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Habitat corridors usage by wildlife in wooded patches of an agricultural landscape in New Bussa, Nigeria

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Abstract

This study assesses the dispersal and use of corridors by wildlife in wooded patches of an agricultural landscape in New Bussa. The study was undertaken to derive information on the species of wildlife associated with different habitat corridors in both wet and dry seasons in the area, as well as to determine their relative abundance and diversity in the area. The direct/indirect method of census was used. The data collected were analyzed using descriptive statistics (tables), and Analysis of Variance [ANOVA] was used to test if species distribution differed between habitats. The results gathered revealed that the wet season has the highest number of mammal species than the dry Season. Hedgerows and fencerows have the highest number of mammal's species in both wet and dry seasons. *Agama agama*, *Rattus rattus* of Muridae and *Rousettus acguptiacus* of Pteropodidae family, *Sciurus spermophilus, Sciurus carolinensis* and *Epomophorus ganbianus* were found to be highly abundant in all the habitat types during the two seasons. For the birds' species, the family Estrildidae has the highest relative abundance, followed by the Ardedae family. Mammal species diversity between habitats was significantly low ($P>0.05$) in both the wet and dry seasons, while the bird species diversity in the three habitat types in the wet and dry season indicate high species diversity in all the habitats. Hence all the habitat corridors having representative samples of wildlife are of wildlife conservation value in the agricultural landscape in New Bussa. It is therefore recommended that deforestation and uncontrolled bush burning in the area should be discouraged.

Keywords: Abundance, Diversity index, Habitat Corridors, Nigeria, Wildlife

Introduction

A habitat corridor refers to a linear strip of vegetation that provides a continuous (or near continuous) pathway between two habitats. Corridors are landscape patterns that promote connectivity for species, communities and ecological processes that are a key element in nature conservation (Dickson et al., 1995). Wildlife movement corridors, also called dispersal corridors or landscape linkages as opposed to linear habitats, are linear features whose primary wildlife function is to connect at least two significant habitat areas (Beier and Loe 1992).

Habitat loss and fragmentation are huge threats to our wildlife. Hence habitat corridors are likely to be a more effective means of promoting landscape connectivity where a large part of the landscape is modified and inhospitable to native species; for species that are habitat specialists or have obligate dependence on undisturbed habitats; for species that have a limited scale of movement in relation to distance to be traversed. The habitat corridor must provide resources to sustain resident individuals or a population. Wildlife complex daily requirements require them to travel safely from place to place, looking for nesting sites, food, water, a resting haven and shelter. The corridors bridge the gap between habitats that otherwise would be small and isolated and join them together. The presence of corridors to facilitate colonization of animals might also supplement declining populations before they actually reached extinction, in this way slowing down the rate of species extinction- termed the 'rescue effect'

The types of Fragmentations Corridors include; Riparian Vegetation, Hedgerows/ fencerows and Forest Linkages. Riparian ecosystems frequently support species adapted to streamside habitats which rarely occur in adjacent habitats. Throughout the world, riparian vegetation often persists as remnants of linear habitat or corridors in heavily disturbed environments such as farmland, urban areas and among plantations of exotic tree species (Rushton et al., 1994).

In many regions, there are extensive networks of hedgerows amongst farmlands, forming links between woodlands and forests retained within the rural environment (Fritz and Merriam, 1994). The presence of hedgerows significantly increases the diversity of birds, especially woodland species in farmlands and much attention has been given to the use of hedgerows as a habitat for birds, particularly in Great Britain and this has provided insight into their value for wildlife (Green et al. 1994).

Sites with hedges, ditches or linear woods have more species than comparable areas of arable land (Harris and Woollard, 1990). Studies have shown that there is a significant relationship between species richness and isolated habitats linked to a nearby forest habitat (Newmark, 1991).

There has been an intense interest and activity in this area of conservation biology 'corridors' that connect to small natural areas. The protection or provision of continuous corridors of habitat to connect isolated habitats such as nature reserves, woodlands or patches of old-growth forest have been widely recommended as conservation measures to counter the impacts of habitat reduction and fragmentation. Hence it is expected that the findings from the study will reveal the conservation value of the habitat corridors and or linkages and the need to conserve them. The objective of the study is to determine the significance of habitat corridors for wildlife conservations in wooded patches of an agricultural landscape in New Bussa, provide the species list of wild animals associated with different habitat corridors in both wet and dry seasons in the area, determine the relative abundance of wildlife species associated with different habitat corridors during wet and dry seasons and determine the wildlife species diversity in each and among habitat corridors during wet and dry seasons.

Materials and methods

Study area

New Bussa is the administrative headquarters of Borgu Local Government Area of Niger state, it covers a total land mass of about 16,200km2 and it is situated between Latitude 90N and 11′ N and longitude 200E and 40′E. It has a total population census of 171, 965 people. The length of the rainy season is from about 175 to 190 days (5 – 6 months) during which 1000mm -1250mm rainy is recorded annually. The rainy season normally comes in April accompanied by strong wind and thunderstorm reaching its peak in July to August and declines in September.

Generally, the temperature is high during dry season just before the rain. It declines during the rainy season from June to October and rises again in November and drop slightly in December and January due to Harmattan in the dry season. The mean maximum temperature is 350C - 400C but minimum temperature ranges between 140C – 150 C in the Harmattan. The vegetation may be described broadly as wooded guinea savanna with legumes accounting for 55.7% of trees and almost an equal mixture of legumes and Combretacae plants making up shrubs and small trees while grasses dominates the herbaceous layers. The vegetation has a lot of flora species which are found all over the area which includes: Annona senegalensis,Boswelia dalselli,Combretum molle, Combretum nigricans, Terminalia, glaucoscens,Terninalia, mollis Terminalia macroptera, Anogeissus leiocarpus, Afzellia Africana, Daniella oliverii etc. While the fauna species found in the study area includes: Civet cat, Bats, Squirrels, Fishes,

Snails, Duikers, Monkeys, Baboons Snakes, Skink, Lizard, Crocodiles, Hawks, Senegal coeval, stone partridge, Guinea fowls, Green parrots, Grey-horn bill etc. (Ekeke and Stopfords, 1984).

Firgure1. Map of Nigeria showing Location of the study area

Design Survey

The study was conducted in the guinea savanna agricultural landscape of New Bussa and its environments. Three locations covering 9km^2, was selected as study sites, and these include; Monia= riparian forest woodland 3km^2, Donian woodland= Thicket woodland 3km^2, and New Bussa Residential = Hedgerows and Fencerows 3km^2. The methodology employed in the study includes the use of direct/indirect method of census. Wildlife species was identified and census in each study site for a period of 6 months, and was conducted for 3 months in the wet season and 3 months in the dry season. Each site was visited for five days in a month during both seasons. The census was conducted in the morning (6.00am to 12.00 noon) and evening (4.00pm to 6.00pm) during each day of visit.

Data Collection Techniques

The researcher and a student field assistant aided with binoculars walk along the strips, road, the fence/hedge row and the edge of the woodlands at a maximum speed of 1.5km/hour, and viewing for the wildlife species. When the animals/birds were sighted, the following information were recorded on the data sheet: species name, sighting distance, number of individuals of a species, activities and habitat present condition.

Data Analysis

Both qualitative and quantitative statistics were carried out. Percentages, and Tables were used to present descriptive analyses of species population.

Relative abundance; The relative abundance was estimated using the ratio of total individual species to the total population counted thus; $A = n/N \times 100$ (eq 1)

Where A = Relative abundance

n = Quantity of each species present

N = Quantity of all species present.

Diversity index which states the structure of the community and the stability of the ecosystem. Species studied in the field can be identified by calculating the value of species diversity. Simpson's Diversity Index is a measure of diversity which takes into accounts both richness and evenness. As species richness and evenness increase, so diversity increases.

Diversity of species was achieved using Simpson's (1949) diversity index.

The index is mathematically stated thus: $D_s = \sum^{S}_{t-1} \frac{(n_1 (n-1))}{(N (N-1))}$ (eq 2)

Description:

- D_s = Simpson's diversity index
- n_1 = Total number of individuals in each species
- N = Total number of individuals in all species
- s = Number of species present
- $\sum$ = Summation sign.

Evenness of species is the distribution of individuals between species in a balanced community. Species are considered maximum if all species in the community have the same number of individuals. Species evenness index*(E)* shows the level of evenness of individuals per species. The value of the Species Evenness Index (E) provides insight into the stability of a community in an ecosystem. It indicates the evenness of the distribution of individuals among different species in a community (Sipahutar, 2017). A higher E value suggests that the species are more evenly distributed and not dominated by any particular species. The closer the E value is to 1, the higher the evenness value below 0.6 is low. Ludwig and Reynolds (1988), the value of E is calculated using the following mathematical formula.

$E = H' \text{ Ln } (S)$ (eq 3)

Where:

- E = Species Evenness Index;
- H' = Index;
- S = Number of Types found;
- Ln = Natural logarithm.

Analysis of Variance [ANOVA] was used to test if species population distribution differed between sites.

Data entering and coding

Data that was generated from the field was coded, entered and stored using Microsoft excel spread sheet, then Microsoft Office Excel® 2013 was used to calculate the percentage relative abundance, Paleontological Statistics software (PAST) were used to calculate the diversity of wild animals and birds.

Results

Species list and Composition Type

Table1. Species list of wild animals utilizing Habitat fragmentations corridors, the habitat types and the seasons in which they were sighted. The result shows that in habitat A, seventeen (17) species of mammals were sighted in wet season and fifteen (15) in the dry seasons, in habitat B, sixteen (16) species of mammals were sighted in wet season and 15 in the dry seasons while in habitat C, fourteen (14) species of mammals were recorded in wet and dry seasons. While for the birds' species, 84 birds found in 28 families were observed and inventoried in each of the habitat type.

Table 1. Species List of Wild Animals Utilizing Habitat Fragmentations Corridors in the study area

Family name	Mammals	Scientific name	Riparian forest A		Thicket woodland B		Hedgerows and Fencerows C	
			W	D	W	D	W	D
Leporidae	Hare	Oryctolagus cuniculus	0	0	X	X	0	0
	Giant Rat	Cricetomy gabianus	X	X	0	0	0	0
Cercopithecidae.	Patas Monkey	Erythrocebus patas	X	0	0	0	0	0
Erinaceidae	Hedgehog	Atelerit frontalis	X	0	X	0	0	0
Viverridae.	Civet Cat	Paradoxurus hermaphroditus	X	X	X	X	X	X
Pteropodidae	Egyptians fruit bat	Rousettus acguptiacus	X	X	X	X	X	X

Family name	Mammals	Scientific name	Riparian forest A		Thicket woodland B		Hedgerows and Fencerows C	
			W	D	W	D	W	D
	Gambian fruit bat	Epomophorus ganbianus	X	X	X	X	X	X
Molossidae	Free tail bat	Tadarida brasiliensis	X	X	X	X	X	X
Muridae	Brown Rat	Rattus norvegigus	X	X	X	X	X	X
	House Rat	Rattus rattus	X	X	X	X	X	X
Soricidae	Shrew Rat	Chrotomys gonzalesi	X	X	X	X	X	X
Sciuridae	Gray Squirrel	Sciurus carolinensis	X	X	X	X	X	X
Sciuridae	Tree Squirrel	Sciurus spermophilus	X	X	X	X	X	X
Elapidae	Cobra	Naja nigricollis	X	X	X	X	X	X
Viperidae	Rattlesnakes	Crotalus horridus	X	X	X	X	X	X
Teiidae	Agama lizard	Agama agama	X	X	X	X	X	X
Scincidae	Skink	Scincella lateralis	X	X	X	X	X	X
Varanidae	Nile monitor Lizard	Varanus niloticus	X	X	X	X	X	X
	Total		17	15	16	15	14	14
	AVES							
Ardedae	Cattle egret	Ardeola ibis	X	X	X	X	X	X
	Little egret	Egretta garzetta	X	X	X	X	X	X
	Grey Heron	Ardea cinera	X	X	X	X	X	X
Accipitridae	Black kite	Milvus migrans	X	X	X	X	X	X
	African harrier hawk	Polyboroides radiatus	X	X	X	X	X	X
	Grasshoper buzzard	Butastur rufipennis	X	X	X	X	X	X
Phasianidae	Grey- breasted Helmented guinea fowl	Numida meleagris	X	X	X	X	X	X
	Stone partridge	Ptilopachus petrosus	X	X	X	X	X	X
	Double spurred francolin	Francolinus bicalcaratus	X	X	X	X	X	X
Turdidae	Whin chat	Saxicola rubetra	X	X	X	X	X	X
	Wheatear	Oenanthe oenanthe	X	X	X	X	X	X
	Red tailed chat	Cercomela familaris	X	X	X	X	X	X
	Red breasted chat	Oenanthe bottae	X	X	X	X	X	X
	Ant chat	Myrmecocichla aethiops	X	X	X	X	X	X
	White fronted black chat	Myrmecocichla albifrons	X	X	X	X	X	X
	West African thrush	Turdus pelios	X	X	X	X	X	X
Sylviidae	Melodious warbler	Hippolais polyglotta	X	X	X	X	X	X
	Singing cresticola	Cresticola cantans	X	X	X	X	X	X
	Nuthatch warbler	Sylvietta brachyura	X	X	X	X	X	X

Family name	Mammals	Scientific name	Riparian forest A		Thicket woodland B		Hedgerows and Fencerows C	
			W	D	W	D	W	D
	Fan-tailed swamp warbler	Schoenicola platyura	X	X	X	X	X	X
Muscicapidae	Black flycatcher	Melaenornis edollioides	X	X	X	X	X	X
	Spotted flycatcher	Muscicapa striata	X	X	X	X	X	X
	Pale flycatcher	Bradornis pallidus	X	X	X	X	X	X
	Grey tit babbler	Myioparus plumbeum	X	X	X	X	X	X
Paridae	West Africa penduline tit	Remiz parvulus	X	X	X	X	X	X
			X	X	X	X	X	X
Nectarinidae	Mouse brown sunbird	Anthreptes gabonicus	X	X	X	X	X	X
	Collard sunbird	Anthreptes collaris	X	X	X	X	X	X
	Yellow bill sunbird	Nectarinia venusta	X	X	X	X	X	X
	Splendid sunbird	Nectarinia coccinigaster	X	X	X	X	X	X
	Copper sunbird	Nectarinia cuprea	X	X	X	X	X	X
Lanniidae	Long-crested helmet shrike	Prionops plumata	X	X	X	X	X	X
	Yellow- breasted shrike	Laniarius atroflavus	X	X	X	X	X	X
	Great grey shrike	Lanius excubitors	X	X	X	X	X	X
Sturnidae	Splendid glossy starling	Lamprotornis splendidus	X	X	X	X	X	X
	Blue –eared glossy startling	Lamprotornis chloropterus	X	X	X	X	X	X
	Long –tailed glossy starling	Lamprotornis caudatus	X	X	X	X	X	X
	Crag chestnut glossy starling	Onychognathus morio	X	X	X	X	X	X
Ploceidae	Buffalo weaver	Bubalornis albirosris	X	X	X	X	X	X
	Slender billed weaver	Ploceus luteolus	X	X	X	X	X	X
	White –fronted gross beak	Amblyosiza albifrons	X	X	X	X	X	X
	Vieillot’’s black weaver	Ploceus nigerrimus	X	X	X	X	X	X
	Red bishop	Euplecets orix	X	X	X	X	X	X
	Fire-crowned bishop	Euplects hordeaceus	X	X	X	X	X	X
	Crested malimbe	Malimbus malimbicus	X	X	X	X	X	X
Estrildidae	Malibe finch	Pytilia melba	X	X	X	X	X	X

Family name	Mammals	Scientific name	Riparian forest A		Thicket woodland B		Hedgerows and Fencerows C	
			W	D	W	D	W	D
	Black face fire finch	Estrilida larvata	X	X	X	X	X	X
	Orange –checked wax bill	Estrilida melpoda	X	X	X	X	X	X
	Cameroon indigo finch	*Vidua chalybeate*	X	X	X	X	X	X
Viduidae	Pintail whyday	*Vidua mcroura*	X	X	X	X	X	X
Fringillidae	Yellow-fronted canary	*Serinus mozambicus*	X	X	X	X	X	X
	Grey canary	*Serinus leucopygius*	X	X	X	X	X	X
Cuculidae	Senegal coucal	*Centropus senegalensis*	X	X	X	X	X	X
Columbidae	Vinaceous dove	*Stretopelia vincacea*	X	X	X	X	X	X
	Laughing dove	*Stretopelia senegalensis*	X	X	X	X	X	X
	African mourning dove	*Stretopelia decipiens*	X	X	X	X	X	X
	Red eye dove	*Stretopelia semitorquata*	X	X	X	X	X	X
	Speckled pigeon	*Columba guinea*	X	X	X	X	X	X
Strigidae	White-faced owl	*Otus leucotis*	X	X	X	X	X	X
Apodidae	Palm swift	*Cypsiurus parvus*	X	X	X	X	X	X
	White–rumped swift	*Apus caffer*	X	X	X	X	X	X
	Bates's black swift	*Apus batesi*	X	X	X	X	X	X
Meropidae	Black bee-eater	*Merops gularis*	X	X	X	X	X	X
	Little bee-eater	*Merops pusillus*	X	X	X	X	X	X
	White-throated bee-eater	*Merops albicollis*	X	X	X	X	X	X
Coraciidae	Abyssinianin roller	*Caracias adyssinica*	X	X	X	X	X	X
	Grey hornbill	*Tockus nasutus*	X	X	X	X	X	X
	Piping hornbill	*Bycanistes Fistulator*	X	X	X	X	X	X
	White crested hornbill	*Tropicarnus albcristatus*	X	X	X	X	X	X
Capitonidae	Yellow bill barbet	*Trachyphonus purpuratus*	X	X	X	X	X	X
	Speckled tinker bird	*Pogoniulus scolopaceus*	X	X	X	X	X	X

Family name	Mammals	Scientific name	Riparian forest A		Thicket woodland B		Hedgerows and Fencerows C	
			W	D	W	D	W	D
Picidae	Grey Woodpecker	*Mesopicos goertae*	X	X	X	X	X	X
Motacillidae	African pied wagtail	*Motacilla aguimp*	X	X	X	X	X	X
Pycnontidae	Little green bulbul	*Adropadus virens*	X	X	X	X	X	X
	Simple leaf love	*Chlorocichla simplex*	X	X	X	X	X	X
	Yellow-billed greenbul	*Phyllasterphus Falvostriatus*	X	X	X	X	X	X
Timaliidae	Brown babbler	*Turdoides plebejus*	X	X	X	X	X	X
	Blackcap akalata	*Malacocincla rufipennis*	X	X	X	X	X	X
Malconotidae	Many–coloured bush shrike	*Malaconotus multicolor*	X	X	X	X	X	X
	Greta grey grey-headed bush shrike	*Lanius excubitor*	X	X	X	X	X	X
Nicator	Mountain sooty boubou	*Lanius execubitor*	X	X	X	X	X	X
Corvidae	Hooded crow	*Corvus corone*	X	X	X	X	X	X
	Red checked cordon blue	*Estrilda bengala*	X	X	X	X	X	X
	Black mega pie	*Ptilosomus afer*	X	X	X	X	X	X
	Bunting	*Passerina cyanea*	X	X	X	X	X	X

From the table above = present, W= Wet season and D= Dry season

Species Abundance

Table 2 shows the wet and dry season relative abundance (%) of mammal species in habitat corridors in the study area. The table shows that in the wet season, *Agama agama* having relative abundance of (25.71% is the highest, followed by the *Rattus rattus of* Muridae (14.06% and *Rousettus acguptiacus* of Pteropodidae family with (11.2%) relative abundance, while in the Dry season *Agama agama* having

relative abundance of (22.96 %) is the highest, followed by *Sciurus spermophilus* (12.35%), *Sciurus carolinensis* (11.63%), and *Epomophorus ganbianus* (11.77%), while *Erythrocebus patas* and *Atelerit frontalis* were not sighted in the dry season across the sites.

Table 2. Wet and Dry season relative abundance of mammal species in the study area%

S /No	Family Name	Mammals	Scientific Name	Seasons	
				Wet	Dry
	Leporidae	Hare	*Oryctolagus cuniculus*	0.23	0.44
		Giant Rat	*Cricetomy gabianus*	0.46	0.87
	Cercopithecidae.	Patas Monkey	*Erythrocebus patas*	0.11	0.00
	Erinaceidae	Hedgehog	*Atelerit frontalis*	0.34	0.00
	Viverridae.	Civet Cat	*Paradoxurus hermaphroditus*	0.57	0.44
	Pteropodidae	Egyptians fruit bat	*Rousettus acguptiacus*	11.20	11.19
		Gambian fruit bat	*Epomophorus ganbianus*	9.26	11.77
	Molossidae	Free tail bat	*Tadarida brasiliensis*	3.20	1.02
	Muridae	Brown Rat	*Rattus norvegigus*	6.86	6.68
		House Rat	*Rattus rattus*	14.06	9.30
	Soricidae	Shrew Rat	*Chrotomys gonzalesi*	1.71	3.49
	Sciuridae	Gray Squirrel	*Sciurus carolinensis*	9.94	11.63
		Tree Squirrel	*Sciurus spermophilus*	9.37	12.35
	Elapidae	*Naja* Snake	*Naja nigricollis*	2.54	3.34
	Viperidae	Rattlesnake	*Sistrurus miliarius*	1.03	0.87
	Agamidae	Agama lizard	*Agama agama*	25.71	22.96
	Scincidae	Skink	*Panaspis togoensis*	1.14	1.16
	Varanidae	Nile monitor Lizard	*Varanus niloticus*	2.28	2.47

Table 3 shows the wet and dry season relative abundance (%) of Birds species in habitat corridors in the study area. The table shows that in the wet season family, Estrildidae having a relative abundance of

23.18% is the highest, followed by the Ardedae family with a 10.34% relative abundance Paridae with 0.09% is the lowest.

Table 3. Wet and dry seasons relative abundance of bird species

S /No	Family name	Seasons	
		Wet	**Dry**
	Ardedae	10.34	12.89
	Accipitridae	0.28	0.41
	Phasianidae	0.49	0.85
	Turdidae	7.55	8.72
	Sylviidae	2.41	2.84
	Muscicapidae	4.75	4.94
	Paridae	0.09	0.11
	Nectarinidae	5.63	6.11
	Lanniidae	3.25	3.46
	Sturnidae	3.66	5.05
	Ploceidae	8.60	10.14
	Estrildidae	23.18	6.26
	Viduidae	1.02	1.42
	Fringillidae	1.85	2.22
	Cuculidae	1.09	1.42
	Columbidae	5.48	6.42
	Strigidae	1.09	1.42
	Apodidae	3.12	4.21
	Meropidae	3.33	3.98
	Coraciidae	3.66	5.05
	Capitonidae	1.43	1.94
	Picidae	1.01	1.37
	Motacillidae	1.09	1.42
	Pycnontidae	1.78	2.29
	Timaliidae	1.05	1.61
	Malconotidae	1.88	2.22
	Nicator	0.18	0.11
	Corvidae	1.04	1.09

Diversity of Species

The results of mammal species diversity indices in three habitat types in wet and dry seasons are shown in Table 4. The results indicate low species diversity in all the habitats. In the wet season habitats A and B are more diverse having 0.89 and 0.88 diversity respectively, than habitat C with lower species diversity of 0.79 and evenness of 0.51. In the dry season habitats B and A are more diverse having 0.89 and 0.87 diversity respectively, than habitat C with lower species diversity of 0.79 and evenness of 0.53.

Table 4. Wet and Dry Season Mammal Species Composition, Richness and Diversity (Simpson's index) between Habitat Corridors

Seasons	Simpson index	Habitat types Riparian forest A	Thicket woodland B	Hedgerows and Fencerows C
Wet	Total number of individuals	274	203	398
	Species richness	17	16	14
	S.Index1-D	0.89	0.88	0.79
	Evenness_e^H/S	0.62	0.66	0.51
Dry	Total number of individuals	221	163	304
	Species richness	15	15	14
	S.Index1-D	0.87	0.89	0.79
	Evenness_e^H/S	0.64	0.72	0.53

Means within the same row are not significantly different at (P>0.05) in the two seasons.

The results of bird species diversity indices in three habitat types in wet and dry seasons are shown in Table 5. The results indicate high species diversity in all the habitats. In the wet season habitat C and A are more diverse with high evenness, having 0.92 and 0.91 diversity respectively, than habitat B with lower species diversity of 0.87. In the dry season habitat B and A are more diverse having 0.94 diversity respectively, than habitat C with a slightly lower species diversity of 0.93 with lower evenness.

Table 5. Wet and Dry Season Birds Species composition, richness and diversity (Simpson's index) between Habitat Corridors in the Area

Seasons	Simpson index	Habitat types Riparian forest A	Thicket woodland B	Hedgerows and Fencerows C
Wet	Total number of individuals	3361	3287	3196
	Species richness	84	84	84
	S.Index1-D	0.91	0.87	0.92
	Evenness_e^H/S	0.6445	0.5394	0.6896
Dry	Total number of individuals	2030	1900	2203
	Species richness	84	84	84
	S.Index1-D	0.94	0.94	0.93
	Evenness_e^H/S	0.7718	0.7888	0.7116

Means within the same row are not significantly different at (P>0.05) in the two seasons

Discussion

In this study, three habitat fragmentation corridors were identified in the New Bussa landscapes such as riparian forest, thicket woodland, and hedgerows /fencerows. Each vegetation type provides wildlife habitat

for various wildlife species. For example, they provide cover, feeding and nesting habitats for primates, medium and small mammals, reptiles as well as birds. are shown in Table 1. Similar results were observed by Schroeder *et al*., (1992) who reported that in New York State, USA, a total of 93 species of wildlife were noted from fencerows while in Lowe USA, 62 species were reported to use fencerow in various ways. Table 2 relative abundance of mammal species in habitat corridors indicates that in the wet season *Agama agama* , *Rattus rattus* of Muridae and *Rousettus acguptiacus of* Pteropodidae family were highly abundant, while in the Dry season *Agama agama*, *Sciurus spermophilus*, *Sciurus carolinensis* and *Epomophorus ganbianus* were all highly abundant in the hedgerows and fencerows close to residential areas. This finding is in line with Bennett *et al.,* **(**1994) report, that the presence of hedgerows significantly increases the diversity of wildlife, especially woodland species in farmlands. These roadside hedgerows are used as a major habitat and as pathway by mammals like bats, particularly during the dry season as also reported by (Downes *et al.* 1997).

The finding in Table 3 relative abundance of birds indicates that although all the habitat types (riparian forest fencerows and thicket woodland) support a significant variety of bird species, the differences in abundance level among species were marginal except for Estrildidae (finches), Ardedae (egret birds) found in large numbers especially during the rainy and early dry seasons of July to October. These birds also dominated both wet and dry seasons. Thus the scale of movement normally undertaken by most birds, together with their habitat tolerance, allowed them to move freely through the mosaic of fragments on daily activities.

Diversity of Species

The finding revealed that mammal species composition between habitats was high in habitat A and B in both the wet and dry seasons, but significantly low in habitat C with evenness of diversity below the classification criteria -E value greater than 0.6. There was no statistically significant difference at ($P>0.05$) in mammal species diversity between habitats and within habitat types across the seasons. However, variations in wildlife species diversity occurred between habitats. Hedgerows and Fencerows recorded more population of mammals than the other areas having a high number of individuals, while the riparian forest and the thicket woodland with high species richness is more diversified in the rainy seasons and the thicket woodland is more diverse in mammal population in the dry season. This result confirmed the report of Bennett (2003); Recher and Serventy, (1991; Barling and Moore, (1994), that linkages such as riparian

vegetation, hedgerows, roadside and broad forested strips provide habitat for a wide range of wildlife species, particularly during the adverse condition such as the dry season.

there was no significant difference ($p>0.05$) in bird's species diversity between habitats in wet season and dry season. The riparian forest has high species composition in the wet season, while hedgerows and fencerows is more diversified in the same season. In the dry season, the riparian forest and the thicket woodland are more diverse in birds population while hedgerows and fencerows have high species composition, this further supports the report of Doyle (1990) that the riparian vegetation is well known as a rich habitat for fauna, and that the occurrence of songbirds in riparian woodlands vegetation in Mexico provides a pertinent example (Warkentin *et al.,* 1995). More so stream edge habitats, floodplain habitats, old stream channels and successional patterns of vegetation associated with fluctuating water levels and isolated pools all add to the habitat diversity and array of opportunities for fauna (Murray and Stauffer, 1995). Birds are found in all the habitats and in all seasons, reasons for their high abundance and diversity could be attributed to the closeness of Kanji Lake National Park to communities' fragmented habitats. These birds use the corridor as a pass to and fro the park. Hence the habitats in the landscape ensure ecological connectivity for wildlife species; moreover, the need for ecological linkages is now recognized as a fundamental principle in land-use planning and land management in developed landscapes (Smith and Hellmund 1993; Forman 1995).

The evenness index values for all the habitats are classified as high evenness, based on the E value classification criteria, which states that an E value greater than 0.6 indicates high evenness of species. These results indicate that the New Bussa agricultural corridors still have a high evenness index except for the thicket natural woodland during the dry season when hunting and bush burning are at their peak. Generally, species abundance and diversity have been affected by deforestation, uncontrolled bush fire and constant land development.

Conclusion

From the available results, it can be concluded that the habitat corridors are of wildlife conservation value because they contain representative samples of mammals, reptiles and birds. The conservation of these faunal species will be further enhanced if these habitat types are perpetuated. The mammal species are however not very abundant because of the small sizes of the habitat types which are within farming communities. Allowing wildlife species movement between important habitat fragments will bring about an increase in the utilization of the habitats by wildlife species and supplement declining populations and

therefore prevent local wildlife extinctions. Indiscriminate killings of birds and other wildlife in the environment should be discouraged, educating the locals in wildlife conservation is required, deforestation and uncontrolled bush burning should be discouraged, and indiscriminate use of herbicides by farmers or pesticide use around wildlife breeding grounds should be minimized.

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