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A Preliminary assessment and diversity of birds in Ramagiri east and west forest, Ananthapuram District, Andhra Pradesh, India

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Abstract
In view of a possible bird and wind turbine interactions like a direct contact with revolving blades, towers, nacelles, and associated power lines and meteorological masts, Forest advisor Committee of the Ministry of Environment, Forests & Climate change, Government of India, recommended a bird study as part of listing out the avian fauna in the areas of their proposed Wind power projects. The present avian study report was submitted as per the guidelines issued by GOI, MoEF& CC, New Delhi, vide F.No.8-47/2008-FC dt16th March, 2008, conducted in Ramagiri East and West reserve forests. It is located in Ananthapuram district of Andhra Pradesh, A complete avian survey was conducted between October 2015 to September 2016in and around the study area spreadover55.73 hectares of mosaic microhabitats categorized into Acacia forest (AF), *Euphorbia-Salvadora* forest (ES), Mixed thorn forest (MTF) and *Prosopis* forest (PF).The survey carried out in the study area has identified the presence of 119 avian species belonging to51 families. Among identified 119 species of birds, 98species are resident species, 19are winter migrants and 2 species summer migrants. A comparative study of these populations of each species across different habitats was carried out of which mixed thorn habitat has recorded the highest species count of 45 followed by 28 species by Acacia habitat, 26 species by *Euphorbia Salvadora* habitat and 20 species by *Prosopis* dominant habitat. Accipitridae is the most dominant family, consisting of 16 species.

Keywords: avian fauna, windmills, reserve forest, microhabitat, bird diversity

Introduction
The Government of India has decided to ratify the Kyoto Protocol with respect to the containing of Green House Gases emissions (GHG) that result in Climate Change with adverse consequences on food productivity, sea levels, water resources, forests and other eco systems. In this respect, renewable sources of energy offer an opportunity for reducing the deleterious environmental impacts of climate change arising from an over-reliance on the traditional / conventional fossil fuels. Of the most advanced renewable technologies, wind energy is set to make a modest contribution towards augmenting green-energy production in India. Forest advisor Committee of the Ministry of Environment, Forests & Climate change, Government of India, has recommended bird study as part of listing out the avian fauna in the areas of their proposed Wind power projects. Accordingly, the user agency has assigned us a project with a view to listing out the available avian fauna as part of assessing the impact of windmills on post wind-power establishments. The user agency has proposed to establish 28 windmills for generating40MW power spread over 55.73 hectares. India harbors 10% of the world's flora and fauna on only 2.4% of the landmass of the world [1]. The Indian subcontinent supports a rich avian diversity in that it is a habitat to 1,300 species [2]. Ornithological surveys carried out in the past include Ali's (1933–34) [3] survey in Hyderabad State, followed by Abdulali (1945) and Ripley *et al.* (1987–88) [4, 5] in Visakhapatnam District while recent works aviafauna of united Andhra Pradesh include [6-12]. No earlier studies on wildlife exist in this region. Present studies provide up-to-date documented information with respect to avian fauna and their habitat utilization pattern as part of baseline information for future conservation programmes, and impact assessment on wildlife in post windmill establishments. Besides, avian studies also focus on anthropogenic threats associated with the ecological degradation of the study area besides offering suggestions regarding their habitat conservation. The topography of the project site is gently undulating in the approaches to steeply raising to the hill tops in the Eastern and Western directions. The geological formation in these RFs comprises older Archaean group of rocks, which includes Schist's, Gneisses, and Granites. The Archaean rocks have suffered considerable geological disturbances as a result of which they have become metamorphosed and recrystallized. The total geographical area of the district, including hills and ridges covers 14 percent; undulating lands 27 percent; gently sloping lands and very gently sloping plains over 54 percent; and valleys cover 5 percent [13]. Champion and Seth (1968) [14] have classified these forests as 6A/C1 Southern Tropical Thorn Forests. The top canopy comprises species like *Albizia amara, Chloroxylon sweitenia, Feronia limonia, Canthium didymum, Wrightia tinctoria* etc; Middle canopy comprises *Cassia fistula, Bauhinia racemosa, Acacia Arabica, Acacia sundra, Dichrostachys cinerea, Dolichandrone falcata, Cassia caranduse*tc; *Shrubs comprises Randia dumetorum, Gymnosporia montana, Gmelina asiatica, Ziziphus nummularia, Ixora arborea, Cadaba fruticosa, Cassia auriculata., Euphorbia antiquorum, Acacia ferruginea., Acacia planifrons., Acacia torta., Acacia horrida., Ziziphus glabrata., Scutia myrtina., Rhus mysorensis., Canthium coromandelianum., Capparis sp., Senna alexandrina*; Grasses that represent are *Sympopogancollaratus, Heteropogon contortus, Panicum repens, Cynodon dactylon* etc.

Table1: Comparative statement of Land use and land cover (LULC) changes from 1995-2016.

	1995		2016	
LULC pattern	**Area in Sq /km**	**Area in %**	**Area in Sq/km**	**Area in %**
Water bodies	3.88	1.75	3.88	1.75
Settlement	0.93	0.42	0.93	0.42
Scrub land	73.42	33.03	36.53	16.43
Forest land	20.58	9.25	20.58	9.25
Agriculture land	123.5	55.55	160.39	72.15
TOTAL	222.31	100%	222.31	100%

Ramagiri East Reserve forest extends up to1405.45 Ha, while West region of Ramagirito832.58, encompassing forestland (9.25%) agriculture land (72.15%), scrub land (16.43%), water bodies (1.75%).The soil is red sandy ferruginous loam and shallow in depth. The forest areas are exposed to heavy grazing and annual fires. The surface is devoid of any humus, while the depth of soil decreases as it approaches the hill slopes where it tends to be loose, with boulder around. It is often gravelly and is occasionally mixed with boulders of varying sizes. District experiences extremes of weather conditions with winter starting from mid-November to the end of February with a minimum temperature of 18°C from December to February and summer from March toJune with a maximum temperature fluctuating from 39-43°C. The geographical location of Ananthapuram District is such that it does not get the full benefit of either of the monsoons. The south-west monsoon is cut off by the Western Ghats, while the full benefit of the north-east monsoon is not derived either, as the district lies far off from the eastern coastline. The district is in the rain shadow area with the normal annual rainfall being 553 mm, which is highly erratic leading to protracted droughts, a very common phenomenon. Mean Wind speed for about a 5-year study is 5.39 (m/s) [15]. Dry land farming (arid agro ecosystem), is the major agricultural practice noticed in the surrounding landscapes of the study area. Bengal gram, groundnut, and paddy are the major crops grown. Prior to an intensive survey, preliminary observations of the study area revealed that the reserve forest was composed of heterogeneous habitats, sub-classified into five micro habitat categories Viz., Acacia forest (AF); *Euphorbia-Salvadora* forest (ES);Mixed thorn forest (MTF); and *Prosopis* forest (PF). Efforts aimed at the conservation of this forest need to take into account these micro habits. Keeping all these aspects in view, this study was designed to document the bird diversity and distribution. The present study area is composed of two Reserve forests-East and west separated by an aerial distance of 16 Kms (Figure 1). Forest type is Southern thorn forest characterized by the presence of dominant vegetation of *Acacia spp*., *Euphorbia spp.* and *Prosopis spp.* etc.

Materials and Methods

Study Area

Ramagiri (E&W) RFs, located in Ramagiri Mandal (Tahsil) of Ananthapuramu District, lie between latitude 14.420435 N to 14.295066 N and Longitude 77.587573 E to 77.466489 E. The maximum elevation of Ramagiri (E) RF is 702Mts above the MSL, while that of Ramagiri (W) RF 694Mts above the MSL. The area is characterized by a broken chain of rugged hills [16]. Location map of the study area is given in Figure 1.

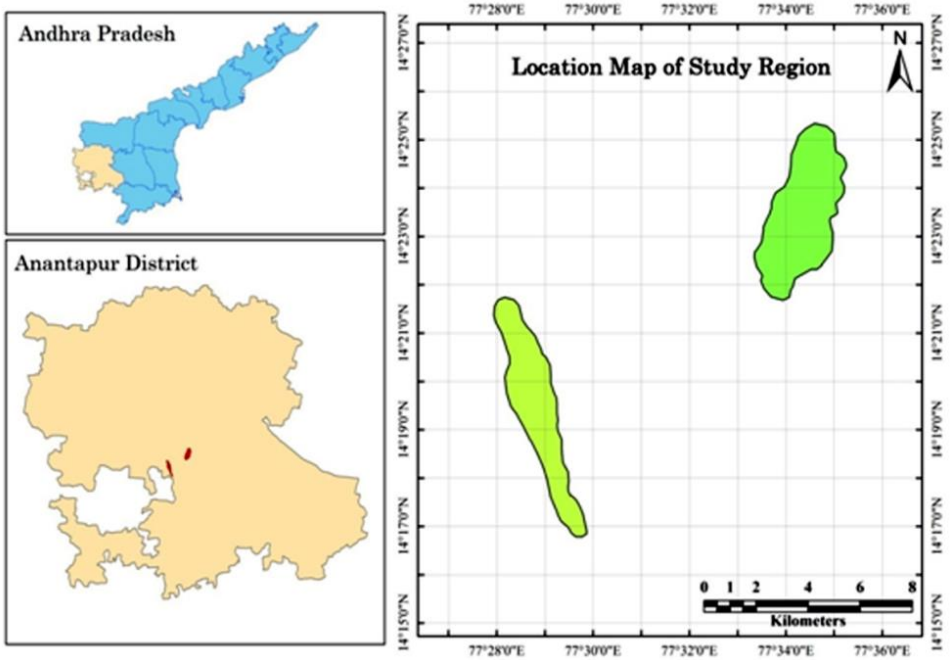

Fig 1: Location map of the Study area

Methodology

Comprehensive avian surveys were conducted in the study area for one year from October 2015 to September 2016 by employing the following standard methods *i.e.* 1) Line-transect method; and 2) Point count method.

Line-transect method: In this method, a straight line of 1 km is drawn, and all birds heard or seen up to a range of 25 m on either side of transect are recorded.

Point count method: In this method, the observer will stand in a haphazardly chosen point and record bird species seen and heard in a 50 m radius for 5 minutes. This observation is repeated in another point at least 300 m off from the first point. In addition to this, opportunistic bird sightings were made, while traveling within the study region [17 – 20]. Survey and observations were made twice a day when avifauna was usually most active (05:00 am to 10 am and 03:00 pm to 06:00 pm). Birds were observed with the help of an Olympus Binocular (8X42) and photographs taken using a Canon EOS 700DSLRcamera. Sometimes, birds were identified by listening to bird calls. Identification of birds was done by using standard field guides [21-23]. Birds were also grouped into trophic guilds as insectivores(I); nectarivores (N); omnivores (O); scavengers (S); frugivores (F); carnivores (C); piscivores (P); and granivores (G) based on descriptions provided by Wills (1979) [24].

Results

A total of 107 bird species belonging to 51 families (Figure 2) were recorded across various micro habitats of the study area**.** Detailed checklist of avian fauna of study area is given in Table 2. With 45 species mixed thorn habitat recording highest species count of 45 followed by 28 species by Acacia habitat, 26 species by *Euphorbia-Salvadora* habitat and 20 species by *Prosopis* dominant habitat (Table 3 & Figure 3).

Table 2: Checklist of Avian fauna with their feeding habits

S. No	Scientific Name	Common Name	Family	Description of feeding habits
1.	*Circus macrourus*	Pallid harrier	Accipitridae	Small mammals, birds and large insects. Take advantage of demographic.
2.	*Circus pygargus*	Montagu's harrier	Accipitridae	Small ground birds, including many of their young in breeding season; small mammals, mainly voles,
3.	*Pernis ptilorhynchus*	Oriental honey buzzard	Accipitridae	Mainly social bees and wasps, in particular their larvae, also eating bits of comb and honey; feeds on nests in tree-holes.
4.	*Circus aeruginosus*	Eurasian marsh harrier	Accipitridae	Great opportunist lacks specialization; very wide range of prey, varying with local availability. Prefers small- or medium-sized birds.
5.	*Acrocephalus stentoreus*	Clamorous reed warbler	Acrocephalidae	Mainly insects. Recorded items include dragonflies and damselflies (Odonata), mayflies (Ephemeroptera), stoneflies (Plecoptera).
6.	*Acrocephalus dumetorum*	Blyth's reed warbler	Acrocephalidae	Diet includes following items: mayflies (Ephemeroptera), dragonflies (Odonata: Agriidae), stoneflies (Plecoptera), orthopterans, larval.
7.	*Iduna rama*	Sykes's warbler	Acrocephalidae	Mainly insects and spiders (Araneae); caterpillars taken in summer.
8.	*Aegithina tiphia*	Common iora	Aegithinidae	Insects and other arthropods; rumoured to take small fruits, but this unconfirmed. Recorded preying on a bush frog
9.	*Aegithina nigrolutea*	Marshall's iora	Aegithinidae	Diet arthropods, including insect imagines and larvae. Hunts alone or in pairs
10.	*Eremopterix griseus*	Ashy crowned sparrow lark	Alaudidae	Die include seeds, e.g. of grasses and forbs Chenopodiaceae), and insects, e.g. small beetles (Coleoptera).
11.	*Ammomanes phoenicura*	Rufous tailed lark	Alaudidae	Die include seeds, e.g. of grasses and forbs Chenopodiaceae), and insects, e.g. small beetles (Coleoptera).
12.	*Mirafra erythroptera*	Indian bushlark	Alaudidae	Die include seeds, e.g. of grasses and forbs Chenopodiaceae), and insects, e.g. small beetles (Coleoptera).
13.	*Galerida deva*	Sykes's lark	Alaudidae	seeds and invertebrates
14.	*Alcedo atthis*	Common kingfisher	Alcedinidae	Fish the main prey and also include minnows (*Phoxinus*), sticklebacks (*Gasterosteus*), bullhead (*Cottus*)
15.	*Anas poecilorhyncha*	Indian spot-billed duck	Anatidae	vegetarian diet; seed; occasionally water insects
16.	*Cypsiurus balasiensis*	Asian palm swift	Apodidae	Insectivorous habit feeds on Hemiptera, Coleoptera and Hymenoptera recorded
17.	*Apus nipalensis*	House swift	Apodidae	Insectivorous
18.	*Ardeola grayii*	Indian pond heron	Ardeidae	Small Fish including *Barilius*, *Nemacheilus* and *Ophiocephalus*), frogs (*Rana*), tadpoles, crabs
19.	*Egretta garzetta*	Little egret	Ardeidae	Mainly insects (e.g. Tabanidae, Calliphoridae, beetles, caterpillars, dragonflies, mayflies, ticks, cicadas), locusts, grasshoppers
20.	*Bubulcus ibis*	Cattle egret	Ardeidae	Feeds on insects (e.g. Tabanidae, Calliphoridae, beetles, caterpillars, dragonflies, mayflies, ticks, cicadas), locusts, grasshoppers
21.	*Pericrocotus speciosus*	Scarlet minivet	Campephagidae	Eats mainly insects, including caterpillars (Lepidoptera), grasshoppers and green crickets (Orthoptera) and cicadas (Cicadidae)
22.	*Pericrocotus cinnamomeus*	Small minivet	Campephagidae	Takes moths and caterpillars (Lepidoptera) and other insects, including beetles (Coleoptera) and cicadas (Cicadidae).
23.	*Coracina melanoptera*	Black-headed cuckooshrike	Campephagidae	Food mostly insects, especially caterpillars (Lepidoptera); also takes fruit such as *Lantana* berries and figs (*Ficus*)
24.	*Caprimulgus asiaticus*	Indian night jar	Caprimulgidae	Diet includes moths, dung beetles, grasshoppers, crickets and bugs. During non-breeding season, also takes flowers of *Euphorbia*

25.	*Caprimulgus atripennis*	Jerdon's nightjar	Caprimulgidae	Feeds on insects, especially beetles, moths and termites
26.	*Ceryle rudis*	Pied kingfisher	Cerylidae	Largely feeds on fish
27.	*Vanellus indicus*	Red wattled lapwing	Charadriidae	Beetles and other insects, including ants, butterfly and fly larvae, grasshoppers, crickets, bugs, earwigs and termites; also molluscs
28.	*Vanellus malabaricus*	Yellow wattled lapwing	Charadriidae	Beetles and other insects, including ants, butterfly and fly larvae, grasshoppers, crickets, bugs, earwigs and termites; and molluscs.
29.	*Ciconia nigra*	Black stork	Ciconiidae	Mostly fish, such as loaches (*Misgurnus*) and pike (*Esox lucius*); also amphibia, insects, snails, crabs and small reptiles
30.	*Ciconia episcopus*	Wooly necked stork	Ciconiidae	Fish, frogs, toads, snakes, lizards, large insects, crabs, reptiles, molluscs, marine invertebrates; fibres of palm nut.
31.	*Orthotomus sutorius*	Common tailor bird	Cisticolidae	ood almost entirely tiny invertebrates, chiefly insects, including small beetles (tenebrionid and curculionid species), bugs (Hemiptera)
32.	*Prinia buchanani*	Rufous fronted prinia	Cisticolidae	Food small invertebrates, chiefly insects and their larvae, gleaned from leaves and on ground.
33.	*Prinia hodgsonii*	Grey breasted prinia	Cisticolidae	Food basically insects, including small beetles (Coleoptera), small moths and caterpillars (Lepidoptera) and grasshoppers (Orthoptera).
34.	*Prinia socialis*	Ashy prinia	Cisticolidae	mall invertebrates, chiefly insects and their larvae, and small spiders (Araneae); believed also to take flower nectar.
35.	*Prinia inornata*	Plain prinia	Cisticolidae	Chiefly insects and their larvae; recorded items include small flies (Diptera), grasshoppers.
36.	*Spilopelia senegalensis*	Laughing dove	Columbidae	Seeds less than 2 mm in length comprise most of diet, but species also takes entire sunflower seeds or grains of maize; also eats fruits.
37.	*Streptopelia decaocto*	Eurasian collared dove	Columbidae	Takes seed, cereal grain, fruits of herbs and grasses and some green parts of plants; 30 food plants have been identified.
38.	*Streptopelia tranquebarica*	Red collared dove	Columbidae	Feeds on seeds of grasses and herbs, as well as cultivated seeds, including rice and maize, buds and young leaves. Most if not all food.
39.	*Columba livia*	Blue rock pigeon	Columbidae	Studies reveal that birds feed typically on grains, such as *Triticum*, *Hordeum* and *Avena*; legumes.
40.	*Coracias benghalensis*	Indian roller	Coraciidae	Large arthropods and small vertebrates: grasshoppers, crickets, earwigs, mantises, bugs, termites, beetles, moths, wasps, ants, and larvae.
41.	*Dendrocitta vagabunda*	Rufous treepie	Corvidae	Omnivorous, but primarily carnivorous. Recorded items include large variety of insects and their larvae, such as crickets and grasshoppers.
42.	*Corvus macrorhynchos*	Long-billed crow	Corvidae	Generally omnivorous, diet also includes various fruits and berries.
43.	*Phaenicophaeus viridirostris*	Blue faced malkoha	Cuculidae	An insect, caterpillars, grasshoppers, mantids, cicadas, beetles; also lizards, fruit. Spends time in branches and thickets.
44.	*Centropus sinensis*	Greater coucal	Cuculidae	Small mammals (mice, hedgehog), lizards, snakes, frogs; insects (caterpillars, grasshoppers, katydids, beetles, larvae of rhinoceros.
45.	*Taccocua leschenaultii*	Sirkeer malkoha	Cuculidae	Large insects, grasshoppers, mantids, caterpillars, termites, also lizards, berries, fruits.
46.	*Clamator jacobinus*	Jacobin cuckoo	Cuculidae	Insects, mainly hairy caterpillars, also grasshoppers, mantids, termites; forest snails; eggs of host birds; berries. Feeds mainly in trees.
47.	*Eudynamys scolopaceus*	Asian koel	Cuculidae	Fruits, including figs (*Ficus*), berries of *Morus*, *Zizyphus*, papaya (*Carica papaya*) and other fruiting plants.
48.	*Dicrurus macrocercus*	Black drongo	Dicruridae	Food predominantly insects (often agricultural pests), including locusts, grasshoppers and crickets (Orthoptera), beetles (Coleoptera).
49.	*Emberiza buchanani*	Grey-necked bunting	Emberizidae	Wide variety of seeds, and shoots of dry-country plants, including those of bistorts (*Polygonum*), spurge (*Euphorbia*)
50.	*Lonchura malabarica*	Indian silverbill	Estrildidae	Grass seeds, also seeds of sedges (Cyperaceae), rice and cultivated millet when available; also small insects, and nectar of *Erythrina.*
51.	*Lonchura punctulata*	Scaly breasted munia	Estrildidae	Seeding grasses (including rice at milky stages, *Cynodon*, *Panicum auritum*, *Digitaria marginata*, *Pennisetum.*
52.	*Amandava amandava*	Red avadavat	Estrildidae	Small grass seeds; occasionally insects, including termites (Isoptera). Clings to stems to take ripening grass seeds; takes ripe seeds.
53.	*Falco tinnunculus*	Common kestrel	Falconidae	Mainly small mammals with some mice and shrews in open-area passerines
54.	*Halcyon smyrnensis*	White breasted kingfisher	Halcyonidae	Wide variety of prey recorded. Insects include mole-crickets (*Gryllotalpa*), crickets and grasshoppers (Locustidae, Tettigidae,
55.	*Hirundo rustica*	Barn sparrow	Hirundinidae	Insectivorous

56.	*Cecropis daurica*	Red-rumped swallow	Hirundinidae	Adult diet includes flies (Diptera), beetles (Coleoptera), bugs (Hemiptera), termites (Isoptera), Orthoptera and Hymenoptera.
57.	*Ptyonoprogne concolor*	Dark crag martin	Hirundinidae	Not studied well
58.	*Lanius vittatus*	Bay-backed shrike	Laniidae	lmost exclusively insects, mainly beetles (Coleoptera) and Orthoptera, also Lepidoptera, Neuroptera, flies (Diptera) and Hymenoptera.
59.	*Lanius schach*	Long tailed shrike	Laniidae	Very opportunistic. Wide variety of insects, with preference mostly for larger species and groups, e.g. grasshoppers and crickets.
60.	*Lanius meridionalis*	Southern grey shrike	Laniidae	Diet consists of arthropods (mostly large insects) and small vertebrates (reptiles, small mammals and birds).
61.	*Turdoides caudata*	Common babbler	Leiothrichidae	Wide range of invertebrates, mainly insects, including hymenopterans (ants, wasps, ichneumon flies), beetles (Coleoptera), grasshoppers.
62.	*Turdoides affinis*	Yellow bellied babbler	Leiothrichidae	Insects such as beetles (Coleoptera), grasshoppers (Orthoptera), cicadas (Cicadidae) and other bugs, caterpillars, termites (Isoptera).
63.	*Merops orientalis*	Green bee eater	Meropidae	Feeds mainly on Hymenoptera, also beetles, termites, bugs, moths and many flies, ranging in size from fruit-flies (*Drosophila*).
64.	*Terpsiphone paradisi*	Asian paradise flycatcher	Monarchidae	Chiefly small winged insects, such as dipterans, neuropterans, hemipterans, coleopterans, lepidopterans and Odonata; occasionally spiders.
65.	*Anthus campestris*	Twany pipit	Motacillidae	Mainly insects, also other invertebreates, and seeds; rarely, small vertebrates (reptiles). Recorded prey include grasshoppers and locusts.
66.	*Anthus rufulus*	Paddyfield pippit	Motacillidae	Mainly adult and larval insects. Stomach contents included weevils (Curculionidae), ants (Hymenoptera), termites (Isoptera), bugs.
67.	*Motacilla cinerea*	Grey wagtail	Motacillidae	Prey mainly insects, notably fly larvae and adults (Diptera, especially Chironomidae) and nymphal and adult mayflies (Ephemeroptera).
68.	*Motacilla maderaspatensis*	White browed wagtail	Motacillidae	Diet consists of insects, especially small coleopterans (e.g. Tridactylinae), grasshoppers (Orthoptera) and dragonflies (Odonata).
69.	*Anthus hodgsoni*	Olive-backed pipit	Motacillidae	Insects, including adult and larval moths and butterflies (Lepidoptera), flies (Diptera), beetles (Coleoptera) and bugs (Hemiptera).
70.	*Monticola solitarius*	Blue rock thrush	Muscicapidae	nvertebrates, small vertebrates, and fruit. Mainly insects, including grasshoppers, locusts, crickets, mole-crickets, adult and larval.
71.	*Saxicola caprata*	Pied bush chat	Muscicapidae	mall insects and their larvae, including beetles, caterpillars, moths, midges and ants, also earthworms.
72.	*Copsychus saularis*	Oriental magpie robin	Muscicapidae	Mainly insects, notably crickets, beetles (including weevils, scarabs, ladybirds), locustids, ants, firebugs, caterpillars, wasps, termites.
73.	*Phoenicurus ochruros*	Black redstart	Muscicapidae	Invertebrates and berries, switching proportions considerably. Invertebrates in diet include grasshoppers, earwigs, bugs, cockroaches.
74.	*Saxicola maurus*	Siberian stonechat	Muscicapidae	Insects, taken in typical manner in flights to ground from stems of tall grass; also makes aerial sallies.
75.	*Muscicapa dauurica*	Asian brown flycatcher	Muscicapidae	Food not well known; recorded items small invertebrates, including beetles (Coleoptera), stoneflies (Plecoptera), bugs (Hemiptera), wasps.
76.	*Ficedula parva*	Red breasted flycatcher	Muscicapidae	Eats mainly insects and other invertebrates, especially beetles (Coleoptera) and spiders (Araneae), but also dragonflies and damselflies.
77.	*Cinnyris asiaticus*	Purple sunbird	Nectariniidae	Small insects, and spiders (Araneae); nectar, also fruits.
78.	*Leptocoma zeylonica*	Purple-rumped sunbird	Nectariniidae	Insects, including caterpillars, also spiders (Araneae); also nectar and grapes, and fruits of mistletoes (Loranthaceae)
79.	*Passer domesticus*	House sparrow	Passeridae	Mainly vegetable matter, especially seeds of grasses, cultivated cereals and low herbs, but also buds, berries and wide range of household grains.
80.	*Microcarbo niger*	Little cormorant	Phalacrocoracidae	Mainly small freshwater fish; also frogs and tadpoles. Feeds mainly by pursuit-diving. Sometimes fishes.
81.	*Pavo cristatus*	Indian peafowl	Phasianidae	Omnivorous but comprised 91% of intake seeds.
82.	*Francolinus pondicerianus*	Grey fancolin	Phasianidae	Seeds of weeds and cereals, grass and crop shoots, berries and drupes (*Zizyphus jujuba, Z. oenopia, Lantana.*
83.	*Dinopium benghalense*	Black-rumpd flameback	Picidae	Chiefly ants, e.g. *Camponotus* and *Meranoplus*, and including larvae and pupae of the fierce red ant
84.	*Ploceus philippinus*	Baya weaver	Ploceidae	Diet seeds, including those of *Phalaris minor*, *Echinochloa colonum*, *Pennisetum typhoideum*, cultivated rice
85.	*Tachybaptus ruficollis*	Little grebe	Podicipedidae	Mainly insects and larvae, especially mayflies (Ephemeroptera), stoneflies (Plecoptera), various water bugs (Heteroptera), beetles.
86.	*Psittacula krameri*	Rose-ringed parakeet	Psittaculidae	In Africa, recorded fruits include *Ficus*, *Ziziphus*, *Tamarindus*, guavas, dates, mangoes.

87.	*Pterocles Indicus*	Painted sand grouse	Pteroclididae	Seeds, some shoots and apparently termites in certain seasons.
88.	*Pterocles exustus*	Chestnut bellied sand grouse	Pteroclididae	Mainly seeds, which are often hard and very small; shows a possible preference for legumes
89.	*Pycnonotus cafer*	Red vented bulbul	Pycnonotidae	An opportunist and generalist; diet includes fruit, nectar, buds and invertebrates, occasionally vertebrates.
90.	*Pycnonotus luteolus*	White-browed bulbul	Pycnonotidae	Bulk of diet comprises fruit and berries; small amount of invertebrates consumed, including spiders (Araneae) and a range of insects.
91.	*Himantopus himantopus*	Common stilt	Recurvirostridae	Carnivorous, preying on great variety of small, mainly aquatic, invertebrates and vertebrates, occasionally seeds.
92.	*Saxicoloides fulicatus*	Indian robin	Saxicoloides	Insects (including termites, ants, beetles, flies, caterpillars, grasshoppers, bees and wasps) and their eggs, spiders.
93.	*Tringa ochropus*	Green sandpiper	Scolopacidae	Feeds on aquatic and terrestrial insects, mainly adults and larvae of beetles, Diptera and Trichoptera, but also dragonfly larvae, ants.
94.	*Actitis hypoleucos*	Common sandpiper	Scolopacidae	Adult and larval insects (e.g. beetles, Diptera), spiders, molluscs, crustaceans and annelids, sometimes frogs, tadpoles or small fish.
95.	*Bubo bubo*	Eurasian eagle owl	Strigidae	Mostly mammals, from size of water vole (*Arvicola*) to adult hares (*Lepus*), and birds.
96.	*Athene brama*	Spotted owlet	Strigidae	Mainly small insects; also small roosting birds, mice, shrews (Soricidae), geckos (Gekkonidae), toads (Bufonidae).
97.	*Acridotheres tristis*	Common myna	Sturnidae	Open country, avoiding forest; dry open woodland, floodplains, grasslands, cultivated areas.
98.	*Sturnia pagodarum*	Brahminy starling	Sturnidae	Diet insects and other invertebrates, fruit and berries, flowers and nectar. Adults take spiders (Araneae) and snails (Gastropoda).
99.	*Pastor roseus*	Rosy starling	Sturnidae	Insectivorous during breeding season, when diet dominated by locusts and other grasshoppers, and fruits.
100.	*Sylvia curruca*	Lesser white throat	Sylviidae	Mostly insectivorous during breeding season. Studies of stomachs contents revealed some predominance of lepidopteran larvae and beetles.
101.	*Sylvia althaea*	Hume's white throat	Sylviidae	Insectivorous; probably takes some berries. Recorded as feeding nestlings with dipteran flies and lepidopteran larvae.
102.	*Chrysomma sinense*	Yelloy eyed babbler	Sylviidae	Caterpillars,grasshoppers (Orthoptera) and other insects, also spiders (Araneae); also berries (*Lantana, Salvadora persica.*
103.	*Tephrodornis pondicerianus*	Common woodshrike	Tephrodornithidae	Takes insects, chiefly beetles (Coleoptera), adult and larval lepidopterans, and orthopterans (grasshoppers, praying mantises).
104.	*Threskiornis melanocephalus*	Black headed ibis	Threskiornithidae	Diet includes frogs, tadpoles, snails, adults and larvae of insects, and worms; also fish and crustaceans.
105.	*Dumetia hyperythra*	Tawny-bellied warbler	Timaliidae	Mainly insects, in Sri Lanka larvae and minute beetles (Coleoptera) noted; nectar of coral trees (*Erythrina*) and *Salmalia.*
106.	*Turnix suscitator*	Barred button quail	Turnicidae	Grass and weed seeds, invertebrates and green shoots. Terrestrial; forages among grass and leaf-litter.
107.	*Upupa epops*	Eusrasian hoopoe	Upupidae	Mostly larger insects and their soft soil-dwelling larvae and pupae; body size of prey rarely exceeds bill length. Crickets (Gryllidae).

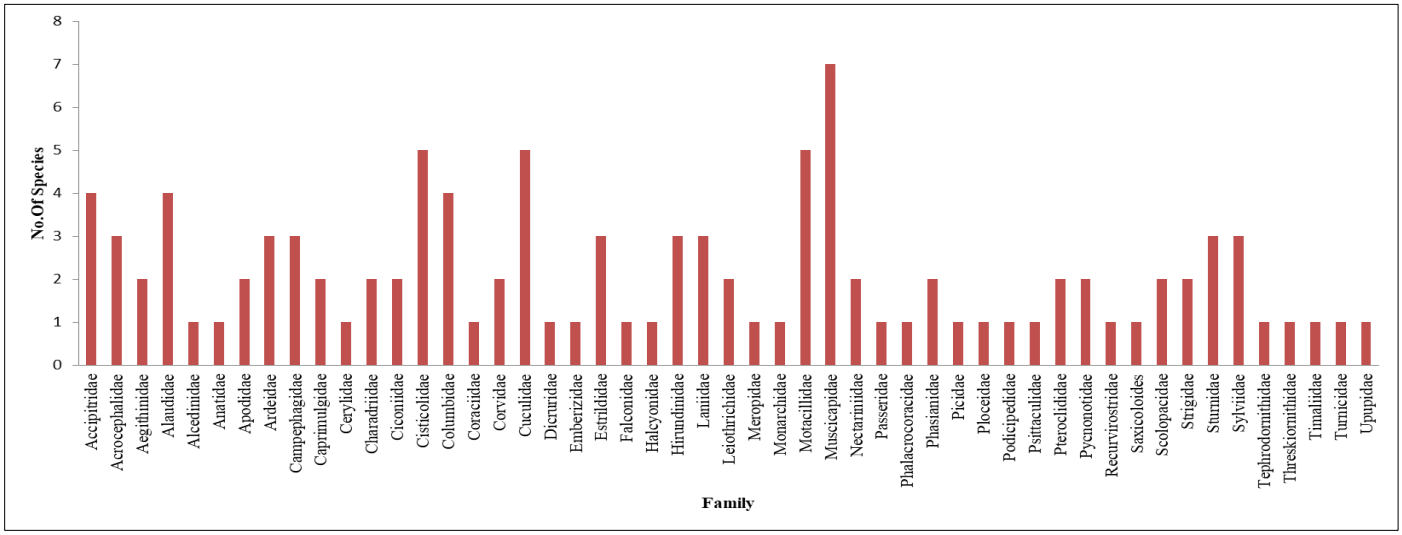

Fig 2: Number of Species in various Families

Table 3: Number of bird species in various habitat types.

Foraging Status	Microhabitats			
	AF	ES	MTH	PF
Carnivore	5	2	5	2
Frugivore	2	2	2	2
Grainivore	7	7	11	4
Insectivore	9	10	21	8
Nectorivore	2	2	3	2
Omnivore	2	2	2	1
Pisivore	1	1	1	1
Total	28	26	45	20

*AF- *Acacia* Forest; ES- *Euphorbia-Salvadora* habitat; MTH- Mixed thorn Habit; PF- *Prosopis* forest

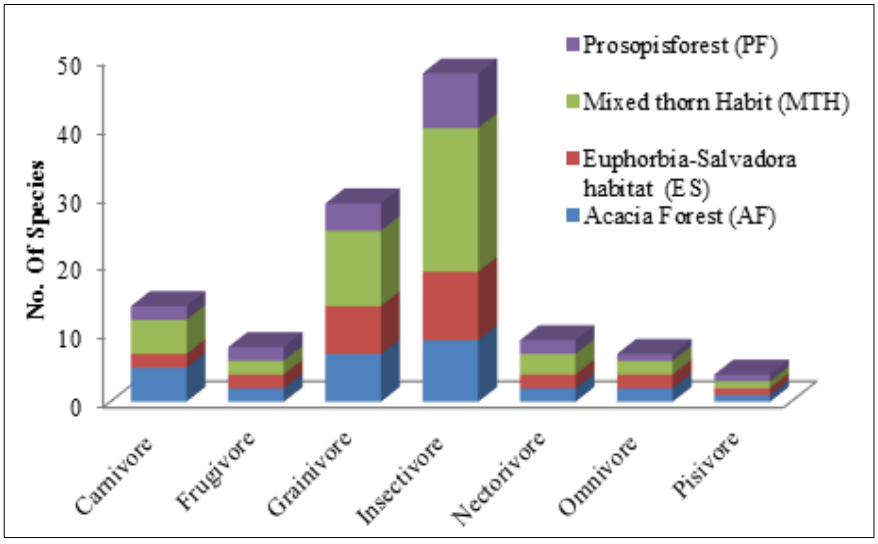

Fig 3: Number of bird species in various habitat types under various feeding guilds.

Accipitridae happens to be the most dominant family consisting of 16 species in the study area followed by Muscicapidae (7 Species), Cistiocolidae, Cuculidae & Motacillidae (5 Species), Columbidae & Alaudidae (4 species)**.** Detailed feeding guilds of birds were studied and documented from the study area and the details have been given in (Table 2). The distribution of recorded birds according to food habits from both the reserve forests shows the maximum number of bird species belonging to insectivorous (78 species) followed by carnivores (22 species) and granivore (21 bird species).

The most abundant species observed across these two forest areas happen to be White herons**,** Greater short-toed Lark, Rufous Treepie, Rosy Starling, House Sparrow, francolins, doves, bee-eaters, robins, larks, prinia, silver bill, bulbuls, warblers Lesser short-toed Lark, Baya Weaver and Indian Bush lark, while the least abundant species include Long-tailed Shrike, Lesser Kestral, Rufous Chat, Palla's Fish-Eagle, Dusky Thrush, Large-billed Leaf-Warbler, Jungle Bush Quail and Eurasian Eagle Owl. While some of the species such as yellow fronted pied woodpecker, spotted creeper were recorded occasionally across the study area. During the study period, some bird species like francolins, doves, bee-eaters, robins, larks, prinia, silver bill, bulbuls and warblers were commonly observed in the study area.

Discussion

Habitat complexity is an important factor governing species richness and habitat selection of birds. Generally, habitats with a complex architecture tend to support more species than habitats with a simple architecture because they provide more resources and opportunities for microhabitat segregation [25]. Thus, there is a likelihood of the presence of more species per unit area, indicating at a positive correlation between biological diversity and structural diversity [26]. While some of the species such as pied tit, yellow fronted pied woodpecker, spotted creeper were recorded occasionally in the study area, Pied tit is a critically endangered species as per IUCN's red list. Studying about feeding habits of birds provides will also be helpful for conservation of avian fauna in a particular (Any Ecosystem) [27]. Appropriate Conservation strategies or measures should be developed for managing the adverse impacts on biodiversity [28]. This present work provides baseline information for future studies in this area and also this study will help to make decisions for conservation and management of avian fauna in this region.

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