Use of Flowering Trees by Birds in Savanna in Nigeria During the Dry Season

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ABSTRACT

A survey of nectar-producing trees and nectar-feeding birds of Ahmadu Bello University, Zaria, was conducted in the dry season during the period of January to June, 1997. The point count method was used for the study. A total of 33 tree species flowered during the period. Ten nectar-bird species visited them. Of the nectarivorous birds, three species (Scarlet-Chested Sunbirds, Beautiful Longtailed and Pygmy Longtailed Sunbirds) were most abundant. Birds were most active between 6.00-10.00 am and 16.00-19.00 pm, with little activity between 13.00-15.00 pm. Birds preferentially visited flowers primarily to lap nectar. Cases of opportunistic insectivory were recorded. Nectarivorous birds made less often visits to some trees which flowered but have no or little nectar. The importance of exotic trees as a nectar substitute for nectarivorous birds in residential areas represent a critical ecosystem service of great value to humanity (esthetic, ethical and economical). In this research, exotic species proved to be a good substitute for indigenous species especially in the periods when flowering plants are scarce. This has attracted the attention of conservation biologists to undergo a paradigm shift away from single-species conservation efforts towards habitat, ecosystem and regional efforts. Nectarivorous bird species and nectar producing trees should benefit from this change, because nectar feeding by many bird species is not yet identified and they stand to gain protection from conservation efforts.

Key words: Guinea savanna belt, residential areas, point count method, nectarivorous birds, exotic nectar producing trees as substitutes for native trees, bird conservation.

RESUME

Une enquête des arbres produisant du nectar et des oiseaux s'alimentant du nectar de l'université d'Ahmadu Bello à Zaria, a été faite pendant la saison sèche au courant de la période de Janvier à Juin 1997. La méthode de compte de point a été utilisée pour l'étude. Un total de 33 espèces d'arbres ont fleuri durant cette période. Dix espèces d'oiseaux nectarifères les ont visitées. Parmi les oiseaux nectarifères, trois espèces (Scarlet-Chested Sunbirds, Beautiful Longtailed and Pygmy Longtailed Sunbirds) étaient les plus abondante. Les oiseaux étaient plus actifs entre 6.00-10.00 heures et 16.00-19.00 heures avec peu d'activité entre 13-15 heures. Les oiseaux ont de préférence visitées les fleurs premièrement pour sucer le nectar. Les cas des insectivores opportunistes étaient enregistrés. Les oiseaux nectarifères ont effectués moins de visite sur certains arbres qui ont fleuri mais n'avaient aucun ou peu de nectar. L'importance des arbres exotique comme substitut du nectar pour les oiseaux nectarifères dans les endroits résidentiels représentent un service d'écosystème critique de grande valeur pour les l'humanité (esthétique, moral et économique). Dans cette recherche, les espèces exotiques se sont révélées comme étant un bon substitut pour les espèces indigènes particulièrement dans les périodes où les plantes fleurissantes sont rares. Ceci a attire l'attention des biologistes de conservation d'entreprendre un recul de paradigme des efforts de conservation des espèces uniques vers l'habitat, l'écosystème et les efforts régionales. Les oiseaux d'espèces nectarifères devront bénéficier de ce changement, car la consommation du nectar par plusieurs espèces d'oiseaux n'a pas encore été identifié et pourra bénéficier des efforts de la conservation.

Mots clés : zone de la savane de Guinée, secteurs résidentiels, méthode de compte de point, oiseaux s'alimentant de nectar, arbres exotique comme remplacement des arbres indigènes, conservation d'oiseau

INTRODUCTION

To persist on the planet Earth, humans depend on "life-support services" provided by biological processes arising from the interaction among species, enhancing other species population and benefiting from biotic agents (Kearns et al., 1998). This is demonstrated by nectarivorous birds which pollinate flowers in the course of nectar feeding, bringing about sexual reproduction and without which humans would lose many food and other plant products (Nabhan & Buchmann, 1996). At the same time, woodlands in Guinea savanna belt are being lost by tree-felling for fuel and degradation by overgrazing. Many bird species are already in serious jeopardy or endangered at an alarming rate. If sources of nectar are not adequately managed, there will be no basis for the survival of nectarivorous birds.

One way of helping to conserve birds so as to enjoy the numerous benefits they offer, is to ensure the availability of their food. The importance of food availability becomes more critical for specialist feeding groups such as nectarivorous birds. In the dry belt of the African savanna, the availability of flowers during the dry season appears to exert a limiting influence on the survival of sunbirds (Nectarinidae). Some nectarivorous species migrate south during the dry season (Elgood, 1966; Elgood et al., 1976). Others subsist on the tree species which flower in the area during this period. In Zaria area where many of these dry season flowering trees have been lost to deforestation (Pettet, 1975), the few that remain serve as a keystone resource to nectarivorous organisms. This may lead to competition among birds and insects for the nectar of flowers (Akinpelu, 1989; Gill et al.1980).

This study is therefore aimed at describing nectarivorous bird assemblage, identifying critical nectar sources and describing structures of ornithophilous flowers.

MATERIALS AND METHODS

Study Area

Zaria (11°10´N, 7° 40´E, Kaduna State, Northern Nigeria, Africa) is in the Guinea savanna belt (Keay, 1959). The small inserted map below shows the position of the study area with reference to Kaduna State and the entire country within Africa (Fig. I). This area consists of open woodland, everywhere penetrable even in the wet season. In the dry season when grasses have dried up, the ground vegetation is more open. The vegetation is a typical savanna with gentle undulating grassland with isolated tress and an intensity of shrub density. Zaria experiences 4-6 months of rains and 6-8 months of dry season. Very low humidity occurs from November to March during the harmattan (northern trade wind with low absolute humidity). Annual rainfall is 1000 mm. The relative humidity is 30% in the dry season and 95% in the wet season. Temperatures are between 35-40°C in the warm season. The hottest month is April and the coldest is August (Anon, 1981).

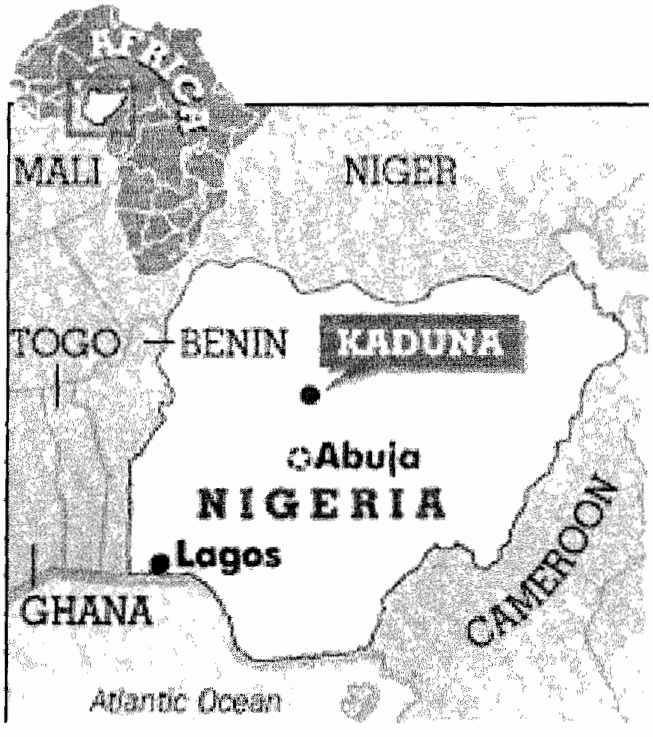

Figure 1: Location of the study area. Source: http://geography .about.com/library/cia/blcnigeria.htm.

The University site at Samaru lies within this ecological zone. It is located on the western edge of Zaria in an open countryside. The campus covers 12.000 km^2 of land. It is bounded on the south and west by open countryside with small villages, in the north by the Zaria-Sokoto road and southeast by an extensive water reservoir and the civil aviation authority-training center. The campus is dissected by a river system. The built-up area of the University mainly occupies the terraces of one river. The open valley floor of the Kubani river is cultivated, as are the adjacent uplands. The residential areas especially Area A and C are well planted with ornamental and fruit trees giving them the appearance of savanna woodlands from the air. Some of these trees flower during the dry season and attract nectarivorous organisms. There is also a small swamp and a wetland created by the Kubani river system. Furthermore, a well-wooded botanical garden exists in the northeast corner of the campus and together with Area A form a large block of both ground-dwelling and arboreal avifauna (Fig. 2).

Materials and Method

For this study a reconnaissance survey was carried out in January 1997 to locate flowering trees and nectarivorous birds. Observations done were restricted to 10 representative locations within the main campus. The study area was divided into 8 observation areas. These were the botanical garden, area around Sulieman and Amina halls and the social center, the institute of Agriculture Research complex, Area A, BZ, E, F and G. Each had a representative location but for the area around Sulieman and Amina halls and the social center having three representative locations (Fig. 2).

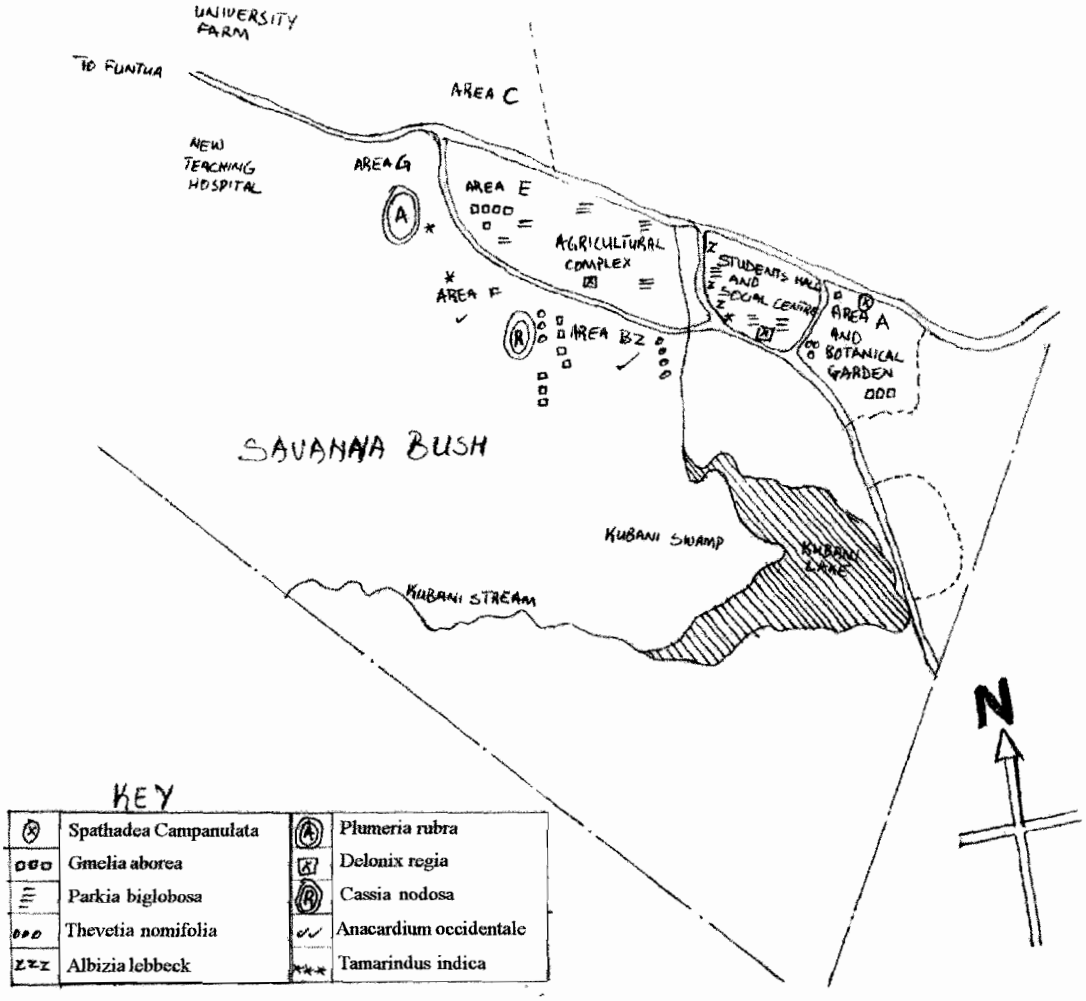

Figure 2: Ahamadu Bello University campus showing the study points.
Source: Traced from the Ahamadu Bello University campus master plan map (Yusuf & Associates, 1981).

In each of these areas, the point count method of Ferry & Frochot (1958) was used. Surveys were done on foot to watch a focal tree. A good position under a flowering tree gives a clear view of bird activity. Data were collected at affixed censuring spots well marked for relocation. Counts were done 3 days weekly. Activities of birds seen were monitored, standardized and recorded. For each day, observations were made between 6.00-10.00am, 13.00-15.00pm and 16.00-19.00pm local time. Observations were aided with a pair of 8 * 10m circular area around each focal tree. Observations were repeated for each of the localities to obtain a better relative abundance of nectar eating birds. All birds visiting flowers for nectar were identified, monitored and counted. Activities such as perching, singing and territorial behaviour were noticed. Identification of birds was done with the aid of field guides by Elgood (1960) and Serle et al. (1992). Flowering plants from which observations were made were identified. Seventy-two observations were made per plant. Plant specimens including flowers, leaves and fruits were taken to the herbarium for identification aided by Hutchinsen & Daiziel (1963). Collected and identified plants were deposited in the herbarium of the department of biological sciences of Ahmadu Bello University Zaria.

RESULTS AND DISCUSSION

Ten tree species were found in the eight observation areas comprising both indigenous and exotic ornamental flowering species. These were separated according to pollination types and flora morphology into ornithophilous, chiropterophilous and entomophilous based on the principles of pollination ecology (Faegri & van der Pijl, 1971). The nomenclature used was that of Hutchinsen & Daiziel (1963).

Elsewhere, experiments have been conducted with humming birds to prove that birds actively visit flowers for nectar. Feeders were placed next to flowers and Van Devender et al., (2000) observed nine species of humming birds feeding on flowers of 18 species of plants. Frequency of visits by birds was higher for these exotic than indigenous species at 20.9 for *Spathodea campanulata*, 19.2 for *Thevetia noriflora* and 8.5 for *Gmelina arborea* (Table 2).

The introduction of exotic species has the potential to harm native species. For example, fig wasps were introduced to California in 1899, at which point non-native trees that had been grown there for decades began to produce fruits (Donovan, 1990). Introduction of exotic species sometimes has negative results

Table 1: Flowering tree species visited by birds

Family	Scientific Names	Common Names	Flower colour	Status
ORNITHOPHILOUS				
Caesalpiniaceae	*Tamarindus indica*	Tamarind	Red	IN
Mimosaceae	*Albizia lebbeck*	Women´s tongue	White	IN
Apocynaceae	*Thevetia noriflora*	False oceander	Yellow	EX
Anacardiaceae	*Anacardium occidentale*	Cashew	Redish-brown	IN
Bignoniaceae	*Spathodea campanulata*	Flame tree	Red	EX
CHIROPTEROPHILOUS				
Mimosaceae	*Parkia biglobosa*	W. African locust tree	Redish-brown	EX
ENTOMOPHILOUS				
Caesalpiniaceae	*Cassia nodosa*	Pink cassia	Pink	IN
Caesalpiniaceae	*Delonix regia*	Flamboyant	Red	IN
Verbenaceae	*Gmelina arborea*	Snapdragon tree	Yellow	EX
Apocynaceae	*Plumeria rubra*	Frangipani	White	EX

IN= Indigenous plant
EX= Exotic plant

Table 2: Frequency of birds visit to flowering plants

Tree species	Mean number of trees	Mean monthly number of birds						Frequency of visit
		Jan	Feb	Mar	Apr	May	Jun	
Tamarindus indica	3.5	-	-	-	-	10	-	1.8
Albizia lebbeck	3.5	-	-	-	5	5	-	1.8
Thevetia noriflora	5.0	50	50	15	18	-	-	19.2
Anacardium occidentale	1.5	-	-	-	-	-	-	3.0
Spathodea sp	0.1	50	50	25	25	-	-	20.9
Parkia biglobosa	0.5	-	-	25	-	10	-	10.0
Cassia nodosa	3.0	-	-	5	-	-	-	0.9
Delonix regia	2.5	-	-	-	-	5	5	1.8
Gmelina arborea	3.0	-	25	18	-	-	-	8.5
Plumeria rubra	2.0	-	-	-	-	-	-	0.0
Total		100	125	88	48	30	5	63.49

of competition. For example, Honey bees (*Apis spp*) remove as much as half of all the available nectar from flowers of Australian bottlebush, *Callistemon rugulosus,* and New Holland honeyeaters respond by visiting individual flowers less frequently and expand their feeding territories (Paton, 1993). However, Kearns et al., (1998) has shown that Honey bees (*Apis mellifera*), which themselves are non-native species on most continents, are none-the-less critically important for crop pollination. Therefore, the need to further develop native tree species which produce nectar for nectarivorous birds brings home the importance of nectar availability.

Petit & Pors (1996) calculated the carrying capacity for nectar-feeding bats on the Island of Curacao by using the daily availability of flowers on three species of columnar cacti. They estimated the carrying capacity for one bat species at 1200, about 300 more than the actual population, and suggested that removal of native vegetation on the Island should be strictly regulated to prevent further decline. If human exploitation must continue, replacement of trees cut whether they are ornamental, exotic or indigenous, will make a good substitute especially for nectarivores which have a key role in the ecosystem mechanism.

In the dry season, nectar-feeding birds depend on nectar but when the rains appear, they become insectivorous probably because the rains wash or dilute the nectar. This is clearly seen in the decrease in the mean monthly number of birds feeding on nectar as the rainy season approaches. It is also seen that flowering is photoperiodically controlled. Trees flower at different periods giving an overlap in the flowering phenology showing the ecological complexity ensuring food availability. Studies on the flower availability, seasonal abundance, foraging and breeding show that all nectarivorous species feed on nectar and its availability is seasonal depending on the species.

Comparing the flowering species during the dry season in Zaria, *Tamarindus indica, Albizia lebbeck, Cassia nodosa* and *Gmelina arborea* had high mean number of trees (3-3.5) while *Spathodea sp* and *Parkia biglobosa* were least (0.1-0.5) but the frequency of birds to tree species was higher for *Spathodea sp.* and *Parkia biglobosa* (20.9 and 10.0), respectively. The most important preferred nectar plant was *Thevetia noriflora* which flowered almost the entire period, abundant, with the highest mean of 5 and frequency of visit of 19.2. Birds preferentially visited flowers for nectar.

Collins & Paton, (1989), have shown the importance of birds as obligate or facultative flower visitors and Nabhan & Buchmann, 1997 summed up the number of flowers visited by species worldwide to 300,000.

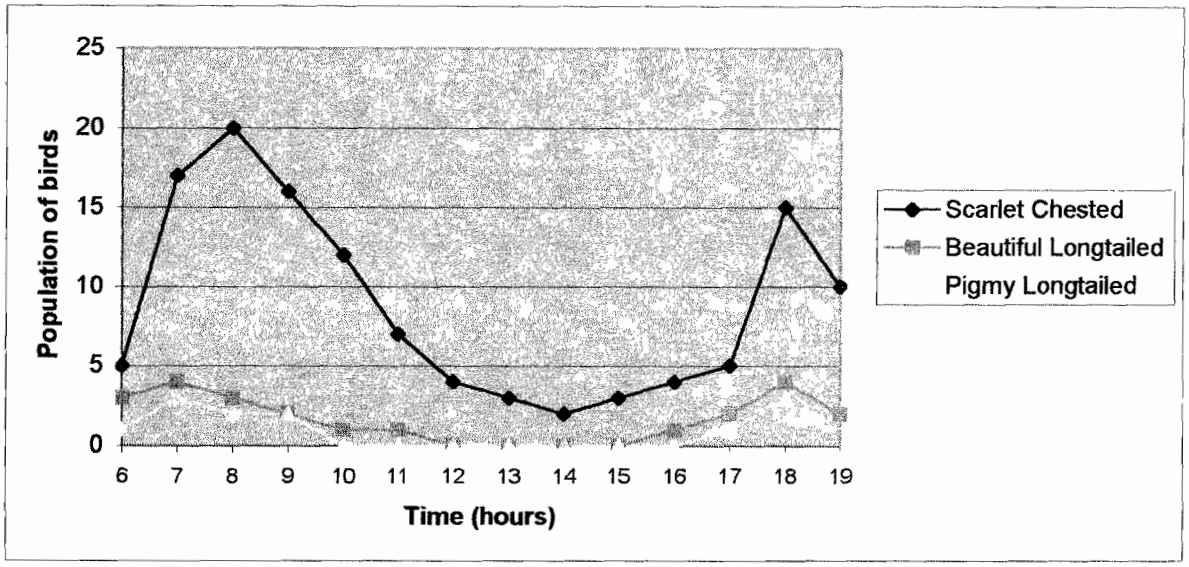

Figure 3: A comparison of feeding activity of three nectarivorous bird species.

Nectarivory by nectar-feeding birds was mostly on ornithophilous plants which had red or yellow flowers and were found in wooded areas near human habitation. Van Devender et al., (2000) also identified humming birds feeding on cultivated plants in yards including Orchidaceae, Leguminaceae, Liliaceae, and Malvaceae like *Hibiscus syriacus*. In southern Spain, shrubs like *Lavandula latifolia* have been visited by 54 insect taxa from three orders, with insects varying substantially in their quality (Herrera, 1989).

Other trees, notably *Plumeria rubra* and *Cassia nodosa*, flowered brightly during this period but were not ornithophilous and were rarely visited. However, chiropterophilous trees like *Parkia biglobosa* were intensively used by nectarivorous birds in April when nectar was scarce. *Gmelina arborea*, despite being entomophilous, was visited frequently by birds. A longer duration of visit was done early in the morning and evening. Afternoon visits showed a great reduction in activity (Fig. 3).

Sunbirds are among the best adapted of nectar feeding birds. They range from 3.5 inches to about 8 inches in length. Their small size makes it possible for them to alight on flower-bearing twigs without breaking them. Generally the bill is slender, decurved and the tongue is highly protractile and modified for feeding on nectar taken from different kinds of flowers. In addition to nectar, they devour many kinds of small insects and spiders, some of which they obtain on leaves (Gillard, 1958).

Certain birds species depend exclusively upon flowers as a food source at certain seasons of the year. This may involve long-distance travel to reach areas where flowers are available (migratory birds). These have a marvelous variety of specialization in beak and tongue as adaptations to certain flower structures and types. These nectar-feeding birds also help in pollination (Roche, 1974).

Faegri & Van der Pijl (1971) described nectar birds to be diurnal, visual and sensitive to flower colours, too large to alight on the flowers themselves, hard bill, long bill, long tongue and intelligent in finding an entrance. All these characteristics conform to the sunbirds discovered to probe into flowers for nectar throughout the period of observation. Beautiful long-tailed and Pygmy longtailed sunbirds were also found feeding on shrubs like *Lantana camera* and *Pedilanthus lithymaloides* with smaller flowers despite the larger trees offering many flowers. Not all birds seen on flowers were feeding on nectar. Carothers (1986) equally found out that nectar-feeding birds face special dietary demands because the amino acid content of nectar is very low.

Cases of opportunistic nectarivory by non-nectarivorous species at Ahmadu Bello University main campus were recorded. For example, the Yellow-White Eye, a regular nectar feeder elsewhere, Willow Warbler, Village Weaver and Yellow Fronted Canary which also quite commonly takes nectar were observed feeding on nectar (Pettet, 1979). Hess et al. (1999) found out in Hawaii that flowers of the Mamane tree are the primary food resources for Hawaiian honeycreepers (*Loxioides bailleui*) while their seeds are the primary food resources of the endangered palila. This confirms the

Table 3: Bird species observed in association with flowers
Classification adapted from Stronach (2003)

Family/ Scientific names	Common names	Feeding Type
FRINGILLIDAE		
Serinus leucopygia	Grey Canary	G
Serinus mozambicus	Yellow Fronted Canary	G
NECTARINIIDAE		
Nectarinia pulcella	Beautiful Longtailed Sunbird	N,F & I
Anthreptes platura	Pigmy Longtailed Sunbird	N,F & I
Nectarinia senegalensis	Scarlet-Chested Sunbird	N,F & I
ORIOLODAE		
Oriolus auratus	African Golden Oriole	I & F
PLOCEIDAE		
Ploceus cuculatus	Village Weaver	I & S
Ploceus pelzelni	Little Weaver	I & S
SYLVIIDAE		
Phylloscopus trochilus	Willow Warbler	Is & F
ZOSTEROPIDAE		
Zosterops senegalensis	Yellow White-Eye	N, Is & F

G = Granivore I = Invertebrate feeder Is = Insectivore
N = Nectarivore F = Frugivore

findings that a single tree could be of extreme importance to different bird species.

At the beginning of the rains in June, nectarivorous birds become conspicuously insectivorous and appear to spend more time searching for insects than for nectar. Myers (1992) in his study of nectarivorous bats, saw the durian tree as a famous nectar source. During the lengthy stretches of the year when the durian tree is not in flower, the bat sustains itself by feeding on the nectar of several other trees. This period (June) in Ahmadu Bello University main campus, coincides with the start of their breeding period in sun birds and they feed more on insects. Humming birds must originally have been insect-eaters, but have later largely switched to nectar, their young are still reared on insects in addition to nectar (higher protein requirements of growing organisms). Faegri & van der Pijl (1971), Udvardy (1969) and Engilis (1990) have enough data to support a more complex movement of birds from numerous breeding locations in the Holarctic as a result of a suitable habitat.

CONCLUSION

Despite the habitat destruction resulting from the construction of the University, nectar-feeding birds do not appear to be badly affected. The growing of exotic trees in residential areas and gardens has provided substitutes for the loss of native trees as some produce nectar for nectarivorous birds. It is therefore important to encourage the planting of flowering trees both native and exotic in areas where the maintenance of avifauna and diversity is desired.

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