EFFECT OF HABITAT DEGRADATION ON AVIAN SPECIES DIVERSITY AND ABUNDANCE IN GUINEA SAVANNAH REGION OF NORTH EAST NIGERIA

Final Report



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EXECUTIVE SUMMARY

Tula Mountains Woodland (TMW) in north east Nigeria is one of least disturbed areas which serve as refugia of avian species that have lost their habitats in areas prone to anthropogenic activities. This project is the second biodiversity project at TMW. The project on plant species diversity and abundance was carried out from May, 2014 to May 2015. The second phase of the project aimed at investigating the effect of habitat degradation on avian species diversity and abundance was carried out from January 2016 to March 2017. The project has two main objectives: (i) survey to document avian species of TMW and (ii) build capacity through establishment of environmental clubs in secondary schools to create in the young generation a mindset of environmental responsibility and stewardship. Bird survey was carried out using point transect method. A total of 100 points with 200 m gap between points were sampled. Our survey recorded 129 species of birds belonging to 49 families at TMW. Bird groups included insectivores, frugivores, granivores, nectarivores and carnivores. Shannon's diversity index was 3.93 and Simpson's index of dominance 0.03. Estimated number of species adjusted for Bootstrap was 141.96 and first order Jacknife 160.64±5.88. Species richness and diversity was higher in the degraded site with fewer sample plots (39) than the less degraded site with more plots (61). Number of species recorded in the degraded site was 93±6.16, Shannon's diversity index 3.89 while in the less degraded site, species richness was 92±4.29, Shannon's diversity index 3.63 although not significant. The Common Bulbul and Stone Partridge were the most dominant species. Net Difference Vegetation Index (NDVI) for 3 decades showed about 56 % decrease in vegetation from1987 to 2017. This information is important in developing a monitoring strategy for vegetation and avian population of TMW. Environmental clubs were established in three secondary schools around TMW. Indoor and outdoor conservation activities aimed at creating environmental awareness were conducted through lectures, drama competitions and field training. Results obtained from this project will be used to buttress our appeal to government agencies to grant TMW a status of protection from human activities.

INTRODUCTION

As a result of anthropogenic activities in Nigeria, only protected reserves and areas rendered inaccessible to humans by difficult terrain harbour the remains of our natural habitats. Tula Mountains Woodland (TMW) is one of the few places that harbour remains of the Gombe guinea savannah vegetation. Due to its rocky terrain, pressures from farming activities have been minimal. However, other activities such as logging, grazing and firewood collection are intensive around the woodland. These mountains being one of the least disturbed environments in the locality serve as refugia to many species that have lost their habitats in areas that are mostly affected by anthropogenic activities. A baseline data on plant species and vegetation structure of Tula TMW have been documented (www.rufford.org/projects/rahila_yilangai). A report on this has been submitted to Local Government Agency and stakeholders to work towards developing informed management strategies for designating TMW as a nature reserve. A second phase of this project on effect of habitat degradation on bird species diversity and abundance was carried out from January, 2016 to March 2017. The project consists of two major objectives: to document avian species of TMW and build capacity by establishing environmental clubs in the 3 secondary schools around TMW. This is to cultivate in the younger generation, a mind set of environmental responsibility and stewardship. The study on effect of habitat degradation on avian species composition in addition to Net Difference Vegetation Index (NDVI) analysis will help in understanding the impact of human-induced landscapes on avian species population and rate of habitat degradation over time. The survey has provided baseline data on bird species found within the TMW. The information gathered from here will be useful for long term monitoring of bird populations and habitat quality of TMW.

PROJECT SITE

The TMW is located in Gombe state in North eastern part of Nigeria (9° 8'36.07"N, 11° 27'27"E). The mountains which cover a total area of about 596 km^2 harbour wide stretches of guinea savannah woodland as the primary ecosystem. Due to the hilly nature of the terrain and lack of infrastructure, human activity has been minimal, a factor that has worked so far in favour of its

conservation. Over 130 plant species comprising majorly understory species have been documented (www.rufford.org/projects/rahila_yilangai). The most Common plant species found on TMW are *Detarium macrocarpum, Combretum species, Annona senegalensis,* and *Terminalia species*. Economically important plant species include *Prosopis african* and *Swartzia madagascarirensis* which the local people use in making local food seasoning. Other species of conservation importance include the globally threatened *Vepris heterophylla*; *Khaya senegalensis* and *Afzelia africana* which are considered globally vulnerable (IUCN RedList of threatened species, version 2014.3). *Azanza garckeana*, a range restricted plant species and currently extinct in the wild is found only in Tula communities in Nigeria. Several animal species such as baboons (*Papio anubis*), warthogs (*Phacochoerus africanus*), Patas monkeys (*Erythrocebus patas*), and several species of butterflies, reptiles and avifauna are also found on TMW. The TMW can be classified into two distinct natural habitat types which include the xeric (dry) savannah and mesic (moist) savannah. However, human interference has modified the woodland into a landscape mosaic resulting in 4 habitat types. These include wooded savannah (less disturbed: xeric), open savannah (degraded: xeric), gallery forest (less disturbed: mesic) and mesic savannah (degraded gallery forest: mesic).

METHODS

Bird survey and Vegetation measurement

Systematic random sampling using point count method was employed for this survey. A total of 100 points, 61 points in the less-disturbed and 39 in the degraded sites with 200 m gap between points were sampled. Bird count was conducted in the morning (0630 to 0930 hours) and evening (1500 to 1800 hours). Bird species seen and heard were identified and recorded within 10 minutes. Plots were visited twice in May - November 2016 and February - March, 2017. A Pair of binoculars and Birds of Western Africa (Borrow and Demey, 2004) were used for bird identification. After each session of bird count, all woody trees, shrubs, saplings, snags and stumps were counted within a 400m^2 plots at each point.

Data analysis for bird survey: Microsoft excel was used for data imputation. R statistical package version 3.0.1 (**R** Core Team, 2013) was used for analysis of data. Species richness and

diversity indices were analysed in EstimateS Software 9.10 (Colwell, 2013). Asymptotic species richness estimates were obtained using Bootstrap and First order Jacknife estimators in EstimateS. Species diversity and dominance were determined using Shannon Weiner diversity index (H) and Simpson Diversity index obtained from EstimateS. Shannon's index of diversity takes into account the relative number of individuals across species while Simpson's Index measures dominance. Linear model (LM) was used to determine the effect of vegetation (trees and saplings) variables on bird species diversity and abundance. Kruskal Wallis Test was used to test difference of avian species abundance across feeding guilds. Chi Squared test was used to test difference in avian species richness, abundance and diversity between degraded and less degraded sites.

NDVI analysis

Change in landscape cover types and pattern within TMW was investigated using landsat satellite data spanning over three decades. The software ILWIS 9.3 and ArcGIS 9.3 were used for data processing and analysis respectively. Landsat images of January 1987, 1997 and 2017 were used. The world wide reference system (WRS) was used to identify path and row of each land sat image for the study area. The acquired images were corrected and registered to UTM zone 32 projections and WAS84. The corrected images were resample and subset to the boundaries of the TMW, and classified to determine the NDVI and the vegetation proportion of the woodland. The NDVI will be calculated as follows: NIR - RED/NIR + RED where: NIR stands for near infrared regions and RED stands for the spectral reflectance measurement acquired in the red. Thus, land sat image was calculated as: Band 4 - Band 3/Band 4 - Band 3. Coordinates points were collected from 30 random points and imputed on image for verification. An independent-sampled t test was used to test NDVI between each two successive decades.

RESULTS AND DISCUSSION

Species Diversity, Abundance and Composition

A total of 2141 individuals belonging to 124 species and distributed among 49 families were recorded. There were also 5 incidental sightings bringing the total number of species observed to 129. Shannon's index of diversity 3.93 shows a high diversity of avian species. Simpson's index of 0.03 indicates low dominance, therefore high diversity. Estimated number of species adjusted for

Bootstrap was 141.96 and first order Jacknife 160.64±5.88 (fig.1). Singletons (only one individual of a species) were 25; unique (species recorded in only one point) were 36 (table 1). More species were recorded in the degraded site (93±6.16), than the less degraded site (92±4.29) but this was not significant (χ^2 = 0.0054, df = 1, p = 0.9414). Consequently, Shannon's diversity index was higher in the degraded site (3.89) than the less degraded site (3.63) but not significant (χ^2 = 0.009, df = 1, p = 0.9245). However, more individual birds were recorded in the less degraded site than degraded site but this also was not significant (χ^2= 3.0645, df = 1, p = 0.08002).

The four most dominant families are the family Acciptridae (raptor; 10 species), Silviidae (warblers; 7 species), Columbidae (Doves and Pigeons; 7 species) and Estrildidae (Finches; 7 species). Silviidae (warblers) recorded the highest number of individuals (275). The dominant species are Common Bulbul (*Pycnonotus barbatus*), family Pycnonotidae with 169 individuals and Stone Patridge (*Ptilopachus petrosus*), in family Phasianidae with 155 individuals recorded.

Table 1: Summary of Result of Bird Species Diversity and Abundance

Parameter	Degraded	Less degraded	Both Sites
No. of observed Species	93±6.16	92±4.29	124±4.69
No. of Individuals	1030	1111	2141
Bootstrap	108.61	105.51	141.96
First order Jacknife	130.03±5.84	120.52±4.75	160.64±5.88
Singletons	25	22	25
Uniques	38	29	36
Exclusive Species	32	33	60
Shannon's Index	3.89	3.63	3.93
Simpson's Index	0.03	0.04	0.03

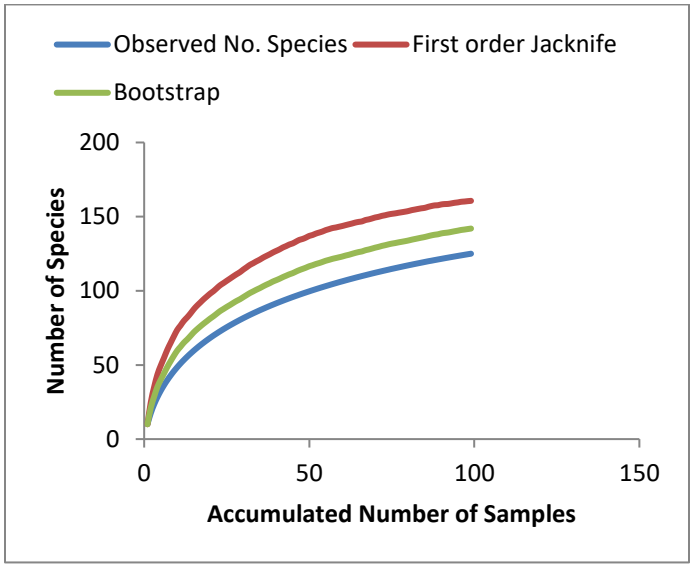


Figure 1: Species Accumulation Curve

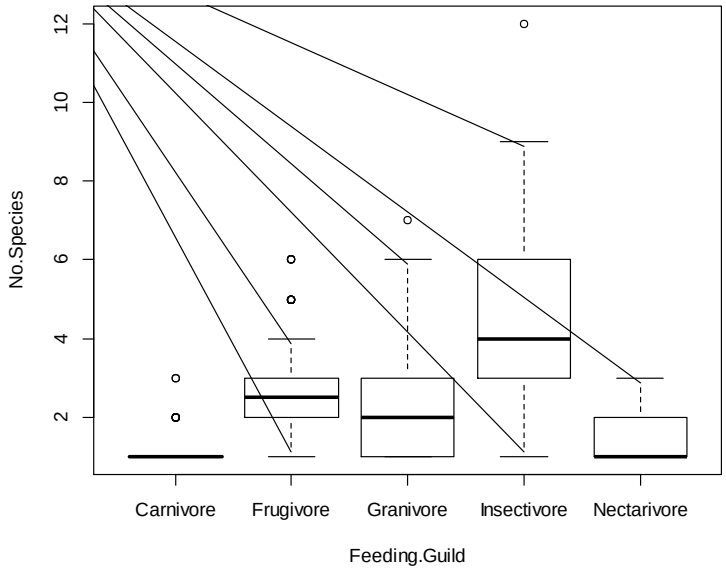


Figure 2: Number of avian species according to feeding guilds

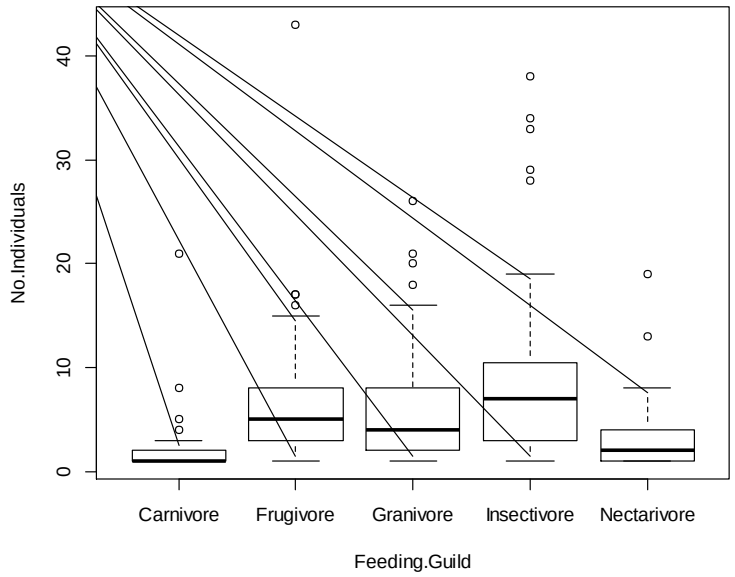


Figure 3: Number of Individual birds according to feeding guilds

Composition of bird species differed significantly between feeding guilds (Kruskal-Wallis $\chi 2 = 150.5807$, df = 4, $p < 0.001$: fig. 2). Abundance of birds according to feeding guilds also differed significantly (Kruskal-Wallis $\chi 2 = 100.0517$, df = 4, $p < 0.001$: fig. 3).

Effect of number of trees and shrubs on number of species was not significant (One-way ANOVA: $F_{3, 46} = 2.357$, $R^2 = 0.07673$, $p = 0.08398$). Likewise effect of number of trees and shrubs on number of individuals was not significant (One-way ANOVA: $F_{3, 46} = 1.337$, R^2: 0.0202, $p = 0.274$)

Due to heterogeneity of the woodland landscape, avian assemblages are majorly understory generalist that utilize the four different habitats. The derived habitats (open and mesic savannahs) provided unique habitats for some specialists' avian species including the Common Sand Piper, Dunlin, Greater-painted Snipe, African-wattled Lapwings, Common Sand Martins and Grey Heron in the mesic savannah, while 23 species were recorded exclusively in the open (degraded) savannah. Open savannah habitat specialists among these included the Cut-throat Finch, African

Silverbill, Village Indigobird, Croaking Cisticola, Yellow-billed Shrike, Double-spurred Frankolin, Rose-ringed Paraket, Black-rumped Bunting, Flappet Lark and PiacPiac (see Appendix 1 for scientific names). Insectivorous birds are higher in species richness and abundance (figures 2 & 3).

Species Distribution and Conservation Status

Conservation status of avian species recorded was evaluated using the IUCN RedList of threatened species. A total of 125 out of 129 species recorded are least concerned. However, 22 of the least concerned species have decreasing population trend while 85 have stable population trend. Red-necked Falcon is near threatened (NT), Wooly-necked Stork is vulnerable (VU), while 2 species, Yellow-throated Leaflove (*Chlorocichla flavicollis*) and Lavender Waxbill (*Estrilda caerulescens*) have not been evaluated on the IUCN RedList of threatened species (IUCN, 2016).

Table 2 shows the different distribution patterns of avian species recorded in relation to their position of TMW on the distribution map. A larger number (90 out of 129) of species that utilize TMW are resident species. Nineteen of these 90 species are partially migratory but mainly resident at TMW. Eight Intra-African migrants and breeding visitors comprising 3 raptor species, 3 cuckoo species, Pygmy Sunbird and Abdim's Stork were recorded and evaluated as least concern (LC). Abdim's Stork and Grasshopper Buzzard with 2 and 5 individuals respectively recorded in this study have decreasing population trends on IUCN RedList. The Cuckoos (Diederik, Klaas's and Jacobin) have stable population trends. They are brood-parasitic breeding visitors usually in close association with Bulbuls as brood hosts. The other intra African migrant breeding visitors are Lesser Kestrel and Black Kite. Also non-breeding Palaearctic migrants recorded are least concern with 7 out of the 9 species having decreasing population trend. The species recorded are Common Kestrel (n = 6), Common SandPiper (n = 1), Common Quail (n = 4), Common Sand Martin (n = 1), Garden Warbler (n = 1), Pallid Harrier (n=1) and Wood-chat Shrike (n = 1). Common and Palid Swifts (n = 24, 2 respectively) have stable population trends. African Goshawk, Rock Firefinch and Dunlin were recorded although TMW is outside their normal range of distribution (Borrow and Demey, 2004.)

Table 2: Distribution Status of Avian Species at TMW

Distribution	Migratory Status	Number of Species
Main Range	Resident	90
Main Range	Partially Migratory	19
Intra-African migrant	Breeding Visitors	9
Main Range	Non-Breeding Visitor	6
Out of range	Out of Range	3
Sparse Occurrence	Non-Breeding Visitor	2

NDVI Result

NDVI is a common and widely used index for global environmental and climate change research (Gandhi *et al*, 2015). NDVI values range from -1 to +1: dense vegetation range from 0.3 to 0.8; shrubs and grasslands have moderate values of 0.2 to 0.3; barren areas of rocks and sand have very low values of 0.1 and below; while free standing water usually have very low positive to slightly negative values (Weier and Herring, 2000). Generally, pattern of vegetation dynamics of TMW shows evidence of landscape modification with about 56 % reduction in vegetation cover in 3 decades. NDVI of 1987 shows relative variation across sampled-points (0.29±0.07 SD) through 1997 (0.14±0.10). However, NDVI in 2017 is relatively uniform across sampled points (0.13±0.01; see fig.4) which indicates that loss in plant cover eventually became even across the woodland in 2 decades. Change in NDVI between 1987 and 1997, spanning a decade was highly significant (Independent-sampled t test: $t = 7.017$, $df = 47.846$, $p < 0.001$). However, there was no significant change in NDVI from 1997 to 2017 representing two decades (Independent-sampled t test; $t = 0.4008$, $df = 28.144$, $p = 0.6916$). In 1987, 90 % of sampled points had NDVI between 0.2 and 0.35, within normal range for shrubland aforementioned. In 1997, only about 27 % of sampled points had NDVI between 0.2 and 0.35 and 0 % in 2017. Thus NDVI of TMW is currently between 0.1 and 0.15 with a mean of 0.13 (fig. 5D) for dry season months. Negative NDVI was recorded at free standing water (points 5, 6) resulting from low reflectance in both spectral bands. Barren rocky areas also showed low NDVI values between 0.1 and below (fig. 4; 5A-C). This result represents only dry season when most plants have lost their leaves. NDVI during growing

season may be higher when plants are in full leaf. This information is important in making vegetation monitoring plan and restoration for TMW.

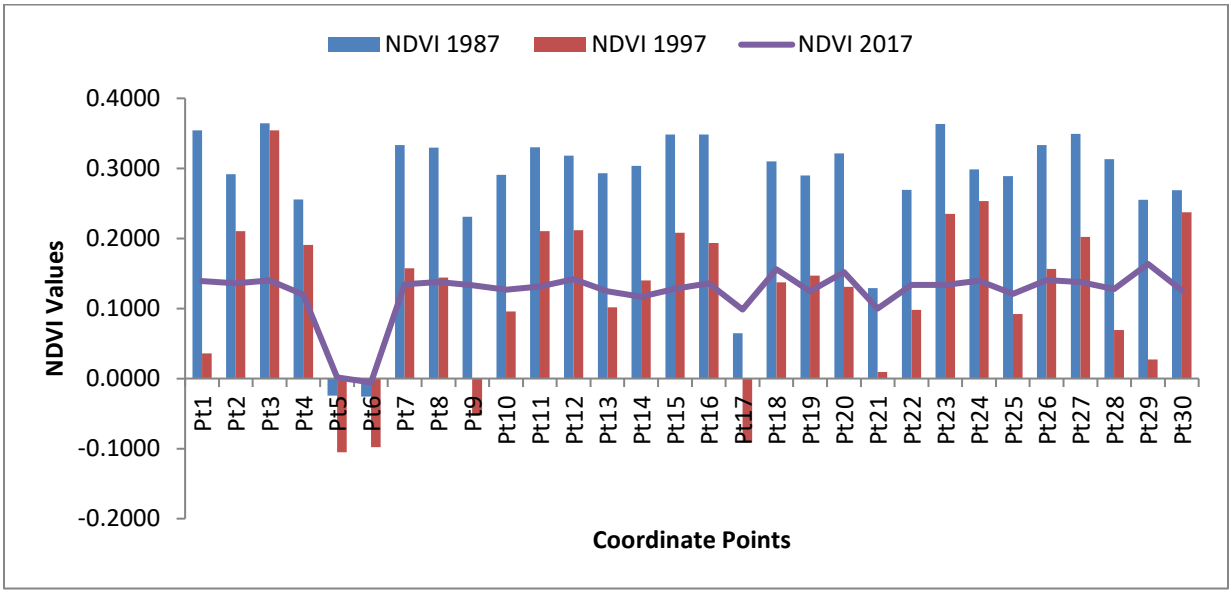
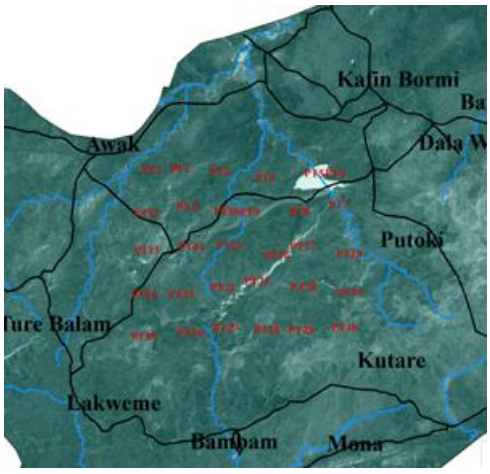


Figure 4: NDVI for 1987, 1997 and 2017



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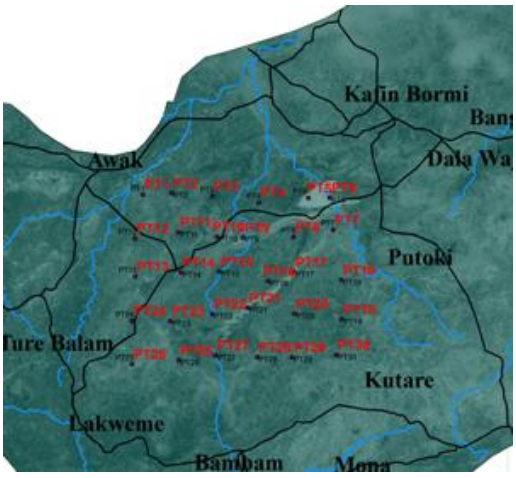

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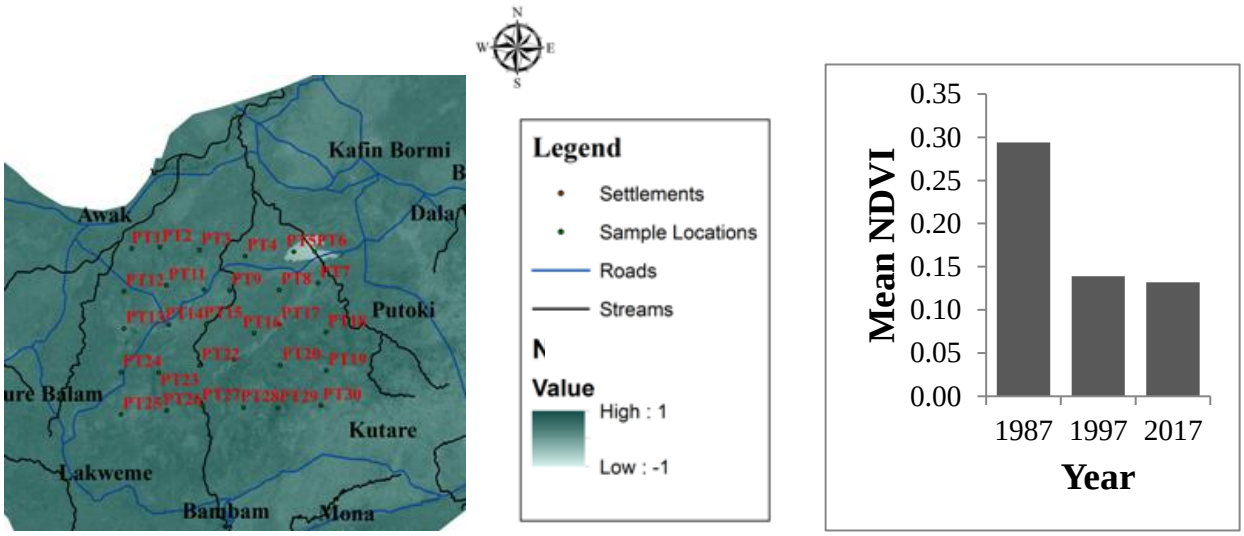

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Figure 5: (a). NDVI 1987; (b). NDVI 1997; (c). NDVI 2017; (d). Mean NDVI in 1987, 1997 and 2017

Capacity Building

Stakeholder Involvement: At the onset of the project, meeting was held with the community leaders where the second phase of the project was introduced to them. The chief of Yiri, Mr. Yerima Doma and the community leaders were very pleased to have the project in their community. They accepted our proposal for establishing environmental clubs in the secondary schools around Tula Yiri community and reassured us of their support to get the woodland designated as nature reserve. The chief informed us about the effort he made to follow up our proposal to Kaltungo Local government Area and is also working towards gazetting grazing areas outside the woodland for cattle rearing and the woodland for protection.

Meeting was also held with government agencies: First with the education secretary of Local Government Area of Kaltungo where the plan for setting up environmental clubs was discussed. The education secretary of the LGA accepted our request by signing the letters prepared for the different schools. Secondly, with the Head and 2 staff of Forestry Department of the LGA. The content of the meeting included review of the first project report on plant species diversity of TMW submitted to them and the proposal for designating TMW as a nature reserve. The Head of department was greatly impressed and mentioned that he was challenged by our initiative to

preserve the woodland which the LGA had paid little attention to and promised to make arrangement to start a patrol around the woodland.

Environmental Clubs: Environmental clubs were established in 3 secondary schools around Tula Yiri community. Conservation activities involved indoor and outdoor activities. Students were given lectures about the environment within the context of secondary school basic science course alongside film shows from the Cross River Gorilla folk films. Field activities were conducted during field survey where students were trained on the use of binoculars, hand held GPS device and bird identification using the guide, Birds of Western Africa by Borrow and Demey (2004).

In addition, a drama competition was conducted between the three schools. However, one of the junior secondary schools failed to participate with complain that they didn't have the resource person to train the students. The Junior Secondary School Galadima Yiri acted a play about waste management. They demonstrated in their play how a particular family dispose their waste carelessly along the street even after receiving several warnings from the environmental health officers. Subsequently, the villagers started having environmental and health associated problems. Their crops fail to germinate because of non biodegradable plastic in the soil and malaria fever as a result of breeding mosquitoes from waste bottles around. With the help of the environmental workers and the village head, environmental sanitation was conducted while the head of the family responsible for littering the environment was arrested after his daughter was cured of malaria by the doctors. Tula Yiri Senior Secondary School demonstrated in their play how a community harvest a particular plant continuously from the wild for medicinal uses. One day the king sent his messengers to collect some parts of the plant; the messengers got the plant after a hard struggle. Another day when he sent them to collect the plant, they came back and told him the plant has gone extinct. The competition took place in Tula Yiri Senior Secondary School with over 200 students in attendance. After the competition, Junior Secondary School Galadima came first. The two schools including the non-participating junior secondary school Yiri were given sets of waste baskets and customized notebooks. It was a very exciting moment for the students and their teachers and they look forward to having more of it.

Conservation Outputs

1. A checklist of bird species of TMW was produced. This will serve as a baseline data for further research and bird monitoring projects.
2. Environmental clubs were established in 3 secondary schools around TMW. The aim is to educate the students to make them understand the importance of the wildlife around them and to create in the young generation, a mindset of environmental stewardship and responsibility.
3. The involvement of local field guide in field work have provided some green income to the local people. This local field guide was also trained in the field methods so that he will subsequently assume responsibilities as forest conservation guard.
4. Data have been submitted to the Bird Atlas Database hosted by Animal Demography Unit, University of Cape Town, South Africa and BirdTrack Database hosted by British Trust for Ornithology (BTO). Report will be used as a tool to buttress our appeal to local, state and federal government agencies to grant TMW a status of protection.
5. The involvement of stakeholders at the local community and local government agency in the first project has been strengthened. Currently, plans are being put in place with the help of the Gombe State University to approach the State and Federal agencies to designate TMW as a nature reserve and also as research station for the university.

Conservation Importance

TMW is refugia of biodiversity in the degraded guinea savannah region of north east Nigeria. During the first project, plant species of conservation importance were recorded which included *Vepris heterophylla* (EN), *Khaya senegalensis* and *Afzelia africana* which were both vulnerable (VU) according to IUCN RedList of threatened species (2014.3). In addition to these plant species, avian species that are near threatened, vulnerable and species that are least concern but with decreasing population trends are of paramount conservation importance. Mountains are associated with endemism, diversity and little invasion. Although so far no endemic species have been recorded at TMW, a plant species with restricted range and extinct in the wild was found in Tula Community. The plant species (*Azanza garckeana*) is largely distributed in some African countries

but in Nigeria, it is only found on TMW and currently, only as domesticated stands around Tula community for commercial purpose. Invasion by plant species is minimal at TMW, however, with human activities intensive around the edges, few stands of *Azadirachta indica* have been sighted at the degraded edges.

Besides plants and birds, other animals which have lost their habitat in areas vulnerable to human activities have found refuge at Tula Mountains: Patas monkeys (*Erythrocebus patas*) and Olive Baboons (*Papio anubis*), were mammal species sighted during survey alongside diverse species of lizards.

Major target of this project to designate TMW as a nature reserve if achieved, will benefit the conservation of these endangered and vulnerable species that were recorded at TMW. With the baseline data collected on plant and avian species and NDVI, biodiversity monitoring and conservation strategies will be put in place to reduce further habitat loss and invasions.

Team and Links

The Nigerian Bird Atlas project team visited TMW twice during the course of the project. The team included Dr. Ulf Ottoson, Dr. Talatu Tende and Dr. Taiwo Omotoriogun who visited in May 2016 and March 2017. The first ringing exercise at TMW was carried out in March 2017 by Mr. Chima Nwaogu, a PhD student at St. Andrews University, UK. Chima is currently working on the breeding ecology of Common Bulbuls, he ringed common bulbuls and other species which included: African Thrush, Yellow-throated Leaflove, Black-billed Wood Dove and Blue-spotted Wood Dove. A visit was paid to Tula Mountains by the Gombe State University Research centre, Dr. Babale Abdullahi and Dr. Charles Nsor Ayuk who participated in field work with secondary school students and conservation activities during drama competition.

Currently, Links have been formed with the Nigerian BirdAtlas Project, the BirdTrack project by British Trust for Ornithology to update databases, as well as The Gombe State University Research Centre and Kaltungo Local Government Area to designate TMW as a nature reserve and as a research centre for the University.

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Appendix 1: Taxonomic Checklist of Avian Species of TMW

S/No	Family	Common Name	Scientific Name	IUCN Status	Pop. Trend	No
1	Ardeidae	Cattle egret	Bubulcus ibis	LC	Increasing	38
2	Ardeidae	Grey Heron	Ardea cinerea	LC	Unknown	2
3	Scopidae	Hamerkop	Scopus umbretta	LC	Stable	1
4	Ciconiidae	Abdim's Stork	Ciconia abdimii	LC	Decreasing	2
5	Ciconiidae	Woolly-necked Stork	Ciconia episcopus	VU	Decreasing	1
6	Accipitridae	African Goshawk	Accipiter tachiro	LC	Decreasing	1
7	Accipitridae	African Harrier-hawk	Polyboroides typus	LC	Stable	2
8	Accipitridae	Black Kite	Milvus migrans	LC	Unknown	2
9	Accipitridae	Black-shouldered Kite	Elanus caeruleus	LC	Stable	1
10	Accipitridae	Dark Chanting-goshawk	Melierax metabates	LC	Stable	2
11	Accipitridae	Gabar Goshawk	Micronisus gabar	LC	Stable	3
12	Accipitridae	Grasshopper Buzzard	Butastur rufipennis	LC	Decreasing	5
13	Accipitridae	Lizzard Buzzard	Kaupifalco monogrammicus	LC	Stable	2
14	Accipitridae	Red-necked Buzzard	Buteo auguralis	LC	Increasing	3
15	Accipitridae	Shikra	Accipiter badius	LC	Stable	2
16	Falconidae	Common Kestrel	Falco tinnunculus	LC	Decreasing	6
17	Falconidae	Fox Kestrel	Falco alopex	LC	Stable	13
18	Falconidae	Lanner Falcon	Falco biarmicus	LC	Increasing	2
19	Falconidae	Lesser Kestrel	Falco naumanni	LC	Stable	1
20	Falconidae	Red-necked Falcon	Falco chicquera	NT	Decreasing	1
21	Phasianidae	Common Quail	Coturnix coturnix	LC	Decreasing	4
22	Phasianidae	Double-spurred Francolin	Pternistis bicalcaratus	LC	Decreasing	3
23	Phasianidae	Stone Patridge	Ptilopachus petrosus	LC	Stable	155
24	Rostratulidae	Greater Painted-snipe	Rostratula benghalensis	LC	Decreasing	1
25	Charadriidae	Black-headed Lapwing	Vanellus tectus	LC	Unknown	4

26	Charadriidae	Wattled Lapwing	Vanellus senegallus	LC	Stable	18
27	Scolopacidae	Common SandPiper	Actitis hypoleucos	LC	Decreasing	1
28	Scolopacidae	Dunlin	Calidris alpina	LC	Decreasing	1
29	Pteroclidae	Four-banded Sandgrouse	Pterocles quadricinctus	LC	Stable	9
30	Columbidae	Black-billed Wood-dove	Turtur abyssinicus	LC	Stable	41
31	Columbidae	Blue-spotted Wood-dove	Turtur afer	LC	Stable	4
32	Columbidae	Bruces' Green-pigeon	Treron waalia	LC	Decreasing	61
33	Columbidae	Laughing Dove	Streptopelia senegalensis	LC	Stable	25
34	Columbidae	Red-eyed Dove	Streptopelia semitorquata	LC	Increasing	4
35	Columbidae	Speckled Pigeon	Columba guinea	LC	Stable	6
36	Columbidae	Vinnaceuos Dove	Streptopelia vinacea	LC	Stable	18
37	Psittacidae	Rose-ringed Parakeet	Psittacula krameri	LC	Increasing	1
38	Psittacidae	Senegal Parrot	Poicephalus senegalus	LC	Stable	24
39	Musophagidae	Violet Turaco	Musophaga violacea	LC	Stable	8
40	Musophagidae	Western Plantain-eater	Crinifer piscator	LC	Stable	37
41	Cuculidae	Diederik Cuckoo	Chrysococcyx caprius	LC	Stable	2
42	Cuculidae	Jacobin Cuckoo	Clamator jacobinus	LC	Stable	2
43	Cuculidae	Klaas's Cuckoo	Chrysococcyx Klaas	LC	Stable	8
44	Cuculidae	Red-chested Cuckoo	Cuculus solitarius	LC	Stable	5
45	Cuculidae	Senegal Coucal	Centropus senegalensis	LC	Stable	11
46	Strigidae	Greyish Eagle Owl	Bubo cinerascens	LC	Stable	1
47	Caprimulgidae	Standard-winged Nightjar	Caprimulgus longipennis	LC	Stable	1
48	Apodidae	African Palm-swift	Cypsiurus parvus	LC	Increasing	60
49	Apodidae	Common Swift	Apus apus	LC	Stable	24
50	Apodidae	Little Swift	Apus affinis	LC	Increasing	3
51	Apodidae	Pallid Swift	Apus pallidus	LC	Stable	2
52	Alcedinidae	Blue-breasted Kingfisher	Halcyon malimbica	LC	Decreasing	1
53	Alcedinidae	Grey-headed Kingfisher	Halcyon leucocephala	LC	Stable	7

54	Meropidae	Northern Carmine Bee-eater	Merops nubicus	LC	Decreasing	30
55	Meropidae	Red-throated Bee-eater	Merops bulocki	LC	Stable	37
56	Coraciidae	Abyssinian Roller	Coracias abyssinicus	LC	Increasing	26
57	Coraciidae	Broad-billed Roller	Eurystomus glaucurus	LC	Stable	4
58	Phoeniculidae	Green Woodhoopoe	Phoeniculus purpureus	LC	Decreasing	10
59	Bucerotidae	African Grey Hornbill	Lophoceros nasutus	LC	Stable	32
60	Bucerotidae	Red-billed Hornbill	Tockus erythrorhynchus	LC	Stable	17
61	Capitonidae	Bearded Barbet	Lybius dubius	LC	Unknown	28
62	Capitonidae	Vieillot's Barbet	Lybius vieilloti	LC	Unknown	76
63	Capitonidae	Yellow-fronted Tinkerbird	Pogoniulus chrysoconus	LC	Stable	111
64	Picidae	Fine-spotted Woodkpecker	Campethera punctuligera	LC	Stable	2
65	Alaudidae	Flappet Lark	Mirafra rufocinnamomea	LC	Decreasing	11
66	Hirundinidae	Collared Sand-martin	Riparia riparia	LC	Decreasing	8
67	Motacillidae	Yellow-throated Longclaw	Macronyx croceus	LC	Stable	1
68	Pycnonotidae	Common Bulbul	Pycnonotus barbatus	LC	Increasing	169
69	Pycnonotidae	Yellow-throated Leaflove	Chlorocichla flavicollis	NE	NE	11
70	Turdidae	African Thrush	Turdus pelios	LC	Unknown	20
71	Turdidae	Black Scrub-robin	Cercotrichas podobe	LC	Stable	1
72	Turdidae	Familiar Chat	Cercomela familiaris	LC	Stable	2
73	Turdidae	Mocking Cliff-chat	Myrmecocichla cinnamomeiventris	LC	Stable	9
74	Turdidae	Snowy-crowned Robin-chat	Cossypha niveicapilla	LC	Stable	4
75	Turdidae	White-fronted Black-chat	Oenanthe albifrons	LC	Stable	3
76	Sylviidae	Croaking Cisticola	Cisticola natalensis	LC	Stable	8
77	Sylviidae	Garden Wabler	Silvia borin	LC	Decreasing	1
78	Sylviidae	Grey-backed Camaroptera	Camaroptera brachyura	LC	Increasing	117
79	Sylviidae	Moustatched Grass-warbler	Melocichla mentalis	LC	Stable	1
80	Sylviidae	Northern Crombec	Sylvietta brachyura	LC	Stable	4
81	Sylviidae	Senegal Eromomela	Eremomela pusilla	LC	Stable	97

82	Sylviidae	Tawny-flanked Prinia	Prinia subflava	LC	Stable	45
83	Muscicapidae	Northen Black-flycatcher	Melaenornis edolioides	LC	Stable	2
84	Monarchidae	African Paradise-flycatcher	Terpsiphone viridis	LC	Stable	13
85	Platysteiridae	Senegal Batis	*Batis senegalensis*	LC	Decreasing	11
86	Timaliidae	Brown Babbler	Turdoides plebejus	LC	Stable	14
87	Paridae	Pale-eyed Black Tit	Melaniparus guineensis	LC	Stable	9
88	Remizidae	Yellow Penduline-tit	Anthoscopus parvulus	LC	Stable	3
89	Nectariniidae	Beautiful Sunbird	Cinnyris pulchellus	LC	Stable	6
90	Nectariniidae	Pygmy Sunbird	Hedydipna platura	LC	Stable	16
91	Nectariniidae	Scarlet-chested Sunbird	Chalcomitra senegalensis	LC	Stable	119
92	Nectariniidae	Variable Sunbird	Cinnyris venustus	LC	Stable	64
93	Zosteropidae	African Yellow White-eye	Zosterops senegalensis	LC	Stable	4
94	Laniidae	Woodchat Shrike	Lanius senator	LC	Decreasing	1
95	Laniidae	Yellow-billed Shrike	Corvinella corvina	LC	Unknown	3
96	Malaconotidae	Black-crowned Tchagra	Tchagra senegalus	LC	Stable	36
97	Malaconotidae	Brubru	Nilaus afer	LC	Stable	4
98	Malaconotidae	Sulphur-breasted Bushrike	Chlorophoneus sulfureopectus	LC	Stable	2
99	Malaconotidae	Tropical Boubou	Laniarius aethiopicus	LC	Stable	3
100	Malaconotidae	Yellow-crowned Gonolek	Laniarius barbarus	LC	Stable	6
101	Prionopidae	White-crested Helmet-shrike	Prionops plumatus	LC	Stable	6
102	Oriolidae	African Golden Oriole	Oriolus auratus	LC	Stable	1
103	Dicruridae	Fork-tailed Drongo	Dicrurus adsimilis	LC	Stable	21
104	Dicruridae	Piapiac	Ptilostomus afer	LC	Stable	28
105	Sturnidae	Long-tailed Glossy Starling	Lamprotornis caudatus	LC	Stable	4
106	Sturnidae	Neumann's Starling	Onychognathus neumanni	LC	Increasing	2
107	Sturnidae	Purple Gossy Starling	Lamprotornis purpureus	LC	Stable	1
108	Sturnidae	Violet-backed Starling	Cinnyricinclus leucogaster	LC	Decreasing	16
109	Passeridae	Bush Petronia	Gymnoris dentata	LC	Stable	36

110	Passeridae	Chestnut-crowned Sparrow-weaver	Plocepasser superciliosus	LC	Stable	27
111	Ploceidae	Black-necked Weaver	Ploceus nigricollis	LC	Stable	1
112	Ploceidae	Black-winged Bishop	Euplectes hordeaceus	LC	Stable	1
113	Ploceidae	Little Weaver	Ploceus luteolus	LC	Stable	4
114	Ploceidae	Village Weaver	Ploceus cucullatus	LC	Stable	10
115	Estrildidae	African Silverbill	Euodice cantans	LC	Stable	2
116	Estrildidae	Bronze mannikin	Spermestes cucullata	LC	Stable	16
117	Estrildidae	Cut-throat Finch	Amadina fasciata	LC	Stable	1
118	Estrildidae	Lavender Waxbill	Estrilda caerulescens	NE	NE	16
119	Estrildidae	Red-billed Firefinch	Lagonosticta senegala	LC	Stable	5
120	Estrildidae	Red-cheeked Cordon-bleu	Uraeginthus bengalus	LC	Stable	39
121	Estrildidae	Rock Firefinch	Lagonosticta sanguinodorsalis	LC	Stable	1
122	Viduidae	Village Indigobird	Vidua chalybeata	LC	Stable	1
123	Emberizidae	Brown-rumped Bunting	Emberiza affinis	LC	Stable	15
124	Emberizidae	Cinnamon-breasted Bunting	Emberiza tahapisi	LC	Stable	44
	Incidental Sightings					
25	Estrildidae	Black-bellied Firefinch	*Lagonosticta senegala*	LC	Stable	
26	Accipitridae	African Hawk-eagle	*Hieraaetus spilogaster*	LC	Decreasing	
27	Accipitridae	Pallid Harrier	*Circus pygargus*	LC	Decreasing	
28	Strigidae	Pearl-spotted Owlet	*Glaucidium perlatum*	LC	Stable	
29	Buphagidae	Yellow-billed Oxpecker	*Buphagus africanus*	LC	Decreasing	

Appendix 2: Pictures

Plate 1: Nigerian Bird Atlas Team: Dr. Talatu Tende (front in yellow shirt), Prof. Ulf Ottosson (middle), Dr. Taiwo Omotoriogun (behind). Photo by Rahila. **Plate 2**: The Gombe State University Research Team & Myself, Rahila Yilangai: Dr. Charles Nsor Ayuk (right); Dr. Babale Abdullahi (middle). Photo by Magaji. **Plate 3:** Mist net set up to catch Common Bulbuls for ringing. **Plates 4:** Chima Nwaogu ringing birds at TMW. Photos by Rahila. **Plate 5:** Students during drama competition at Tula Yiri Secondary School: Myself third person from the left in brown T shirt. **Plate 6:** Field training for students. Photos by Charles.