soil nutrients (Berendse 1994; Chapman et al. 2006; Wardle 1991) or symbiotic mutualisms (Kikvidze 2002; Van Der Putten et al. 2016) and may eventually lead to clumped distribution patterns or monodominance (Crawford & Knight 2017; Diller et al. 2014; Tiner et al. 2017). Positive PSFs could be used to explain conspecific facilitation when a plant modifies its soil environment in a way that has positive effects on its conspecifics (Ruschert et al. 2021). Negative feedbacks are generated through nutrient depletion (Berendse, 1994) or changes in litter quality and nutrient cycling (Drewett & Kikvidze 2018) or the accumulation of soil pathogens (Bever et al. 2015; Chang & Badgers 2016; Smith-Ramanak & Reynolds 2017; Van Der Putten et al. 2016). Soil microbial effects tend to be more stronger than nutrient effects (Li et al. 2013) and are most pronounced at the seedling stage. Negative soil feedbacks occur when a plant modifies its soil biota in a way that inhibits conspecifics more than heterospecific neighbours (Bever et al. 2015; Margen et al. 2018).
 Evidence suggests that rare species are more prone to negative PSFs than abundant species (Kikvidze 2002; Mason et al. 2016; Thakar et al. 2021). Plants' traits may also help predict the direction of PSFs; fast growth rates and larger specific leaf areas are associated with more negative values (Mason et al. 2016; Xi et al. 2021; Xi et al. 2023) while larger seed size is associated with more positive (or less negative) values (Li et al. 2013). Thus, fast-growing small-seeded plants investing less in traits associated with nutrient enemy defence are predicted to have more negative PSFs than slower-growing large-seeded species (Xi et al. 2023). Shade tolerance can also influence the direction of PSFs; shade-tolerant species tend to be slower growing and therefore more resource limited (Bever et al. 2015; Xi et al. 2023).
 In this study, we explored the relative contributions of soil biota in generating negative feedback across six plant species with different abundances, soil traits and shade tolerance in a West African montane forest. A shade-house experiment was used to assess PSFs on plant performance. Our specific question was: Does the performance of conspecific seedlings differ when grown in the presence of soil biota associated with their adult trees compared to the soil biota of heterospecific adults? Earlier studies in this forest demonstrated weak or non-existent



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Alfred Christopher and Jennifer Markus measuring the distance from a seed trap to the nearest tree.

Passive Forest Restoration is turning grassland into forest

This year the team measured and tagged every tree within a 5 m radius of each of 150 seed traps, recording stem diameter, height and species. 20 years ago there were almost no trees near the traps, now almost all of the traps have at least one tree close by- highlighting the rate of forest recovery.

Fence line observations lead to further research

Fences play multiple ecological roles in Ngel Nyaki Forest Reserve, including protecting the forest from cattle grazing and facilitating the natural recovery of degraded areas. Observational surveys indicate the emergence of 'tree lines' associated with fence posts, highlighting their role as perches for seed dispersing bird species. Ongoing surveys of fence structures are being conducted to quantify such restoration effects.



Field assistants Yakubu and Idris measuring seedlings along the fence line



Our staff members, L to R Baba Ali and Mallam Hussaini, are controlling the cows to keep them within the experimental plots.

Investigating how grazing affects regeneration

We have established experimental treatments to quantify the effects of cattle grazing on biomass accumulation and habitat recovery, thereby explicitly integrating grazing ecology into our restoration framework. These experiments are generating empirical data on herbivore–landscape interactions in grassland areas surrounding the forest. Building on this foundation, experimental plots with different management treatments, including controlled burning and grazing, have been established across grassland areas in the Reserve. Together, these plots will provide a baseline for developing a data-driven approach to restoration planning and the long-term ecological management of montane ecosystems.

ForestGEO plot seedling recensus

Each year, the NMFP ForestGEO team conducts detailed seedling censuses within the Ngel Nyaki ForestGEO Dynamics Plot. By monitoring recruitment, growth, and survival at the earliest life stages, this long-term effort reveals how plant populations are maintained through time. These data are central to our goal of understanding the processes that shape forest dynamics and regeneration in Ngel Nyaki Forest Reserve.



Abubakar Bawuro and Hammadu Yusufu



Intern students tagging and measuring seedlings around the seedtraps.

Seedtrap seedling monitoring

For more than 15 years, NMFP has maintained a network of seed traps strategically deployed along the forest edge and in adjacent open areas to document seed rain and regeneration processes. The early establishment of these traps coincided with a period of active forest recovery, and over time, areas that were once open or degraded have regenerated to the extent that several traps originally positioned outside or at the forest margin are now located well within closed forest. In addition to recording seed dispersal patterns, the traps have acted as focal points for seed deposition, facilitating local recruitment and vegetation establishment. We are now systematically monitoring the vegetation surrounding these former edge traps better to understand the trajectories and mechanisms of montane forest recovery.

Tracking mast seeding events across six species

This long-term project investigates the synchrony of seed production among individuals of the same species, using seed traps to quantify annual seed output. By tracking seed production across six focal plant species, the study reveals patterns of reproductive timing and variability, providing insight into how coordinated seed production influences regeneration and population dynamics in the Ngel Nyaki forest.



Isti (right) and Exodus (left) monitoring one of the mast seeding seedtraps



Dr Ivy Abiem and the field team collecting composite soil for mycorrhizal DNA extraction

Mycorrhizal fungi composition in an Afromontane forest ecosystem

We conducted a comprehensive assessment of mycorrhizal fungi within the Ngel Nyaki Forest Reserve as part of a project led by Dr Iveren Abiem, focusing on a montane ecosystem that is relatively drier, cooler, and less species-rich than lowland tropical forests. Using a combination of field sampling and molecular analyses, we extracted DNA from soil samples, amplified, and sequenced the ITS2 rDNA region to characterize mycorrhizal fungal communities. By addressing a major gap in tropical mycorrhizal research, this work advances understanding of microbial ecology in montane forests and explores the role of mycorrhizal fungi in supporting forest resilience under changing environmental conditions. The project is funded by the Society for the Protection of the Underground (SPUN).



The local school children spell out the letters with their bodies after the SPUN seminar.

Long-term monitoring

Long-term ecological monitoring at Ngel Nyaki makes us unique in Nigeria and beyond.



These long-term data includes:

- Weekly records of flowering, fruiting, leaf fall and new leaf production, for 2,000 trees along 8 km of transects, revealing how climate change is influencing phenology and ecosystem interactions.
- Weekly counts and species identification of seeds in 150 seed traps placed strategically outside of the forest to measure natural restoration rates and regeneration dynamics.
- Weekly seed counts from 200 seed traps inside the forest to measure seeding patterns and spatial dispersal.
- Five-year censuses of our 20.28 ha

ForestGeo plot, measuring and mapping every stem > 1 cm DBH to track growth, mortality, and carbon dynamics. There are more than 41,000 stems and 40,000 individually mapped, labelled and measured trees of 106 tree species.

- Regular counts of seedlings in 318 seedling plots and seeds, fruits, flowers and other reproductive parts in 106 traps located throughout the ForestGeo plot.

All these data underpin our understanding of how the forest and surrounding grassland are changing over time. It allows us to extract slow and complex trends from natural year-to-year variation.

Long term data allow us to understand how forest dynamics and resilience are changing with climate. They allow us to evaluate the success of our conservation efforts, and provide us with data for evidence-based management and policy making.

The success of this long-term data collection relies on our dedicated team on the ground at Ngel Nyaki—almost entirely from the local community. Some field assistants have been with us for almost 20 years and are truly expert at their jobs. Others are trained to become part of the team. All have become astute ecologists and almost all, expert plant taxonomists.

frontiers | Frontiers in Forests and Global Change

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Factors limiting plant recruitment in a tropical Afrotropical Forest

Iveren Abiem^{1,2,3} | Ian Dickie⁴ | David Kenrick⁵ | Hazel M. Chapman^{1,6}

Abstract
Predicting how forest species composition may change in response to global change is essential for meaningful management. Which species are most likely to successfully recruit depends on a multitude of factors, but processes operating at the seed-to-seedling transition being especially important. Here, we explore how influential seed dispersal, abiotic and biotic factors, and establishment of seedlings in a lowland tropical forest to measure dispersal and establishment limitation across species. We history strategies, and seed sizes. From 350 seed traps and 215 seedling plots, we recorded 12,230 seeds from 28 species and 2025 seedlings of 42 species. All species except for one have showed strong dispersal limitation while 23 out of the 30 species showed establishment limitation. The few trees that were sampled had significantly lower dispersal limitation compared to the trees investigated in this study. Our results suggest that both dispersal and establishment limitation are markedly high in this Afrotropical forest but, notably, are less so in a lowland counterpart.

KEYWORDS
seed dispersal, tropical forest, recruitment limitation, seed rain, seed-to-seedling transition

1 | INTRODUCTION
In Nigeria, demonstrated a disproportionate increase in seedlings of shade-intolerant species in humid sites (Ehrlén et al., 2010) in Ghana based on the forest, the relative frequency of shade-tolerance species has been a key question in tropical ecology (Fisher et al., 2011; Laurance, 2004; Sisk et al., 2015). An anthropogenic effect increases in their extent and severity, landscape and forest composition are changing and species interaction networks are being altered (Braz et al., 2020). Different species respond in different ways to change (Foster et al., 2007), while some species increase in abundance, others decline or even may be driven to local extinction (Braz et al., 2020). For example, a study of seedling recruitment in humid forest non-humid forests (Givnish & Baskin, 2003; Grubb, 2003) biodiversity conservation (Foster et al., 2007; Foster & Gignac, 2012) and for predicting future carbon stocks (Muller-Landau, 2016).

Processes happening at the seed-to-seedling transition play a crucial role in determining the individual's life and therefore community structure and diversity (Clark et al., 2013; Chellappan, 2019). During these early stages of development, potential recruits may be limited by dispersal, abiotic, or biotic factors (Clark et al., 2013; Chellappan, 2019). Processes happening at the seed-to-seedling transition play a crucial role in determining the individual's life and therefore community structure and diversity (Clark et al., 2013; Chellappan, 2019). During these early stages of development, potential recruits may be limited by dispersal, abiotic, or biotic factors (Clark et al., 2013; Chellappan, 2019).

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Assessing the impact of abiotic and biotic factors on seedling survival in an African montane forest

Iveren Abiem^{1,2,3} | David Kenrick⁵ | Hazel M. Chapman^{1,6}

Abstract
The seedling dynamics undergo subsequent forest structure and diversity an different species/guilds respond differently to abiotic and biotic stresses. Thus, understanding differential seedling responses to stresses helps us to predict forest trajectories. Because forests vary in both environment and species composition, generalizations across tropical forests are difficult. Afrotropical forests are important carbon stores, harbor high diversity and provide critical ecosystem services, yet they are vulnerable to climate change. Here, we investigate the importance of key abiotic and biotic factors on survival of seedling guilds along spatial and temporal scales in a montane forest in south-western Nigeria. We use data from 318 seedling plots censused every 3 months from 2017 to 2020 to identify key abiotic and biotic factors influencing seedling survival. We used the Kaplan-Meier method to estimate the persistence time of 1,565 seedlings at community and guild levels. In this community, newly recruited seedlings had a median survival time of 15 months and about 37% of the seedlings sampled were still alive after 24 months. Understorey tree species showed significantly longer than the other growth form guilds, and seedling survival did not differ across shade-tolerance guilds. Competitive ability and shade-tolerance were both negatively related to survival. In addition, tree height that recruited (0.60 m) and soil water (beginning of dry) had lower survival probabilities compared to those that recruited in the other months. Except for initial height, seedling survival in larvae was not impacted by any of the abiotic and biotic variables tested. Our results suggest that under the current environment forest structure and diversity is changing, most noticeably larvae are increasing in abundance relative to trees.

KEYWORDS
Afrotropical forest, biotic neighborhood, negative density dependence, Ngel Nyaki, seedling survival

1. INTRODUCTION
The seedling stage constitutes a significant bottleneck for forest regeneration (Ehrlén, 2015; Grubb, 2003; Hartwig et al., 2017; Hubbell et al., 2015), and that understanding factors that influence seedling survival is crucial for predicting future forest structure and diversity (Chellappan, 2019; Clark et al., 2013). Moreover, because seedling recruitment

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Matrix habitat restoration alters dung beetle species responses across tropical forest edges

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Abstract
Restoration from agricultural intensification, for conservation, species invasion and illegal burning, all present major conservation challenges in natural tropical forest reserves. These processes can greatly impact the success of restoration efforts. However, the extent to which restoration strategies that involve natural forest and matrix adjacent areas increase the likelihood of forest recovery remains largely unknown. We investigated the impact of matrix habitat restoration on the success of forest recovery in a tropical forest in south-western Nigeria. We used data from 318 seedling plots censused every 3 months from 2017 to 2020 to identify key abiotic and biotic factors influencing seedling survival. We used the Kaplan-Meier method to estimate the persistence time of 1,565 seedlings at community and guild levels. In this community, newly recruited seedlings had a median survival time of 15 months and about 37% of the seedlings sampled were still alive after 24 months. Understorey tree species showed significantly longer than the other growth form guilds, and seedling survival did not differ across shade-tolerance guilds. Competitive ability and shade-tolerance were both negatively related to survival. In addition, tree height that recruited (0.60 m) and soil water (beginning of dry) had lower survival probabilities compared to those that recruited in the other months. Except for initial height, seedling survival in larvae was not impacted by any of the abiotic and biotic variables tested. Our results suggest that under the current environment forest structure and diversity is changing, most noticeably larvae are increasing in abundance relative to trees.

KEYWORDS
Afrotropical forest, biotic neighborhood, negative density dependence, Ngel Nyaki, seedling survival

Some examples of the many publications from our long-term monitoring studies

Grants and workshops

ForestGEO research grant

Istifanus was awarded a ForestGEO research grant to investigate mast seeding, this being a coordinated reproductive strategy in which plants produce exceptionally large seed crops in certain years. We have conducted a study of this across selected tree species in the reserve. This work represents a significant advancement for ecological research in Nigeria, where mast seeding remains poorly documented, and will generate novel insights into reproductive dynamics in montane forest systems.



L to R: Istifanus, Idris and Alfred counting flowers trapped in a seed trap

Rufford Small Grant

Gabriel was awarded a Rufford Small Grant to assess the population status of two critically endangered plant species within Ngel Nyaki forest, *Eugenia gilgii*, a critically endangered species endemic to Nigeria and Cameroon and *Aubreginia taiensis*, a species with only 18 mature individuals across its range. Alongside field-based population surveys, the project involves community engagement, working with neighbouring communities to raise awareness of threatened species and strengthen local stewardship to improve their long-term persistence in the reserve.



Hammasumo and Esau collecting seeds of *Eugenia gilgii* for planting.

ForestGEO analytical workshop

Dr Iveren Abiem and Gabriel Dabo received funding from the Smithsonian Institute in Washington to attend the 2025 ForestGEO Analytical Workshop in Nanyuki, Kenya. This workshop provides an excellent opportunity for small groups to collaborate on specific research topics, using data from the long-term ForestGEO plots. Ivy focused on seedling dynamics within the ForestGEO plot, while Gabriel analysed the liana data he has been collecting from the plot. The outcomes of these analyses are expected to contribute to high-quality publications.



Dr Ivy and Gabriel during the ForestGEO Workshop

New associates

We are most fortunate to have five new associates join our team.



Ahmed O. Abdulrahman

Research Associate – Geographic Information Systems and remote sensing

Ahmed applies Geographic Information Systems (GIS) and remote sensing to forest management. He is completing a Master's in Space Science and Technology (Remote Sensing and GIS) at the Federal University of Technology Akure, building on degrees in Urban and Regional Planning and Geography (Remote Sensing). His research combines remote sensing, field inventory, and soil analysis to evaluate regeneration patterns across the restoration plots at Ngel Nyaki.



Dr AJ (Anthony) Gillis

Research Associate – Ecological analysis and modelling

AJ is an ecologist at the University of Canterbury. Originally from the USA, AJ's passion is using spatial information to answer ecological questions. Most of his experience has been in marine environments answering questions around the influence of home range on sea turtles diet and exploring the importance of direct and indirect interactions in rocky shore kelp and estuarine communities. AJ is currently working with the NMFP to develop suitable analyses for our long-term forest restoration data.



Atiku M. Jafar, Esq.

Associate – Corporate governance & compliance

Atiku M. Jafar is a Nigerian commercial lawyer and energy-sector professional supporting NMFP by providing advice on legal, governance, and institutional structuring matters, helping strengthen our long-term organisational development and strategic partnerships



Abbas Suleiman Tafida

Associate – IT infrastructure & technical support

Abbas Suleiman Tafida supports NMFP's IT infrastructure and technical operations, thereby helping improve our internal systems and workplace on-boarding support.



Haruna Tijjani Zango

Associate – Digital systems & technology

Haruna Tijjani Zango supports NMFP's digital infrastructure, including website development, systems coordination, and technology platforms that enhance communication, visibility, and operational efficiency. Haruna brings expertise in software engineering, digital systems, and AI-enabled platform development.

Students

With logistical support and science supervision from the NMFP, Ngel Nyaki forest reserve has become a research destination for students from across Nigeria and internationally.

PhD students



Ikima Damian Iorliam

Modibbo Adama University Yola

Assessment of Soil Physio-Chemical Properties and Microbial Diversity

Damian is assessing the soil physio-chemical properties and microbial diversity in relation to tree species diversity in the fragments of Ngel Nyaki forest reserve. His work will answer questions on how some soil and microbial parameters contribute to the diversity of trees within the reserve.



Ogwuche Agnes Ene

Federal University Wukari

Diversity, nutrition and utilization of edible wild plants

Agnes is currently working on the diversity, nutrition and utilization of edible wild plants in the three ecological zones of Taraba State. She has collected both field and questionnaire data to answer her research questions.



Awoku Gboyega

University of Canterbury, New Zealand

The insect pollinators of subsistence farmlands of the Mambilla Plateau

Gboyega and his field assistants have carried out substantial fieldwork on crop plant pollination across multiple sites on the plateau, he has analysed his data and written his thesis. His oral exam is due early 2026. Gboyega's work will inform new strategies that will improve the crop yields for local farmers.

MSc students



Stella Agwom

APLORI

Ecological assessment of fern diversity and their role in habitat structuring for birds

Stella has been working on ferns within the reserve, her project research aims at assess the diversity of fern species in the forest and the ecological role of the fern species in structuring microhabitats that birds use within the montane ecosystem of Ngel Nyaki forest reserve.

Preliminary findings showed that the forest fragment has the most species richness of ferns, while the eucalyptus plantation has the least.



Evelyn Micah Joshua

Gombe State University

Extinction risk assessment of vascular plants and impacts on ecosystem structure

Evelyn is working on the extinction risk assessment of vascular plants, and its impact on the ecosystem structure of Ngel Nyaki Forest Reserve. She has carried out some inventory and identification by using the already established phenology transects in the reserve. These data will be used to provide an extinction risk index for several species.



Bashir Mijinyawa

Ahmadu Bello University Zaria

Edge effects on seed survival within Ngel Nyaki Forest Reserve

Bashir is nearing the completion of his MSc thesis which is investigating the influence of forest edge effects on tree species seed and seedling survival. Dr Kim McConkey from the University of Nottingham, Malaysia, is going to be Bashir's examiner. His MSc oral exam is scheduled for early 2026.



We remain committed to high quality training at tertiary level to build capacity.

Intern students – undergraduate work experience with the NMFP



Intern students out in the field to survey insects.

We hosted 10 undergraduate students from the Forestry and Botany Departments of Taraba State University as part of their industrial training programme. Fully embedded in the project, the students work closely with our staff and contribute to ongoing field and research activities, gaining practical experience in ecological research and conservation.

Taraba State University student field trip

As part of our commitment to training and capacity building, we regularly host students from universities across Nigeria for field-based learning. These

visits expose the students to a range of ecological field techniques and introduce them to applied conservation research in a montane forest setting. In June, we welcomed a group of students from Taraba State University for several days of practical field training within the reserve.



Students from the Forestry Department of TSU during their field trip at Ngel Nyaki.

Community engagement

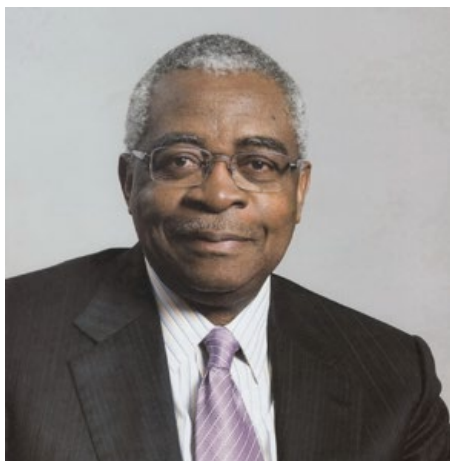
The local community underpins all our research and conservation work—we depend on their goodwill and cooperation. Thus, regular community engagement is extremely important to the Project.

Community school

We hosted students from the Government Secondary School Yelwa and Esso Mobile Primary School Yelwa for a seminar at the field station in November as part of our ongoing outreach and education efforts. During the visit, students were introduced to fundamental ecological processes, including how plant roots interact with fungi to support nutrient cycling and overall ecosystem functioning, creating early interest in ecology and conservation.

Hostel funding

Our friend and benefactor, Retired General TY Danjuma, is very kindly funding the building of a 10 unit hostel in Yelwa village. Each unit has its own bedroom, bathroom and kitchen. The construction will be based on an extremely strong mud-cement blend. Building is due to begin in January 2026. The land is next door to the nursery school and the project includes a bore hole for water and gate house. The hostel will have multiple uses, including for visitors, visiting researchers, student workshops and more.



Retired General TY Danjuma



Dr Ivy, NMFP staff, IT students, and GSS Yelwa students after the community schools workshop

Honey Business

Highlights during the year included the sponsorship and support of NMFP's honey enterprise by Prof. Shehu Hassan, helping advance the Project's 'Beyond Bee' initiative linking conservation, sustainable livelihoods, and rural economic inclusion.



Prof. Shehu Hassan

Our activities encourage participation by all.





Gabriel speaking to a community member of Dujere village about the shared responsibility of conserving the forest.

Ecology and conservation of two critically endangered plant species in Ngel Nyaki

The Rufford Small Grant team has spent time with community members surrounding the reserve to co-develop community-driven recovery pathways for two critically endangered plant species, these being *Eugenia gilgii* and *Aubregrinia taiensis*. Through structured focus group discussions, community members were actively engaged to raise awareness of the ecological and cultural importance of these species and to identify sustainable conservation practices together. This participatory approach is strengthening local stewardship and is expected to contribute to measurable improvements in population recovery.

Yelwa nursery school

In November Hazel met with Stephen Jennings, a fellow Kiwi, the Founder and Chief Executive of Rendevour, a company transforming land across Africa into infrastructure-rich economic zones with sustainable live-work-play communities. Stephen asked for information on the NMFP nursery school in Yelwa which needs an upgrade and we are looking forward to a further discussion in the new year.



Conservation and restoration

Regeneration activities

Our regeneration efforts adopted a more experimental approach than previous years. Seedlings were planted in controlled plots under different management treatments, helping us to develop practical, evidence-based models for restoration and regeneration in Afrotropical landscapes. Throughout these activities, members of surrounding communities volunteered to support seedling planting, reflecting growing local engagement and representing a clear indicator of the project's conservation impact beyond the forest itself.



The team in the early rainy season planting-out tree seedlings of local tree species which were grown from seeds in the NMFP plant nursery.

Fire tracing and fence maintenance

At the end of the rainy season, there is a substantial accumulation of grass biomass in the grassland areas surrounding the forest. This excess biomass can serve as fuel for wildfires. Consequently, we routinely conduct fire-tracing activities to reduce fuel loads, thereby supporting effective forest management and minimizing the risk of uncontrolled fires.

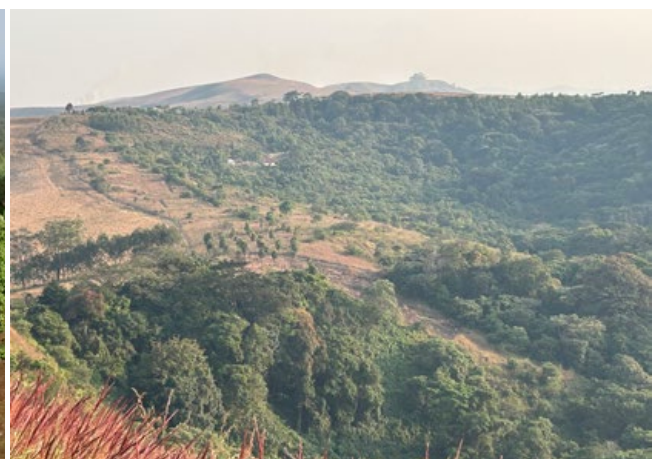


Forest patrollers partitioning the grasslands using fire.

Patrollers

Bature is one of NMFP's long-serving security staff, stationed at the western forest boundary outpost at Ngel Nyaki. Known for his punctuality, discipline, and immaculate appearance, he plays an important role in maintaining a constant presence at the forest edge and helping safeguard the reserve from illegal grazing, burning, and encroachment.

As a member of the Fulani community, Bature also has a strong understanding of local pastoral systems and maintains positive relationships with the surrounding cattle-herding communities. His role reflects NMFP's approach to conservation through trust, local knowledge, and long-term community stewardship of the Ngel Nyaki forest landscape.



Bature outside his patrol post which looks across the northern part of the reserve. From his vantage point Bature can see across a large section of the forest and alert the community if there is a fire.



Helen (centre) engaging with local women about their perception of ecosystem services provided by Ngel Nyaki forest reserve.

Ecosystem services

We have been working closely with key stakeholders, including community Jauros and elders from villages bordering the reserve. During October, we hosted them at the field station for a consultative meeting. A key component of the discussion was a detailed explanation of the ecosystem services provided by the forest, with particular emphasis on those most beneficial to each community.

Each community Jauro left the station with a clear understanding of the concept of ecosystem services, the services most critical to their communities, and how these resources can be sustainably utilised.



An engagement session with community leaders after the ecosystem services project. Dr Abiem is sharing the findings of the study based on the communities perceptions of ecosystem services provided by the montane landscape.

New partnerships

We continue to strengthen and grow our partnerships, locally, nationally and globally.



Our commitment to empowering women in our communities

The NMFP has partnered with the School of Product Design, University of Canterbury, New Zealand, to help formulate a skin care cream from the leaves of *Harungana madagascariensis*, a small tree known to have anti-aging properties, amongst other benefits. Once we have arrived at a formulation, this initiative will involve local community members (especially women) in harvesting the leaves sustainably and, in association with our honey business, produce a face cream for the market.



Vanessa Wood-Lin, Hazel Chapman, Ali Reza Nazmi, Gabriel Dabo, and Istifanus Jesse, discussing *Harungana* formulation.



University of Texas, Austin

We have entered a new collaboration with Dr Brian Sedio from the University of Texas, Austin. Dr Sedio is generating foliar metabolomes across 40 ForestGEO plots globally—for comparative studies that would: i) evaluate variation in chemical diversity and composition over latitudinal and climatic gradients, ii) model individual tree survival and/or growth as a function of neighborhoods defined by metabolites, and iii) evaluate variation over latitude and climatic gradients in the effect of chemical neighborhoods on tree performance (growth and survival, including of seedlings where we have seedling data). In addition to including Ngel Nyaki in these global comparative studies, the metabolomic data would facilitate a range of research focused specifically on the plot. For example, we could use the chemistry to evaluate variation in primate diet preference or host ranges of insect or pathogens, etc. And of course, many of the metabolites are involved in plant-environment interactions and could inform studies of drought tolerance and plant mortality.

Embrace the Earth

We have partnered with Embrace the Earth, a young nonprofit environmental organization committed to the protection and conservation of nature in the Global South. Embrace the Earth are helping us with our social media presence and in the running of our conservation club and school teaching activities.



Participation in mountain biodiversity data collaboration

Another new collaboration involves our participation in a study exploring the challenges and opportunities associated with the collection, access, sharing, and use of mountain biodiversity data in Africa. The project is led by Imperial College London, the Global Mountain Biodiversity Assessment (GMBA), University of the Free State, and University of Namibia.

Online checklist

We are collaborating with Dr. Abubakar Bello and the NaijaFLO project. This is Nigeria's first specimen-based checklist of vascular plants, creating a comprehensive online database that documents Nigeria's rich biodiversity.

Dr Bellow visited the NMFP in November this year, collecting plants and exploring our herbarium.



From left to right: Dr. Hammanjoda Salihu, Evelyn Micah, Prof. Hazel Chapman, Dr. Abubakar Bello and Dr. Daniel A. Zhigala

Raising our profile nationally

Expanding networks, strengthening collaborations

During 2025 we have expanded our national networks and strengthened collaborations. Examples include the NMFP being invited by PreCEFI (Office of the Vice President) to be a special guest and speaker at the Nigeria Forest Economy Summit 2025 at the Presidential Villa, Abuja. NMFP launched its pure montane honey from Ngel Nyaki at the summit exhibition.



Ridwan representing the NMFP at the Nigeria Forest Economy Summit exhibition. Note our honey on display.



Ridwan with the Taraba State Commissioner for Environment and Climate Change, Aisha A. Barde



L-R: Ridwan, Onah A. Friday, Hazel, Atiku Jafar, Esq. Friday is the Technical Advisor to The Honourable Minister on Climate Change and Forestry, in Abuja July 2025.



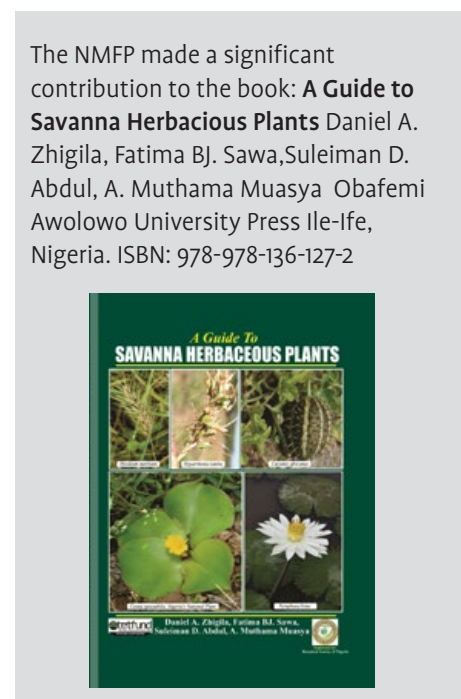
Research papers

Papers published

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- Nsor, C.A., Chapman, H.M., Godsoe, W. Aliyu, A.H. (2025) Floral Resource Availability of Key Afromontane Trees as Predictors of Sunbird Distribution and Abundance in Ngel Nyaki Forest, Nigeria. In *Research Perspective on Biological Science Vol. 6*. Pages108. PB International. DOI: <https://doi.org/10.9734/bpi/rpbs/v6/5936>
- Lai, H. R., Hill, T., Stivanello, S., & Chapman, H. M. (2025). Changes in quantity and timing of foliar and reproductive phenology of tropical dry-forest trees under a warming and drying climate. *Journal of Ecology*.
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- John, A. O., & Olubukola, A. A. (2025). Small mammal diversity and conservation challenges on the Mambilla Plateau, Nigeria. *Dutse Journal of Pure and Applied Sciences*, 11(4c), 19-27.
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- Abdulrahman, A. O., Chapman, H., Tariq, A., Elias, P., Areh, M. O., Abdullah, Z. O., & Soufan, W. (2025). Multi-temporal analysis of forest canopy cover in Ngel Nyaki Forest Reserve using the Sentinel-1 and Sentinel-2 data. *African Geographical Review*, 44(7), 681-699.

Presentations

- **Embrace the Earth seminars**
Prof Hazels Talk: On 29 October 2025, Professor Hazel delivered a webinar titled “The Nigerian Montane Forest Project: Combining science, education, and community engagement for the conservation of Nigeria’s montane forests,” hosted by Embrace the Earth. In her presentation, she highlighted the origins of the project and outlined its more than two decades of impact on forest restoration and protection, as well as on improving the livelihoods of communities surrounding the reserve.
Ridwan’s talk: In August, Ridwan Jaafar presented a talk at the Second Forum on Environment and Climate Change, organized by our new partners, Embrace the Earth, in Belgium
- **Invited seminar at the National University of Singapore** Department of Biological Sciences, During June 2025 Hao Ran Lai gave a presentation titled: The influence of climate change on Afromontane forest phenology



Worksheet for Government Agencies No. 1 March 2025

Contribution to Presidential Committee on Economic and Financial Inclusion

In August NMFP's work and impact on economic and financial inclusion in Ngel Nyaki communities was presented to the Presidential Committee on Economic and Financial Inclusion (PreCEFI). Our poster received significant interest and appreciation from the PreCEFI Secretariat. We agreed to collaborate in advancing economic and financial inclusion programs on the Mambilla Plateau, with a commitment to respond to specific requests for NMFP's support in the future.



Impact and inclusion

Economic development through conservation

Founded with the goal of safeguarding Nigeria's rare montane forests, the Nigerian Montane Forest Project (NMFP) has evolved into one of Africa's most respected ecosystem restoration models – blending world-class science, community empowerment, and long-term climate strategy.

Forest conservation leading to economic and financial inclusion

Through forest ecology and conservation work, the NMFP is benefiting local communities by creating jobs and bringing international partnerships and funding to the region. The NMFP is reducing poverty and inequality, improving education, and creating economic opportunities. Our staff are all from the local communities and all have bank accounts.

Inclusive and sustainable management

We have four primary objectives, each of which is sustainable and directly addresses economic and financial inclusion. Each objective is aligned with the UN Sustainable Development Goals.

Objective	Goal	Impact
Sustainable employment	Creation of a career pipeline for local community members in forest conservation jobs	All staff are from local communities and have financial inclusion through bank accounts. We employ and train 50 staff at any one time, many of whom progress to further training and a wide range of careers, allowing us to employ and upskill further community members.
	Creating community cooperative businesses through the sustainable use of forest resources	An example of this is through beekeeping, enabling community members to become self-employed business operators.
Education and research	Enhance local knowledge and skills, from nursery school to postgraduate, provide training and understanding of the role of forests in economic and sustainable development.	Empowerment of local communities through educational programs and research opportunities. Enabling early learning through provision and funding of a nursery school. Empowering university students to enter careers in environmental sciences, policy and development.
International partnerships	Attract global funding and expertise	Strong educational and development links through international partnerships including with the Universities of Canterbury, NZ and Oxford, UK. Knowledge sharing and training with partners such as the Smithsonian Institute Washington, USA, and the Royal Botanical Gardens, Kew, London.
Biodiversity conservation	Protect endemic species and habitats	Alignment with the UN Sustainable Development Goals for environmental sustainability.

A blueprint for success

The high plateau forests of the Nigerian/Cameroon border are of great social and biological importance and store more carbon per unit area than Amazonian forests. NMFP has transformed threatened hillsides into functioning ecosystems, upskilled villagers into expert botanists, collectors of scientific data and IT literate citizens, and undertaken science that is shaping how Africa understands climate resilience. understands climate resilience.



Our long term scientific data contributes to understanding forest dynamics in a changing climate.



Our conservation club enables the whole community to be involved, fostering connection and ownership over the long term success of the Project and survival of the forest.



A diverse range of locally sourced seeds and seedlings are used to regenerate grassland into forest.



Members of the beekeeping cooperative produce honey sustainably from the forest.



Staff participate in training to upskill, enabling success in a range of future careers.



Take a virtual tour to the research station to see all of our science, history and impact

canterbury.ac.nz/afromontane

Ngel Nyaki is the most studied montane forest in Nigeria.

A long established history

2004-2008
Building roots

- Launched at Ngel Nyaki forest reserve on the Mambilla plateau, establishing the foundation for long-term conservation efforts.
- Built Nigeria's first montane forest herbarium and plant nursery, creating essential infrastructure for scientific research.
- Trained local staff and began ecological monitoring, involving communities in conservation efforts.
- Partnered with communities like Yelwa to foster stewardship, ensuring local support for conservation initiatives.

2009-2013
Science, education & scale

- Climate research network - installed automated weather stations and joined global climate data networks, contributing valuable data from an understudied region.
- Scientific publications - published first of many peer-reviewed studies on forest dynamics, establishing credibility in the scientific community.
- Education pipeline - hosted dozens of Nigerian undergraduates and postgraduates for field training, building local scientific capacity.
- Organizational structure - formalized NGO structure and advisory board, creating a sustainable framework for long-term operations.

2014-2018
Restoration and resilience



- Native tree planting - planted thousands of native seeds and plants in degraded grasslands, beginning the process of ecosystem restoration.
- Protective Infrastructure - built 8 km of protective fencing to shield forest plots from cattle and fire, ensuring the survival of newly planted areas.
- Sustainable livelihoods - created through a beekeeping cooperative, connecting conservation with economic benefits.
- Resilience Innovation - survived regional conflict and fire, innovated fire-resilient planting methods, adapting to challenges on the ground.

2019-2024
National model & global recognition

- 70,000+ trees planted, all locally sourced native species, restoring over 100 hectares of montane forest
- 20.38 hectare ForestGEO plot - A partnership with the Smithsonian Institution
- 20+ native species - diverse planting matched to local ecology
- Published landmark studies on carbon storage, biodiversity, and phenology while training a new generation of Nigerian PhDs, conservation leaders, and GIS experts
- The project established school infrastructure, a nursery school, boreholes, and a science centre, influencing reforestation policy across Taraba State and Nigeria.

Report to Africa Nature Investors


Our report to ANI (Africa Nature Investors) on forest regeneration potential of the southern highlands of Gashaka Gumti National Park was submitted in April 2025. The report is feeding into the assessment of the potential for GGNP to earn funding from carbon credits.






Nigerian Montane Forest Project
Montane Forest Conservation Initiative Nigeria

Forest regeneration potential of the southern highlands of Gashaka Gumti National Park, Taraba State, Nigeria

Report by Hazel Chapman



Poster presented during the the Presidential Committee on Economic and Financial Inclusion (PreCEFI)

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