

Diet and Foraging Ecology of African Harrier Hawk (*Polyboroides typus*) in Ehor Forest Reserve, Edo State, Nigeria

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Abstract

Feeding is an indispensable activity in the life of birds. It is crucial for their survival but the demands of food acquisition impose significant challenges to both the physiology and behavior of birds. Thus, this study on the feeding ecology of African harrier hawk is imperative for understanding the species adaptation to environments and also a crucial factor to be considered while examining their economic status. This research study investigated the diet and foraging ecology of the African harrier-hawk (*Polyboroides typus*) in Ehor Forest Reserve, Edo State, Nigeria. Direct field observation method was used to collect data for 12 months on the diet and foraging ecology of the bird species. The study area was divided into three compartments according to land use types, (mature forest, logged area, and farmlands). The results show that the African harrier-hawk consumed a variety of small animals, insects and fruits of some plant species. The frogs, lizards, adults, eggs of bird species and insects constituted 87.25% of the diets while plant resources made up 12.75%. The major diet resources were bird species belonging to the family Ploceidae and frogs; and the fruits of oil palm (*Elaeis guineensis*) and African pear (*Dacryodes edulis*). African harrier-hawk utilized the three compartments within the study area but with the percentage of utilization of habitat type highest in the logged area (48.9 %), mature forest compartment (32.2 %) and farmland compartment (18.9 %).

Keywords: African Harrier Hawk, Diet, Foraging Ecology and Conservation

Introduction

The African harrier-hawk (*Polyboroides typus*) which belongs to the Family Accipitridae and Order Falconiformes is the largest hawk in Africa (Burton, 1978). It is also called Gymnogene or African Gymnogene and of medium size: 60-66 cm long, wingspan of 160 cm and 635-950 g weight. The upper parts, head, and breast are pale greys; the belly has white plumage with fine dark barring and the broad wings are pale grey having a black trailing edge fringed with a narrow white line. The tail plumage is black with a single broad white band. The facial patch is of a variable color which is

usually red or yellow. The plumage of both sexes is similar but young birds are pale brown instead of grey and dark brown replacing black. This bird species has double-jointed knees and this rare trait enables it to reach into otherwise inaccessible holes and cracks for prey (Brown and Amadon, 2009). Two subspecies of African harrier-hawk are documented namely: *Polyboroides typus typus* and *Polyboroides typus pectoralis* with the latter smaller and darker and having more barring on the under parts (del Hoyo *et al.*, 1994; Ferguson-Lee and Christie 2001). The African harrier-hawk is a fairly silent bird but during the breeding season,

it usually gives a long, plaintive ‘su-eeeeee-oo’ call as well as a high sweep-week-sweep near the nest (Ferguson-Lee and Christie, 2001; Sinclair and Davidson, 2006).

Polyboroides typus is very widely distributed throughout Nigeria and forms a complex and stable society and is very social even during breeding (Morrison *et al.*, 1990). It generally prefers rain forest, savanna woodland and mixed-species fallows as well as forest edges, wooded cliffs, ravines and other rocky habitats, tall trees along drainage lines, artificial plantations and tall trees in gardens (Burrow and Demey, 2011) but moves to the Sahel savannah zone during the dry season (Cooper, 1980). It is listed on Appendix II of the Convention on International Trade in Endangered Species (CITES, 2009) and also listed along with other

Materials and Methods

Study area

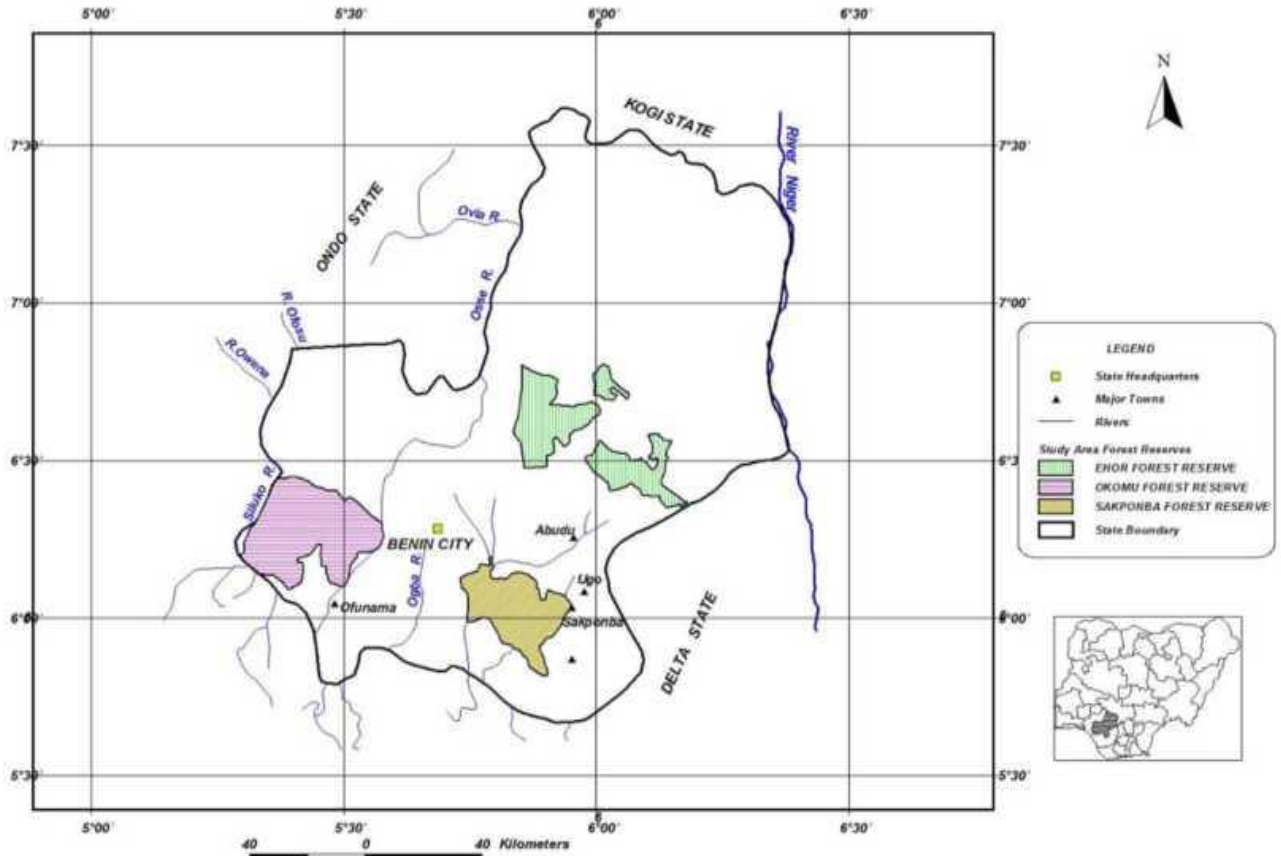
The Ehor Forest Reserve, in Uhumwode Local Government Area of Edo State, Nigeria, is 56 kilometers north of Benin-City, the state capital and located between 6° 34’-6° 38’N and 5° 54’-5° 58’E. It occupies 7,680 hectares (ha) of land and divided into 48 compartments of 160 ha each. There are no settlements within the reserve but it is surrounded by nine villages: Ohe, Eguaholor, Egbisi, Ugieghudu, Uhi, Iriwe, Erhue, Elbow and Aikido.

The reserve lies in the geological region known as the western coastlands characterized by the sedimentary rock of the Eocene Era (Mengistu and Salami, 2007). The soils are acidic sandy loams derived from deep loose deltaic and coastal sediments sometimes referred to as the “Benin Sands” (Isichei, 1995, Mengistu and Salami, 2007). It experiences tropical weather characterized by distinct wet and dry seasons with annual rainfall of 1,524-1,540 mm, mean annual temperature of 30°C and relative humidity ranging from 60% in the driest months (December-January) to almost 100% during the wettest months (July and September).

The vegetation type is Guinea-Congo lowland rainforest including the area of swamp- forest,

African birds of prey under Class B of the African Convention on the Conservation of Nature and Natural Resources, (ACCNR, 2009). Feeding is an indispensable activity in the life of birds. It is crucial for their survival but the demands of food acquisition impose significant challenges to both the physiology and behavior of birds (Chen and Hsieh 2002). Thus, the study of feeding ecology is an imperative for understanding the species adaptation to environments and also a crucial factor to be considered while examining their economic status. The diet and feeding ecology of *Polyboroides typus* have not been studied in Nigeria hence this research aims at providing the baseline information on the food and feeding ecology that will assist other workers interested in the management of the bird.

high forest, secondary forest and open scrubs (Keay, 1989). The sizeable number of timber species which include *Kapok*, *Celtis zenkerii*, *Triplochiton scleroxylon* (*Obechie*), *Antiaris africana*, *Pycnathus angolensis* and *Alstonia congensis* has made the reserve an attractive source of timber to logging companies (Ikhuoria, 1993; Werre, 2001). Other non-timber forest products: fuelwood, chewing sticks, medicinal plants, construction and weaving materials, vegetables and other food materials are exploited from the reserve. However, the land cover and original forest vegetation have long been modified to secondary forest and secondary bush by various forms of human activities particularly logging and farming. A large area of fallow dominated by Siam weed (*Chromolaena odorata*) suggests recent clearing even as the vegetation has regenerated gradually into secondary regrowth and some patches of isolated undisturbed forest in the hilly areas. Farming is the commonest practice within the reserve and cassava is the most encountered arable crop but plantain and cocoa plantations and their forms of agricultural/cropland uses exist (Oates *et al.*, 2008; Mengistu and Salami, 2007).



Map of the Study area (source: Aigbe, *et al.*, 2017)

Data Collection

The study area was divided into three compartments according to land use types: mature forest, logged area and farmlands. The data collection on the diet and feeding ecology of African harrier-hawk was made on 36 pairs ranging in size from 2 to 3 individuals over a continuous period of 12 months (January-December 2016). The Direct Observation method as described by Akinpelu (2004) and Okosodo *et al.* (2016) was used for this study. Field observations with binocular (Bushnell 7×50), whenever found necessary, were made early in the morning or late in the evening when

birds actively fed with least disturbance. Individual pairs were followed for periods varying from 2 to 5 hours during which it was usually possible to keep some birds in view at all times but rarely possible to see all members of the group together. During each visit, observations were recorded on the foraging habitat, type of feeding method employed, feeding session, number of birds, type of diets and association with other bird species. Seasonal changes in the feeding habits of the bird were studied. Pellets were not examined because of the height of the nests from the ground level and girth of the trees.

Results

The major diets of African harrier-hawk (*Polyboroides typus*) are shown in Table 1. The diet consists of varieties of bird species, frogs, lizards and insects; fruits, seeds, leaves and

flowers of plant species such that small animals and insects accounted for 87.25% of the food items while plant species made up 12.75% of the food items (Fig. 2). The major animal diet

items were the adults, eggs and nestling of the village weaver (*Ploceus cucullatus*) at 15.45% observation followed by black-headed weaver (7.5%) and Congo dwarf-clawed frog (*Hymenochirus boettgeri*) (7.4%). African

harrier-hawk is able to change the diet by feeding on fruits and pods of some plant species with the fruits of oil palm (*Elaeis guineensis*) and African pear (*Dacryodes edulis*) most encountered (Table 2).

Table 1, Small mammals and insects consumed by (*Polyboroides typus*) in Ehor Forest Reserve

Common Name	Scientific Name	Family	Parts consumed	Observations (%)
African Green Pigeon	<i>Treron calva</i>	Columbidae	Eggs	2.5
Hammerkop	<i>Scopus umbretta</i>	Scopidae	Eggs	1.1
African Palm Swift	<i>Cypsiurus parvus</i>	Apodidae	Eggs	0.6
Red-eyed Dove	<i>Streptopelia semitorquata</i>	Columbidae	Eggs/Adults	4.6
Blue-spotted Wood Dove	<i>Turtur brehmeri</i>	Columbidae	Eggs/Adults	0.4
African Pied Hornbill	<i>Tockus fasciatus</i>	Bucerotidae	Eggs	0.7
Common Bulbul	<i>Pycnonotus barbatus</i>	Pycnonotidae	Eggs/Nestling	0.6
Black-headed Weaver	<i>Ploceus melanocephalus</i>	Ploceidae	Eggs, Nestling /Adults	7.5
Village Weaver	<i>Ploceus cucullatus</i>	Ploceidae	Eggs Nestling/Adults	15.45
Fanti Saw Wing	<i>Psalidoprocne obscura</i>	Hirundinidae	Eggs/Nestling	0.9
Fork-tailed Drongo	<i>Dicrurus atripennis</i>	Dicruridae	Eggs	0.8
Grey-headed Sparrow	<i>Passer griseus</i>	Passeridae	Eggs/Adults	0.2
Black Neck Weaver	<i>Ploceus nigricollis</i>	Ploceidae	Eggs/ Nestling/Adults	4.0
Fire-tailed Alethe	<i>Alethe castanea</i>	Turdidae	Eggs	0.2
Little Greenbul	<i>Andropadus virens</i>	Pycnonotidae	Eggs	0.2
Bush Petronia	<i>Petronia dentate</i>	Dicruridae	Eggs/Nestling/	0.8
White-throated Bee Eater	<i>Merops albicollis</i>	Meropidae	Adults	0.3
African Thrush	<i>Turdus pelios</i>	Turdidae	Eggs/Nestling	0.5
Laughing Dove	<i>Streptopelia capicola</i>	Columbidae	Eggs/Nestling	2.1
Cameroon Water Frog	<i>Petropedetes cameronensis</i>	Petropedetidae	Visceral organs	4.7
African Tree Toad	<i>Nectophryne afra</i>	Bufoidea	Visceral organs	0.8
Congo Dwarf-clawed Frog	<i>Hymenochirus boettgeri</i>	Arthroleptidae	Visceral organs	7.4
Cameroon Slippery Frog	<i>Conraua robusta</i>	Leptopelinae	Visceral organs	0.3
Pale Running Frog	<i>Kassina fusca</i>	Astylosterninae	Whole	0.2
Efulen Forest Tree Frog	<i>Leptopelis boulenger</i>	Astylosterninae	Whole	0.2
Riggenbach's Reed Frog	<i>Trichobatrachus robustus</i>	Arthroleptidae	Visceral organs	4.8
Common Basilisk	<i>Holaspis guentheri</i>	Lacertidae	Visceral organs	0.9
Guinea Fringe-fingered Lizard	<i>Acanthodactylus guineensis</i>	Lacertidae	Visceral organs	1.9
West African Rainbow Lizard	<i>Agama africana</i>	Lacertidae	Visceral organs	0.1
Ground Agama	<i>Agama aculeate</i>	Agamidae	Visceral organs	0.3
Butter Fly	<i>Latastia longicauda</i> Reuss	Pieridae	Adult Winged	2.2
Grasshoppers	<i>Acridium perigrinum</i>	Acrididae	Adult Winged	0.8
Grasshoppers	<i>Cyrtacanthacris aeruginosa unicolor</i>	Acrididae	Adult Winged	1.0
Grasshoppers	<i>Schistocerca gregaria</i>	Acrididae	Adult Winged	2.3
Grasshoppers	<i>Zonocerus variegatus</i>	Pyrgomorphidae	Whole	1.2
Termite	<i>Macrotermes bellicosus</i>	Termitidae	Whole	3.3
Beetles	<i>Oryctes boas</i>	Scarabaeid	Whole	0.6
Beetles	<i>Analeptes trifasciata</i>	Scarabacidae	Adult Winged	0.6
Beetles	<i>Blaps sp.</i>	Tenebrionidae	Adult Winged	0.4
Weevils	<i>Rhychophorus phoenic</i>	Curculionidae	Larva	2.1
Dragon fly	<i>Nezera viridula</i>	Pentatomidae	Larva	3.1
Caterpillars	<i>Anapha venata</i>	Notodontidae	Whole	0.7
Caterpillars	<i>Anaphe reticulata</i>	Notodontidae	Whole	1.2
Caterpillars	<i>Anaphe infracta</i>	Notodontidae	Whole	0.4
Moths	<i>Phragmataecia fuscifusa</i>	Cossidae	Whole	0.3

Moths	<i>Tanyterys pryeri</i>	Petalurdae	Adult Winged	0.7
Black ants	<i>Campinotus pinnilucnicus</i>	Formicidae	Adult Winged	0.6
Termite	<i>Macrotermes natalensis</i>	Termitidae	Adult Winged	0.7

The Shalom diversity index of the small animals and plant species consumed is shown in Table 3. African harrier-hawk consumed 48 food items of small animals and insects and 20 plant species (Fig 2). It was observed that *Polyboroides typus* utilizes the three

compartments within the study area. The percentage of utilization of habitat type was highest in the logged area (48.9 %) while mature forest and farmland compartments accounted for 32.2 and 18.9% respectively (Fig.3)

Table 2: Fruits of some plant species consumed by *Polyboroides typus* in the study area

Common Names	Scientific Names	Parts Eaten	Observations %
Asin	<i>Baphia nitida</i>	Fruits	0.1
Apaja	<i>Canthium hispidum</i>	Fruits	0.3
African pear	<i>Dacryodes edulis</i>	Fruits	2.4
Oil palm	<i>Elaeis guineensis</i>	Fruits	6.8
Ekú or Achi	<i>Brachystegia eurycoma</i>	Fresh Pods	1.2
Cabbage palm	<i>Anthocleista nobilis</i>	Fruits	0.6
Camwood	<i>Pterocarpus osun</i>	Fruits	0.5
Velvet Tamarind	<i>Dalium guineense</i>	Fruits	0.4
Sandpaper tree	<i>Ficus exasprata</i>	Fruits	0.2
Hog plum	<i>Spondias mombin</i>	Fruits	0.25

Table 3: Diversity of bird species in the study area during the dry season

Diversity index	Small animals	Plant species
Taxa_S	48	20
Individuals	66	18
Dominance_D	0.07	0.17
Shannon_H	3.215	2.213
Evenness_e ^{H/S}	0.5188	0.4572
Menhinick	5.133	3.961

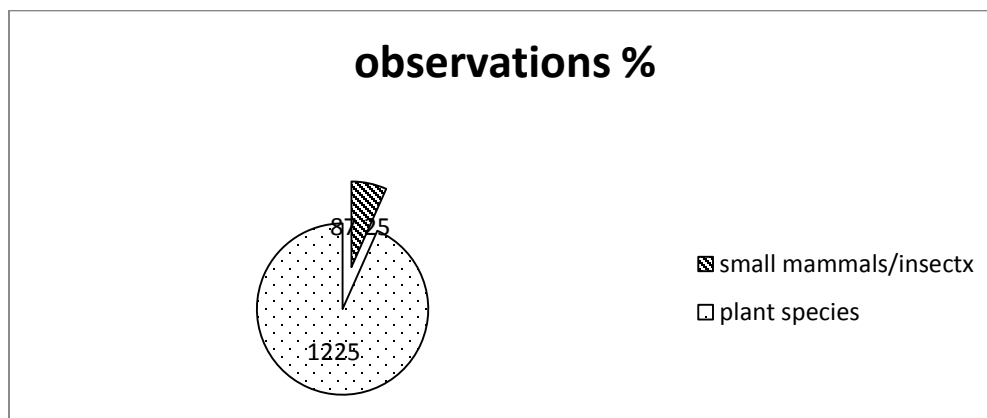


Fig. 2: Composition of the food of *Polyboroides typus* in the study area

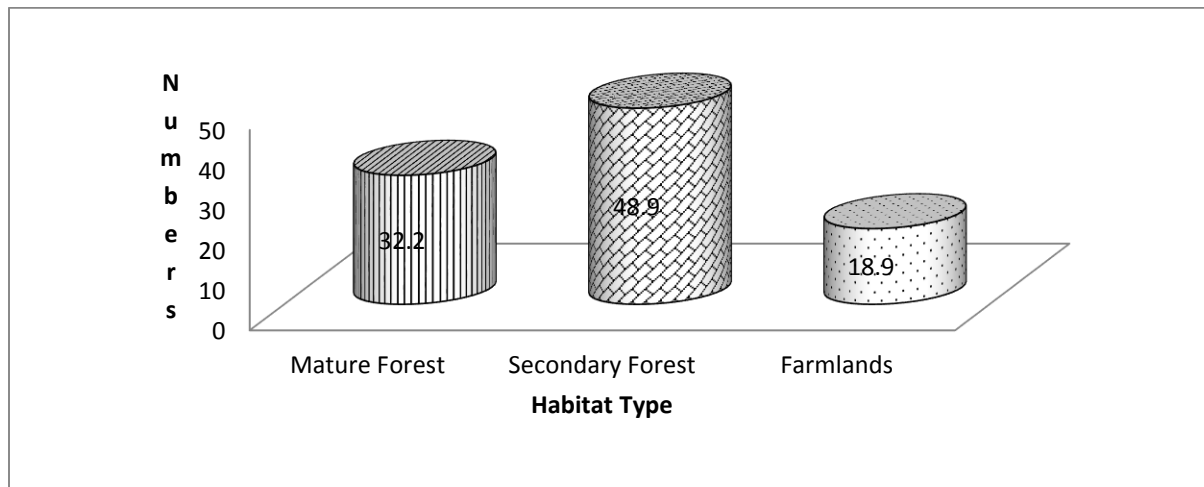


Fig. 3: Percentage of utilization of habitat types in Ehor Forest Reserve

Discussion

From a general dietary perspective, African harrier-hawk (*Polyboroides typus*) was less frugivorous but fed on a number of birds species, frogs, lizards than fruits of plant species. This is consistent with reports from various studies. Greenlaw (2007) had reported that *Polyboroides typus* consumed amphibians, reptiles, adults and eggs of bird species insects and fruits of *Elaeis guineensis* in South Africa. Smeenk *et al.* (2001) observed that avian predators usually prey on small mammals such as rats or ground squirrel, insects such as the Common kestrel. Do - Hockey *et al.* (2000) reported that African harrier-hawk consumed mainly birds and their eggs, amphibian's reptiles using a wide variety of foraging techniques. In this study, the adults, eggs and nestlings of bird species belonging to family Ploceidae constituted the major diet of *Polyboroides typus* in the study area. Brosset (2008) noted that African Harrier Hawk sometimes raids nestlings and colonies of birds, especially ploceid weavers, taking the eggs and nestlings. Thurow and Black (2011) made similar observation that *Polyboroides typus* specializes by using its long legs to extract food from crevices and cavities, such as in the tree canopy or the ground, often stealing eggs and chicks from weaver nests or the more easily accessible nests of other birds without entrance

tunnels. It was observed that the bird switched the diet to take supplements from fruits and pods of some plant species and this occurred mainly during the dry season which is not the time for breeding. This agrees with Simmons, (2000) that *Polyboroides typus* is a general predator that partly adds fruits to its diet such as large insects, especially locusts, fish, reptiles (snakes and lizards). Thiollay (2001) reported that African harrier-hawk is occasional fruit-eating are widespread among tropical forest raptors, even among aerial hunters such as *Elanoides forficatus*. For some of them, palm fruits are regular diet such as the *Polyboroides typus* or even staple food (*Gypohierax angolensis*).

During the study, it was observed that *Polyboroides typus* starts daily activities at 6.15 hours in the morning and ends at 18.00 hours. During field encounters, it was observed that the bird fed on some insects in flight, picked up of eggs and nestlings of hornbills in crevices of tree trunks, fed on eggs on bird species with open nests and sometimes dived to catch lizards on tree branches. During the dry season, the birds were encountered catching frogs on the dry floors of the river bed. It sometimes tore up nests of weaver birds and Hammerkop before feeding on their eggs and nestling. These field

observations agree with work of several authors. Black and Ross (2005) observed that *Polyboroides typus* specializes in using its long legs to extract food from crevices and cavities such as in the tree canopy or the ground, often stealing eggs and chicks from weaver nests or the more easily accessible nests of other birds without entrance tunnels. It also hunts by soaring high in the sky and rapidly descending once it has spotted prey, sometimes scavenging for road kills and raiding nests in suburban gardens. Fontaine (2010) reported that *Polyboroides typus* specializes in using its long legs to extract food from crevices and cavities, such as in the tree canopy or the ground, often stealing eggs and chicks from weaver nests, or the more easily accessible nests of other birds (without entrance tunnels). It also hunts by soaring high in the sky and rapidly descending once it has spotted prey, sometimes scavenging for road kills and raiding nests in suburban gardens. Brown (1972) reported that the most unusual behavior of African harrier-hawk is that it blushes. Most raptors have feathered faces but the face of African harrier-hawk is unfeathered which assist it in probing into holes for food. Unexpected disturbances such as a branch snapping can trigger the face (normally pale yellow) to blush a deep red. Encounters between breeding pairs also result in blushing which is believed to represent an appeasement signal, especially during courtship, and switches in incubation duty. Steyn (1999) reported that it is a prey opportunistic feeder, preying upon small mammals, frogs, lizards, and insects which are found by climbing around on tree trunks and limbs, peering into crevices and holes while hanging at odd angles. They further stated that the reversible intertarsal ("knee") joint which can bend backward as well as forward enables the

Conclusion

The results of this study confirm that *Polyboroides typus* consumed frogs, lizards, bird species and fruits of some plant species resources available to them in the study area. By

bird to reach into deep holes to extract the contents for prey that would otherwise be inaccessible, hang under branches and cliffs, balancing with flapping wings, and feeding on anything that it comes across. Hockey *et al.* (2005) reported that the bird hunts by soaring high in the sky and rapidly descending once it has spotted prey, sometimes scavenging for road kills and raiding nests in suburban gardens. Encounter which represents the percentage of utilization was higher in the secondary forest compartment than the mature forest and farmlands within the forest reserve. This can be linked to preferred food availability or ecological requirements of the bird as well as the faunal component of the diet. Brown and Amadon (2012) had reported that the African harrier-hawk frequents a variety of landscapes throughout its range in Central and Southern Africa, including forest, woodland and savannah, and most often found at the top of tall trees fringing the larger rivers or in hilly country where there are deep ravines and steep hillsides.

This study revealed a positive relationship between percentage ground cover to the food items consumed by African Harrier Hawk recorded in the study area. *Polyboroides typus* were observed to pick up its food items from the ground majorly and sometimes branches of trees. Figure 5 These birds were found during the survey on the bare ground feeding on the frogs, lizards and insects. Thus, habitat has long been used as a predictor of bird species abundance, and each variety of birds has developed different preferences for habitat (Huston, 1994). Birds select vegetation variables according to the manner by which an individual habitat affects access to food, mates or its vulnerability to predators (Manu, 2000)

comparison, the adults, eggs and nestlings of birds, frogs, lizards and insects are consumed in larger proportions than plant parts (fruits). Thus, *Polyboroides typus* can help suppress the

population of insects, frogs, lizard and bird species to maintain the carrying capacity in the ecosystem. The feeding habit makes *Polyboroides typus* a useful species for farmers

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