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INSECT DIET OF SOME AFROTROPICAL INSECTIVOROUS PASSERINES AT THE JOS WILDLIFE PARK, NIGERIA.

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ABSTRACT
Despite being the most common avian dietary strategy, our understanding of the nutrition of avian insectivores lags behind that of less populous granivores, herbivores, and frugivores; thereby attracting research interest. Insect diet of Afrotropical insectivorous passerines at the Jos Wildlife Park was studied by trapping birds using mist nets in 2009. Trapped birds were identified and kept in a wooden box for 15 minutes to create a dark interior for the discharge of faeces. Insect remains in faecal droppings collected from individual passerines were identified to at least Order level. SPSS 2001 506 /id software packages was used for statistical analyses. Identified insect remains in faecal droppings of insectivorous passerines showed that there were 13 positively identified Orders. Ten Families belonging to the Orders Hymenoptera, Coleoptera, Orthoptera, Diptera, Isoptera, Anoplura and Mantodae were positively identified. There was a significant difference (One sample- T-test; t=5.05, df=18, P<0.001) in the choice of insect diet by the insectivorous passerines trapped during the study. Of the fragments recorded from the faecal droppings, 325(83%) constitute insect diet, 35(10%) plant materials and 25(7%) were unidentified. The study shows that insects utilised by avian insectivores in the Jos Wildlife Park is probably a reflection of insect abundance and diversity. Therefore insectivorous passerines may have adapted to feeding largely on abundant and diversed insect species present in the study area.

***Key words*:** Insect diet, Afrotropical, Insectivorous passerines, Insects and Birds.

INTRODUCTION

Fundamental to understanding the ecological requirements of a species is knowledge of its diet and the factors that affect food availability (Newton, 1998). Diet studies deal with fundamental aspect of the biology of organisms and provide important information for an array of evolutionary, ecological, and conservationist questions. Such studies identify the food resources that provide the necessary nutrient and energy requirements of organisms. Food items that meet these requirements may be consumed in a more or less selective manner in relation to their availability (Davies, 1977; Rodway & Cooke, 2002). Diet requirements may limit populations and structure of communities (Loiselle & Blake, 1991; Malizia, 2001) and can also affect the evolutionary physiology, life history and behavior (Brändle *et al.,* 2004)**,** and influence patterns of habitat use as well as intra- and inter-specific interactions (Chapman & Rosenberg, 1991; Pérez & Bulla, 2000). Despite being the most common dietary strategy, our understanding of the nutrition of insectivores lags behind that of less populous granivores, herbivores, and frugivores (Davies, 1977; Klasing, 2000 and Rodway & Cooke, 2002).

Insectivorous birds are beneficial to agriculturists as they control the populations of various insect pests of crops. As enemies of insects, birds are important among vertebrates as they are highly mobile and can congregate within a short period of time in large numbers when sudden outbreak of insect pest occur, thus birds are highly efficient and cost effective insect pest control agents (Dhindsa & Saini, 1994; Asokan *et al.,* 2008). A good knowledge of the type of insects that bird feeds on in any reserve is crucial towards developing a sound management decision and future scientific research on birds and insects. This study seeks to determine the insect diet composition of some insectivorous passerines and how they vary across species in the Jos Wildlife Park, Nigeria.

MATERIALS AND METHODS

Study area: Much of the vegetation of the Jos Plateau has been devastated by tin-mining activities, a high human population has resulted in continued, large-scale deforestation and conversion of grassland and scrub to farmlands and the few remaining patches of forest and woodland are fast being depleted by unsustainable fuel wood collection (Hadejia, 2000; Lodewijik & Were, 2001; Chaskda, 2007). Presently, only a few areas of natural grasslands, savanna-woodlands and forest remain on the Jos plateau, one of which is the Jos Wildlife Park. The Park is located at Latitude 09° 52' and Longitude 08° 53' covering approximately 8 km^2 and characterized by gentle hills and rocky (rock outcrop) topography with seasonal streams, a typical savanna woodlands and gallery forests and also consists of some exotic plants. The vegetation is dominated by *Jacaranda mimosaefolia, Parkia clappertoniana, Ficus* species, *Dedonix dejia* and *Acacia* species. Introduced trees such as *Pinus* and *Eucalyptus* species are common. Herbs and shrubs like *Sida acuta, Bohemia* species and *Emilia sonchiofolia* are also present. The forest has been identified as one of the relatively undisturbed natural vegetation of the Jos Plateau (Mannok, 2006).

Bird trapping and handling: Three 9 m and two 12 m long mist nets were randomly placed in the reserve to trap insectivorous passerines. The mist nets were set up in the morning between 0530 hours and 1000 hours and intermittently checked for possible catch every 25 minutes. Mist netting was carried out for five days per month between February 2009 and March 2010.

Collection and microscopic analyses of faecal droppings: Individual insectivorous passerines captured were identified and kept in a wooden box for a period of 15 minutes to create a dark interior suitable for the discharge of faeces. Birds that do not pass out faecal droppings within the stipulated time were released. Nail varnish was used to mark trapped birds on the claw of the left hind toe in order to distinguish between trapped and untrapped birds. First and second retrap was marked with red and black nail vanish respectively. Non-insectivorous passerines caught in the mist net were noted and released immediately.

Faecal samples were broken up gently with forceps and dissecting needles and content distributed evenly in the section of the petri dish. The sample was viewed in a small amount of 70% alcohol (care was taken so that samples do not become saturated enough to cause motion when the dish is moved, neither left to dry out completely). Small quantity of water was added to each sub-sample so that it became less cloudy and clear enough for effective scanning. Every section of the petri dish was searched carefully, and specimens were identified from Order to at least Family level where possible.

Data analysis: SPSS 2001 506 /id software packages was used for statistical analyses. The data was tested with One-sample Kolmogrorov-Smirnov test (Wilkinson, 1990) and the Levenne test for equality of variances to satisfy the assumption of test model. Bird and insect diversity was calculated using the Shannon-Weiner diversity index (Begon *et al.,* 2003). The choice of diet by insectivorous passerines were tested using One-sample T-test.

RESULTS

A total of 375 fragments were identified and recorded in the overall faecal sample collected at the Jos Wildlife Park. Of these fragments, 325(83%) constitute insect diet, 35(10%) plant materials and 25(7%) was unidentified. Analysis of faecal droppings of insectivorous passerines showed that there were 13 Orders and 10 Families recorded. The ten Families positively identified from faecal droppings of insectivorous passerines belong to the Orders Hymenoptera, Coleoptera, Orthoptera, Diptera, Isoptera, Anoplura and Mantodae. A total of 400 individual insectivorous passerines were trapped and faecal dropping collected. There was a significant difference in the choice of insect diet by some insectivorous passerines trapped (One sample- T-test; t=5.05, df=18, P<0.001). Analysis of faecal droppings of the insectivorous passerines reveals that birds prey primarily on the following insect Order: Hymenoptera (36%), Coleoptera (23%), Orthoptera (12%), Diptera (9%) with. The Orders Hymenoptera, Coleoptera, Orthoptera and Diptera together constituted 80% of the insectivorous passerines insect diet while 13% was made up of other food. 7% of the insect fragments were unidentified at the level of Order (Fig 1 and Table 1).

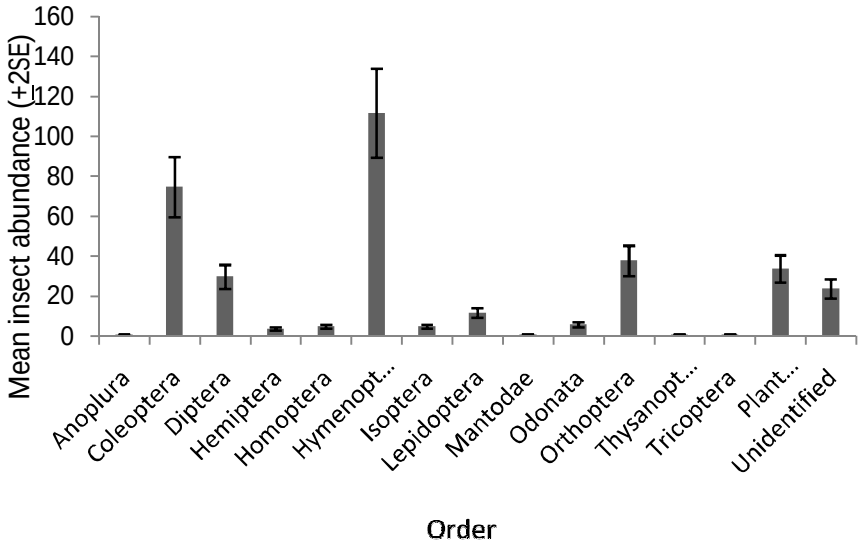

FIG 1. ORDERS OF INSECTS IDENTIFIED IN THE DIET OF INSECTIVOROUS PASSERINES.

TABLE 1. DIET COMPOSITION OF INSECTIVOROUS PASSERINES COLLECTED FROM FAECAL DROPPING.

Prey item	Frequency	% composition	Rank
Hymenoptera (ants, bees, wasp)	125	35.71	I
Coleoptera (beetles and weevils)	84	23.14	II
Orthoptera (grasshoppers and crickets)	42	12	III
Diptera (flies)	33	9.43	IV
Unidentified insect fragment	25	7.14	V
Lepidoptera (butterflies and moths)	15	4.29	VI
Odonata (dragonflies)	8	2.29	VII
Isoptera (termites), Homoptera (cicadas and hoppers)	5	1.43	VIII
Hemiptera (bugs)	4	1.14	IX
Others include Anoplura (sucking lice), Mantodae (mantids), Thysanoptera (thrips) and Tricoptera (caddisflies)	4	1.14	X
Total	**350**	**100**	

DISCUSSION

Trophic niche studies are essential for evaluating ecological interactions between and within species and their evolutionary implications. For example, fundamental aspects of a wide range of hypotheses concerning population divergence, evolution of sexual dimorphism, and adaptations to fluctuating environments rely on dietary evidence (Pincheira-Donoso, 2008). In terms of nutrition, insect diet is quite adequate as it is rich in easily digestible protein and fat though the digestibility of various parts largely depends on their chitin content (Kaspari & Joern, 1993; Klasing, 2000). In this study, analyses of insect fragments show that 83% of the diet of insectivorous passerines was made up of insect remains whilst 10% 7 % constitute plant materials and unidentified fragments respectively. This finding is similar to that of Klasing, (2000) and Pincheira-Donoso, (2008), where Buff-tailed Sicklebill, an insectivorous passerine fed on 80% insect prey remains.

There was a significant difference (One sample- T-test; t=5.05, df=18, P<0.001) in the choice of insect diet by some insectivorous

passerines trapped during the study. Earlier studies have shown that birds prey primarily on the insect Orders Hymenoptera (36%) (Hughes *et al.*, 2000) followed by Coleoptera (23%), Orthoptera (12%) and Diptera (9%) (Wichaikam, 2010). In the present study Hymenoptera, Coleoptera, Orthoptera and Diptera pooled together constitute 87% of the insectivorous passerines insect prey remain. This finding is consistent with results of earlier studies (Sen, 1944; Mukherjee, 1975; Yahya, 2001; Asokan *et al.,* 2009). In a study conducted in Malaysia (Burton 1998), insects mostly ants, beetles and grasshoppers dominated the diet of White-breasted Kingfisher. This study confirmed that there were more ants compared with other insects. Similar result was shown by Pincheira-Donoso, (2008). In another study conducted in India, Asokan, (1998) found that Hymenopterans (dominated by ants) and Coleopterans (dominated by beetles) were the principal food item of the Bee-eater in Nagapattinan district.

The result from this study show that insects sampled from the faecal dropping of insectivorous passerines is a mirror image of those collected from the three habitat types in the study area, particularly for the order Hymenoptera, Coleoptera, Orthoptera and Diptera. Perhaps, the insect diet fed by the insectivorous passerines is a reflection of the frequency of insect abundance and diversity in the study area. Insectivorous passerines may have been adapted to feeding largely on abundant and diversed insect Orders present in the study area. Fry, (1984) who studied Little Bee-eater in Africa reported that Hymenoptera formed its major diet, a similar trend observed in this study as Hymenoptera top other insect Orders identified in insectivorous passerines faecal droppings. Basset, (2001) studied invertebrates in canopy of tropical forests and found that most Hymenoptera and Coleoptera are the dominant Orders of insect abundance and diversity, similar to the report by Molta *et al*., (1998). Many investigators (Kaspari & Joern, 1993; Parasharya *et al.,* 1994; Sivakumaran & Thiyagesan, 2003; Yard *et al.,* 2004 and Asokan, 2008) have also shown that the Order Hymenoptera, Coleoptera, Hemiptera, Orthoptera, Odonata and Diptera are primary food source for insectivorous birds. However, Wichaikam *et al.* (2010) recorded 50% of insects from the Order Collembola in their samples, even though the Orders Hymenoptera, Coleoptera, Diptera and Orthoptera were caught in substantial number. It is important to note however that some insect Orders such as Diptera may be under-represented as they are not heavily sclerotised.

In conclusion, our results showed that the Jos Wildlife Park is rich in avian and insect fauna, thus should be considered an Important Bird Area (IBA). The abundance and diversity of insects sampled from faecal droppings of insectivorous passerines at the Jos Wildlife Park varied significantly across species. The order Hymenoptera and family Formicidae dominated among the insects sampled. This finding further highlight the importance of insects as food for birds compared with other prey items.

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