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SUNBIRDS (*Nectariniidae)* DIVERSITY AND RELATIONSHIP WITH WEATHER CHARACTERISTICS WITHIN THE FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA

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ABSTRACT

Unlike most common bird species there is paucity of information on diversity of Sunbirds Nectariniidae within the Federal University of Agriculture, Abeokuta. Therefore, this study examined the relationship between contemporary weather variables and Sunbirds in the University's Campus. Bird survey was carried out using Line Transect method within the core activities area of the University. Transect lines were surveyed two times per point count station by skilled observers for fifteen weeks. Data were subjected to descriptive analysis. Step-wise regression was used to assess the relationship between the bird's abundance and weather variables. Likewise, data were subjected to ecological indexes such as Evenness index, Shannon diversity index and species richness. Results revealed seven different Sunbird species in the University's campus. Maximum diversity index (H) of the group was 1.89 and the species evenness was 0.97. Collared Sunbird accounted for 22% while Green Sunbird accounted for 5% of the bird's abundance. There was association between the abundance of Sunbirds and the period of survey on the Campus X^2 (2, N = 44) = 7.780, P = 0.020. There was relationship between the abundance of Sunbirds and wind speed in the University's Campus; F (1, 42) = 12.522, P = 0.001. This study concluded that there was relationship between wind speed, period of survey and Sunbirds.

Key words: Sunbirds, contemporary weather, diversity, richness

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INTRODUCTION

Sunbirds are small birds characterized by precise morphology and lightweight bones (Ehrlich *et al.*, 1988). They have curved, slender beaks that taper down, along with tubular brush-tipped tongues for feeding. Sunbirds belong to the family Nectariniidae, which comprises 132 species in 15 genera (Cheke and Mann, 2008). Due to the angle of incident light, their plumage color can suddenly change, causing blue to appear as black or green. Sunbirds typically have black legs with curved, thin, and long claws (Ehrlich et al., 1988). Males usually display vibrant and iridescent plumage, while females generally exhibit dull greenish to brownish coloration (Borrow and Demey, 2014).

Sunbirds inhabit tropical regions in Asia, Africa, and Australasia. In Africa, they are primarily found in sub-Saharan Africa, while in Asia, they occur along certain coastlines (Cheke and Mann, 2008). Some Sunbird species have adapted to modified landscapes such as agricultural areas, plantations, and gardens. Despite this, they can be short-distance seasonal or sedentary migrants (Cheke and Mann, 2008). Examples of Sunbird species predominantly distributed in central, eastern, southern, and West Africa include the Variable Sunbird (*Nectarinia venusta*) and the Copper Sunbird (*Cinnyris cupreus*) (Firouz, 2005). Sunbirds inhabit a wide range of habitats, including woodlands, savannas, and any areas with insects and flowering plants (Klasing, 2004). However, their presence in hot temperate

regions declines when flowering plants are not in season, often leading to migration (Klasing, 2004).

Sunbirds are nectivores, primarily feeding on flower nectar by using their specialized tongues to suck the available juice. However, they also consume small insects (Klasing, 2004). The proportions of insect, invertebrates, or nectar in a Sunbird's diet depend on the species and season. No Sunbird is entirely nectivorous, as relying solely on nectar cannot fulfill their amino acid requirements. Some Sunbird species also consume seeds, small fruits, spiders, and pollen, which are essential components of their diet (Klasing, 2004).

Breeding activities among Sunbirds typically occur during the wet season, although many species also breed in winter outside of equatorial regions (Jackson, 1999). The molting stages of Sunbirds vary among species (Chettri *et al.,* 2001). Sunbirds construct basic nests made of grasses, which are enclosed, purse-shaped, and suspended from thin branches. Female Sunbirds are primarily responsible for nest construction and lay an average of four eggs, which are then incubated for 18 to 19 days. Both male and female Sunbirds participate in feeding the nestlings. Sunbirds are known for vigorously defending their breeding and feeding territories, and they are monogamous species (Cheke and Mann, 2008).

The global population trends of most Sunbird species remain unquantified, and they are currently categorized as Least Concern by BirdLife International (2007). Weather conditions have been reported to impact the existence of Sunbirds (George *et al.,* 1992). Weather can affect bird behavior, such as reduced foraging rates, reproduction, courtship, and metabolic rates (Humphrey, 2004). Sunbirds can experience over-hydration when feeding on extra-diluted nectars and dehydration during the night (Fleming *et al.*, 2004).

These variables play a crucial role in understanding and predicting weather patterns as well as biological elements. Some of the key weather variables include temperature, precipitation, humidity, wind speed and direction, atmospheric pressure, cloud cover, and sunshine duration (World Meteorological Organization-WMO, 2017). Temperature provides information about the hotness or coldness of the air and is vital for determining climatic conditions, and is typically recorded in degrees Celsius or Fahrenheit (The Intergovernmental Panel on Climate Change -IPCC, 2013). Precipitation is an important indicator of the water cycle and has significant implications for agriculture, water resource management, and overall ecosystem dynamics (Houze, 2014). Humidity represents the amount of moisture present in the air and is expressed as a percentage. It influences human comfort levels, as high humidity can make the air feel warmer, while low humidity can cause dryness and discomfort. Wind speed and direction plays a crucial role in shaping weather patterns, redistributing heat, and influencing the transport of pollutants and airborne particles (Jordaan *et al.*, 2017).

Atmospheric pressure affects weather conditions, with high-pressure systems generally associated with fair weather and low-pressure systems often indicating the potential for stormy conditions (Wallace and Hobbs, 2006). Cloud cover refers to the fraction of the sky that is obscured by clouds. It has implications for solar radiation reaching the Earth's surface and affects temperature patterns. Cloud cover is typically reported in terms of the amount of sky covered, ranging from clear skies (0% coverage) to completely overcast conditions (100% coverage). Sunshine duration measures the amount of time during which direct sunlight is received at the Earth's surface. It is expressed in hours and is an essential parameter for various applications, including solar energy production, plant growth, and climate studies (Deneke *et al.*, 2020).

MATERIALS AND METHODS

Study Area

This study was carried out in the Federal University of Agriculture Abeokuta (FUNAAB) in Odeda Local Government area, Ogun State. The institution is located on latitude 7^0 13^1 N and 7^0 20^1 N and longitudes 3^0 20^1 E and 3^0 28^1 E (IFSERAR, 2014). It occupies a total land area of 10,000 hectares and shared boundary with Ogun-Oshun River Basin Development Authority. The area climatically enjoys tropical climate and double maxima of rainfall from April – July and September – October with an average temperature of about 32^0c and humidity as high as 95% (Figure 1).

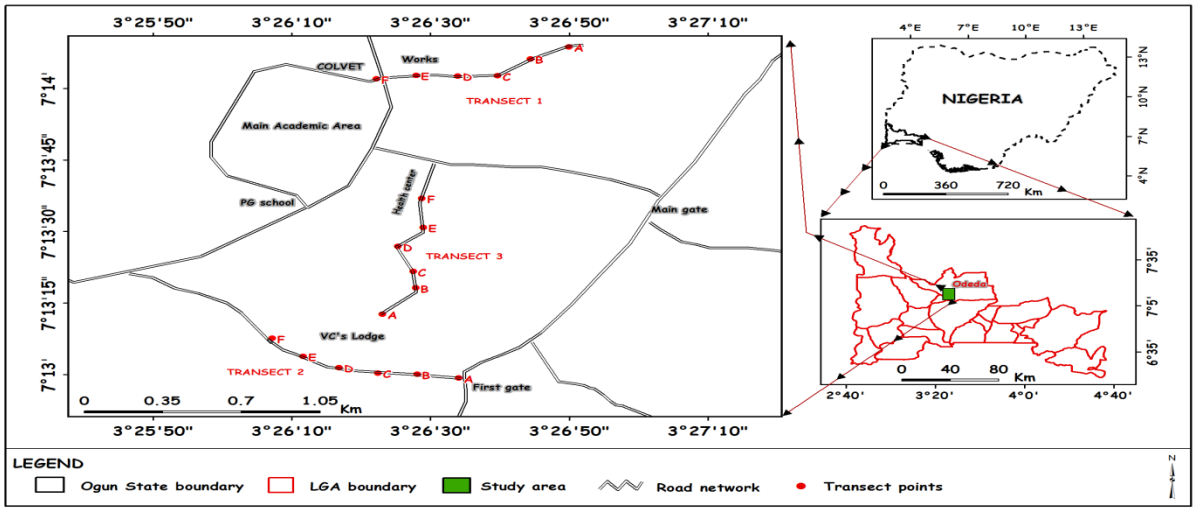

Figure 1: Study location Transects at Federal University of Agriculture Abeokuta Campus

Bird Sampling Method

Bird survey was carried out using Line Transect method (Gibbons and Gregory, 2006) across three main core areas in the institution between August, 2017 and November, 2017. Three transect line of 1,200m each were established and six-point counts of 200m intervals were recognized on each. These covered key habitats such as grassland, lecture halls and buildings, administrative structure, Parking lots, lawns and commercial complex. All transect lines were surveyed two times by skilled observers for fifteen weeks with morning- 6:00am to 8:00am and evening- 5:00pm to 7:00pm observation considered at about 2hours for a visit. All encountered Sunbirds were identified to species level (Borrow and Demey, 2014). Effect of weather conditions such as; visibility, temperature, humidity, dew point, wind speed, were examined on the assemblage of Sunbirds. Weather variables and their real-time data were obtained during the field survey, from online weather stations; www.accuweather.com and www.weatherforyou.com respectively.

Data Analysis

Abundance of Sunbirds species was presented using descriptive analysis and Simpson's index while chi-square test was used to determine the association between Sunbirds species with study sites and period of survey. Step-wise regression model was used to evaluate the relationships between Sunbirds numerical value and weather parameters.

RESULTS

Total abundance of Sunbirds encountered on the Campus was 75 individuals from seven (7) different species of Sunbird. Collared Sunbird (22%), represent the highest proportion of the abundance followed by Copper Sunbird (16%), Green-Headed Sunbird (16%) and Splendid Sunbird (16%). Green Sunbird were less compared to others. The bird Species richness was 7 while the maximum diversity index (H) of the group was 1.89. The species evenness was 0.97 (Table 1).

Mean values of the weather variable were; temperature recorded was 26±2 °C, the dewpoint was 26±2 °C, humidity was 88±2%, mean wind speed of 2.5±0.8 kph, and mean visibility of 4±0.8 km (Table 2) There was association between the abundance of Sunbirds encountered along the traversed transects in the Campus; X^2 (6, N = 75) = 5.012, P = 0.003. There was association between the population of Sunbirds and the period of survey observed at FUNAAB, X^2 (2, N = 75) = 7.780, P = 0.020. (Table 3).

This result explains that at FUNAAB, relationship between the population of Sunbirds and wind speed variable shows a significant relationship; F (1, 42) = 12.522, P = 0.001. The measure of effect R^2 was 0.23, showing that the wind speed

accounted for 23% of the variance in the population of the Sunbirds. Coefficient value of the relationship was -3.539 and it indicated a negative relationship between the variables that the decrease in the population of Sunbirds was as a result of increase in wind speed. Correlation coefficient R value of 0.479 was an indication of positive linear association between the observed and predicted values of dependent variable. Similarly, there is a significant relationship between the population of Sunbirds and dew point variable at FUNAAB; F (2, 41) = 11.552, P = 0.000. The measure of effect R^2 was 0.36, showing that the wind speed accounted for 36% of the variance in the population of the Sunbirds. Coefficient value of the relationship was -2.895 this indicated a negative relationship between the variables that the population of Sunbirds declined as a result of increase in dew point. Correlation coefficient R was 0.600 showing that there was positive linear association between the observed and predicted values of dependent variable (Table 4).

Table 1 List of Sunbirds species encountered within the University's Campus

Common Name	Scientific Name	Abundance (%)	H	Equitability
Collared Sunbird	*Anthodiaeta collaris*	17 (22)	1.89	0.98
Copper Sunbird	*Cinnyris cupreus*	12 (16)		
Green Sunbird	*Anthreptes rectirostris*	4 (6)		
Green-Headed Sunbird	*Cyanomitra verticalis*	12 (16)		
Olive Sunbird	*Cyanomitra olivacea*	9 (12)		
Splendid Sunbird	*Cinnyris coccinigastrus*	12 (16)		
Variable Sunbird	*Cinnyris venustus*	9 (12)		
Species richness = 7		75 (100)		

Values in parenthesis are percentages

Table 2 Means of Sunbirds and Contemporary Weather Variables

Variables	Minimum	Maximum	Sum	Mean ± Std. Error
Sunbirds abundance	2	4	75	3±1
Temperature °C	24	28	207	26±2
Dewpoint (°C)	22	25	187	23±1
Humidity (%)	79	95	707	88±2
Wind speed (kph)	1	3.3	20	2.5±.8
Visibility (km)	3.5	4.5	32	4±.5

Table 3 Association between Sunbirds, Transects Surveyed, Period of Survey on FUNAAB Campus

Location	Variables	Interaction Values	Df	No of cases	Sig.
FUNAAB	Transect * Population	5.012	6	75	0.003
	Period * Population	7.780	2	75	0.020

**Significant at 5% (p<0.05)*

Table 4 Relationship between abundance of Sunbirds species and contemporary weather variables: visibility, temperature, humidity, dew point, moistly clear, wind speed, density, mist-fog, hazy, and cloudy

Site	Variables	*F*(df)	Sig.	Coefficient	R	R^2 (%)
FUNAAB	Wind (mph)	F (1, 42) = 12.522	0.001	-3.539	0.479	23
	Dew point (^{0}C)	F (2, 41) = 11.552	0.000	-2.895	0.600	36

*** Significant at 1% (p<0.01)*

DISCUSSION

The population of Sunbirds found in this study was more than what was reported by Yisau *et.al.*, (2018) in the study carried out within Federal University of Agriculture, Abeokuta. The variation could be traced to this study been specific and time devoted to only a single group of bird. More so, the number of species of Sunbirds were more than what was found by Yisau *et.al.*, (2018). The variation in the species richness of Sunbirds could be as a result of different transects lines surveyed and habitat dissimilarity. The assemblage of Sunbirds encountered in this study despite been around traffic of human and many structural buildings was supported by findings of Chace and Walsh, (2006) that habitat that is highly disturbed by anthropogenic activities results in heterogeneous habitats that attracts certain birds that can coexist with humans. Association between the period of survey and the population of Sunbirds in the study location was significant and could be traced to species richness diversity found in the morning and evening survey. It implies that both period of survey had positive association with Sunbirds detection and their population. Detection of Sunbirds during either of these periods is possible in the study location. This result corroborates Nadeau *et al*., (2008) that the period of survey affects the rate of detection of birds. This study also affirms that Sunbirds preferred to forage both in the morning and evening in this study location. Likewise, the positive interaction between Sunbirds population and transect lines indicates availability of the bird along the routes surveyed. The detection of Sunbirds along these transects could be traced to other environmental variables along the routes such as foraging resources which might be an attraction to the transect route for the bird.

Negative relationship between weather parameters; wind speed, dewpoint and Sunbirds implies decrease in detection of Sunbird along the transect lines. The coefficient value of the relationship affirms that negative weather parameters; wind speed and the dewpoint influence were not favorable to population of Sunbirds. It corroborates Sillett *et al*., (2000) that adverse weather conditions usually cause reduce population of birds during survey.

CONCLUSION

The study concluded that there is a good diversity of Sunbirds species within the University Campus a good consideration for management and conservation approach. Likewise, independents parameters such as; wind speed, period of survey, period of survey and transects line all had relationship with Sunbirds in the study location.

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