Diversity and status of avifauna in Doddabetta hills and surrounding areas of Udhagamandalam, Nilgiris Plateau, Western Ghats, Southern India

Avifaunal diversity is one of the most important biotic components for any type of ecosystem (Dhindsa & Saini 1994). Birds are found from pole to equator almost everywhere in the world and exhibit great diversity by their habitat and geographical conditions. In temperate and tropical forests, bird communities are well studied (Wilson & Comet 1996; Blake 2007). Avian fauna acts as an important bio-indicator (Bilgrami 1995; Centrrbury et al. 2000; Mistry 2008; Slabbekoorn & Ripmeester 2008) that assesses different habitats qualitatively as well as quantitatively. Birdlife recorded worldwide over 10,000 different species of birds. Rapoport (1993), Chen et al. (2011) and Sekercioglu et al. (2012) documented that worldwide decline of avian fauna is due to anthropogenic activities and climatic changes. According to Roy et al. (2012) bird population has declined only because of change in land use patterns. Huges et al. (1997) have reported around sixteen million birds being destroyed annually. India stands at 7th position with 88 threatened bird species over the world (BirdLife International 2010). Generally, organisms do not respond directly to the elevational gradient as such, but to variables correlated with the gradient such as climate or productivity (Terborgh 1977). In addition factors operating at multiple spatial and temporal scales may also influence species diversity. For example local climate, ecotones, competition, habitat structure and heterogeneity play a prominent role in determining species diversity at local level (Terborgh 1977, 1985; Ricklefs & Schluter 1993; Huston 1999; Lomolino 2001). As elevation increases, the availability of resources for birds diminishes reflecting differences in forest stand structure, site productivity, vegetation composition, distribution pattern, secondary biotic interactions and available land area (Able & Noon 1976; McCoy 1990; Rahbek 1995; Sabo 1980; Hofer et al. 1999; Waterhouse et al. 2002). In fact avian community composition and diversity along elevation gradient has not received enough attention in India. Our purpose study is to explore the avifaunal diversity in and around areas of Doddabetta hills of the Upper Nilgiris, Western Ghats.

Review of Literature

Bird community investigations in the higher elevations of the Nilgiris were scarce.

Davison (1883) provided perhaps the earliest and the most comprehensive account of the birds of the Nilgiris, mainly based on his personal observations and bird collections. Cardew (1885) provided observations on some species unrecorded or left doubtful by Davison (1883). Baker & Inglis (1930) provided natural history observations on several Nilgiri birds. Betts (1931) recorded the behaviour and status of bulbuls of the Nilgiris and other birds. Ali (1977) highlighted the affinities of the Nilgiri and Himalayan fauna, including the laughing thrushes. Ornithological exploration in the recent decades focused either on a single species or bird group. For example, Khan (1979) worked on the ecology of the Black-and-Orange Flycatcher *Ficedula nigrorufa*. Islam (1985) investigated the ecology and behavior of the Nilgiri Laughingthrush *Garrulax cachinnans*. Nair (1995) studied the birds in the Nilgiris. Gokula & Vijayan (1996) reported birds of Mudumalai Wildlife Sanctuary. Gokula (1998) studied the bird communities of the thorn and dry deciduous forests of Mudumalai Wildlife Sanctuary in the lower elevations of the Nilgiris. Thirumurthi and Balaji (1999) surveyed raptors in Nilgiris while Vijayan et al. (2000) conducted a preliminary status survey of the Nilgiri Laughingthrush. Zarri et al. (2005) conducted the first intensive ecological investigation on the avifauna of the Nilgiris and reported the patterns of bird community, guild structure and their habitat utilization. Peter et al. (2015) investigated that study on avifaunal diversity and species richness in foothills of Nilgiris. Manikandan & Balasubramanian (2016) studied the bird diversity of a riparian forest (Bhavani River) in the Nilgiri Biosphere Reserve. On this regard the present study is a first attempt to explore the diversity and status of the avifauna in Dodabetta hills in and around area of the Upper Nilgiris region.

Study area

Nilgiris District, which is located in Tamilnadu state. It is elongated in the east - west direction and bounded by $11^0$30'–$11^0$15'N and $76^0$45'–$77^0$00'E. The district is bounded by the states on the west by Kerala, on the north by Karnataka and on the southeast and south by Coimbatore District of Tamilnadu. The total area extent of the district is around 2,551km^2 and is one of the smallest districts in the state. The Nilgiris can be divided into two natural regions: (a) Upper Nilgiris plateau, extending 56km from east to west, 20km from north to south, deeply indented, with an average elevation of 1980m; (b) southeast Wynaad 900m, covered with bamboo forests, and paddy flats (Hockings 1989). Of the numerous stream and rivulets in the study area, most drain into the two principal rivers of the Nilgiris: the Bhavani and the Moyar. Average annual rainfall of the district is 1,920mm.

Since this district is situated at an elevation of 900–2,636 m during summer the climate remains to the maximum of 21–25 ^{0}C and the minimum of 10–12 ^{0}C. During the winter the temperature available to the maximum 16–21 ^{0}C and minimum of 2^{0}C.

Doddabetta hill is the highest mountain in the Nilgiri hill ranges at a height of 2,623m (8,652 ft) in the Nilgiris District of Tamil Nadu. Doddabetta peak along with nearby reserved forest area and hill station of Ooty is the popular tourist attraction of Tamil Nadu. In the Nilgiris plateau Doddabetta is highest peak of the Nilgiris district remarkable for the flattened curve of its summit. Thick woods decorate the hollows of its slopes. Slightly stunted, rhododendron trees, in the midst of thick coarse grass, flowering sub-alpine shrubs and herbs are common sight even very near to the peak. The present study to monitoring the avian status and diversity of avian fauna in the Doddabetta hills containing the different kind of vegetation structure viz., Southern Mountain Wet Temperate Forest hence called as Shola forest, Plantation (Eucalyptus, Wattle), Manmade Ecosystem (Botanical Garden), Agricultural and Human Habitation.

Methods

The study was carried out between June 2013 and May 2016. The line transect method was used, as the habitat of the study area were shola forest, plantations (eucalyptus, wattle, agriculture) and human habitation (Champion & Seth 1968). A total of 25 transects were laid that covered most of the study area. Transect length remained constant (1,000m), but the width varied according to survey area and visibility: in forests, 15m; in agricultural fields, 20m; and in other open fields, 50m. The field surveys were conducted in the morning (between 06.00hr and 10.00hr) and in the evening (from 16.00hr to 19.00hr), when birds were found to be most active. Birds were observed using the Olympus binocular (10X58 DPSI, USA), and photographs were taken with a Cannon EOS D 1200 camera for further identification. Birds were identified by Ali & Ripley (2007) and Grimmett et al. (2011). The data recorded in each survey were kept separate, and later analyzed for relative abundance on the basis of the frequency of sightings, as per MacKinnon and Phillipps (1993): very common (VC) sighted >10 times; common (C) sighted from seven to nine times; uncommon (UC) sighted from three to six times; rare (Ra) sighted once or twice. The residential status of the birds was worked out, and different status categories were used; resident and winter visitor were assigned strictly with reference to the study area on the basis of the presence or absence method (Zarri et al, 2005). Moreover, guild analysis was done based on Joshi (2012). The birds were

grouped into 23 feeding guilds (Table 2). The IUCN Red List categories was also used to compare the local status with the global status as well as population trend was also noted (decreasing, stable, increasing and unknown). Birds' nomenclature was based on Grimmett et al. (2011). During the surveys, other information or threats to birds' conservation were also noted. Bird species richness was estimated by recording the number of bird species observed. The encounter rate was considered as relative abundance and calculated as the number of bird species observed/ distance traveled (km). The relative diversity (RDi) of families was calculated using the following formula (Torre-Cuadros et al. 2007).

$$RDi = \frac{\text{Number of bird species in a family}}{\text{Total number of species}} \times 100$$

Results

The study revealed that a total of 123 species of birds belonging to 36 families and 16 orders were present in the study area (Table 1). Passerine birds are dominated the diversity with 71 species compared to non passerine birds (52 species) (Table 2). The present investigation also revealed that the Muscicapidae family (20 species) dominated the avifauna in this area, followed by Accipitridae (12 species) Turdidae (9 species) Sturnidae (8 species) Phasianidae (5 species) and Columbidae, Motacillidae, Nectariniidae, Ploceidae, Parulidae Ploceidae and Pycnonotidae (4 species each). Moreover, 15 families Apodidae, Caprimulgidae, Ciconiidae, Charadriidae, Dicruridae, Estrildidae, Falconidae, Meropidae, Monarchidae, Pandionidae, Phalacrocoracidae, Rallidae, Sittidae, Upupidae, Zosteropidae were poorly represented in the study area with a single species each (Table 2). The highest RDi value was also recorded for Muscicapidae family (16.26%) and also considerable amount of RDi values were recorded for Accipitridae (11.38%) Turdidae (7.32%) Sturnidae (6.50%) Phasianidae and Hirundinidae (4.07%) respectively (Table 2).

The analysis of data on residential status revealed that out of 123 species, 95 were resident, whereas the remaining 28 Species were winter visitors. The residential status of birds also showed differences in their relative abundance. Further analysis of relative abundance indicated that 22 species were VC (very common), 31 species were C (common), and 36 species were UC (uncommon) and 34 species were Ra (rare). The encounter rate of the species was 8.82 during the surveys.

Feeding guild analysis of the birds species shows that Aerial Insectivore (AI) Grass land insectivore (GLI) (11%), under-storey insectivore (USI) (11%) and arboreal terrestrial

Table 1. Systematic list and status of Birds in Doddabetta Hills, Nilgiri Plateau, Tamil Nadu, India

	Family	Species name	Common English name	IUCN status	IUCN population trend	Residential status	Relative abundance	Feeding guild
1	Accipitridae	*Accipiter virgatus*	Bersa Sparrow Hawk	LC	DC	R	Ra	SC
2		*Ictinaetus malayensis*	Black Eagle	LC	DC	R	Ra	SC
3		*Milvus migrans*	Black Kite	LC	UN	R	C	ATC
4		*Elanus caeruleus*	Black-winged Kite	LC	ST	R	UC	SC
5		*Haliastur indus*	Brahminy Kite	LC	DC	R	UC	ATC
6		*Accipiter trivirgatus*	Crested Goshawk	LC	DC	R	Ra	SC
7		*Spilornis cheela*	Crested Serpent Eagle	LC	ST	R	Ra	SC
8		*Nisaetus cirrhatus*	Crested Hawk Eagle	LC	DC	R	Ra	SC
9		*Buteo buteo*	Common Buzzard	LC	ST	M	Ra	ATC
10		*Lophotriorchis kienerii*	Rufous Bellied Eagle	LC	DC	M	Ra	SC
11		*Accipiter badius*	Shikra	LC	ST	R	Ra	SC
12		*Circaetus gallicus*	Short-toed Snake Eagle	LC	ST	M	Ra	SC
13		*Pernis ptilorhyncus*	*Oriental Honey Buzzard*	LC	ST	R	Ra	ATC
14		*Butastur teesa*	*White-eye Buzzard*	LC	ST	M	Ra	ATC
15	Alcedinidae	*Alcedo atthis*	Small Kingfisher	LC	UN	R	C	WC
16		*Halcyon smyrnensis*	White-throated Kingfisher	LC	IN	R	C	WC
17		*Ceryle rudis*	Pied Kingfisher	LC	UN	R	UC	AC
18	Anatidae	*Anas crecca*	Common Teal	LC	UN	M	Ra	AIGSE
19		*Anas poecilorhyncha*	Indian Spot-billed Duck	LC	DC	M	Ra	APEI
20		*Nettapus coromandelianus*	Cotton-headed Pigmy Goose	LC	ST	M	Ra	APEI
21	Apodidae	*Apus affinis*	Little Swift	LC	IN	R	C	AI
22	Ardeidae	*Bubulcus ibis*	Cattle Egret	LC	IN	M	UC	GLI
23		*Ardeola grayii*	Indian Pond Heron	LC	UN	R	C	GLI
24	Capitonidae	*Megalaima haemacephala*	Coppersmith Barbet	LC	IN	R	Ra	FGIS
25		*Megalaima viridis*	White-Cheeked Barbet	LC	ST	R	C	FGIS

	Family	Species name	Common English name	IUCN status	IUCN population trend	Residential status	Relative abundance	Feeding guild
26	Caprimulgidae	*Caprimulgus asiaticus*	Common Indian Nightjar	LC	ST	R	Ra	USI
27	Ciconiidae	*Ciconia episcopus*	Wooly Necked Stork	VU	DC	M	Ra	TCI
28	Charadriidae	*Vanellus indicus*	Red-Wattled Lapwing	LC	UN	R	Ra	GLI
29	Columbidae	*Columba livia*	Blue Rock Pigeon	LC	DC	R	VC	GSE
30		*Chalcophaps indica*	Emerald Dove	LC	DC	R	C	GSE
31		*Columba elphinstonii*	Nilgiri Wood-Pigeon*	VU	DC	R	VC	GSE
32		*Stigmatopelia chinensis*	Spotted Dove	LC	IN	R	VC	GSE
33	Corvidae	*Corvus splendens*	House Crow	LC	ST	R	VC	ATO
34		*Corvus macrorhynchos*	Large billed Crow	LC	ST	R	VC	ATO
35	Cuculidae	*Centropus sinensis*	Greater Coucal	LC	ST	R	C	TO
36		*Hierococcyx varius*	Common Hawk Cuckoo	LC	ST	R	UC	ATO
37	Dicruridae	*Dicrurus macrocercus*	Black Drongo	LC	UN	R	C	AI
38	Estrildidae	*Amandava amandava*	Red Avadavat	LC	ST	R	UC	GSE
39	Falconidae	*Falco tinnunculus*	Common Kestrel	LC	DC	R	C	SC
40	Hirundinidae	*Hirundo tahitica*	House Swallow	LC	IN	R	C	AI
41		*Lanius schach*	Long-tailed Shrike	LC	UN	R	C	USI
42		*Hirundo smithii*	Wire-tailed Swallow	LC	IN	R	C	AI
43		*Cecropis daurica*	Red Rumped Swallow	LC	ST	M	Ra	AI
44		*Ptyonoprogne concolor*	Dusky Crag Martin	LC	IN	R	UC	AI
45	Meropidae	*Nyctyornis athertoni*	Blue Bearded Bee-eater	LC	ST	R	Ra	AI
46	Motacillidae	*Motacilla cinerea*	Grey Wagtail	LC	ST	M	C	GLI
47		*Motacilla maderaspatensis*	Large Pied Wagtail	LC	UN	R	C	GLI
48		*Anthus nilghiriensis*	Nilgiri Pipit*	VU	DC	R	C	FSE
49		*Motacilla flava*	Yellow Wagtail	LC	DC	M	UC	GLI
50	Monarchidae	*Hypothymis azurea*	Black Naped Monarch	LC	ST	M	Ra	SI
51	Muscicapidae	*Prinia socialis*	Ashy Prinia	LC	ST	R	C	USI
52		*Terpsiphone paradisi*	Indian Paradise-flycatcher	LC	ST	R	Ra	AI

	Family	Species name	Common English name	IUCN status	IUCN population trend	Residential status	Relative abundance	Feeding guild
53	Muscicapidae	*Ficedula nigrorufa*	Black-and-Orange Flycatcher*	NT	DC	R	C	AI
54		*Cyornis rubeculoides*	Blue-throat Blue Flycatcher	LC	IN	M	Ra	SI
55		*Hemipus picatus*	Bar Winged Flycatcher Shrike	LC	ST	M	Ra	AI
56		*Orthotomus sutorius*	Common Tailorbird	LC	ST	R	C	SI
57		*Culicicapa ceylonensis*	Grey-headed Canary Flycatcher	LC	ST	R	VC	USI
58		*Pomatorhinus horsfieldii*	Indian Scimitar-Babbler	LC	IN	R	UC	BGI
59		*Turdoides striata*	Jungle Babbler	LC	ST	R	VC	FGI
60		*Ficedula subrubra*	Kashmir Flycatcher	VU	DC	M	Ra	SI
61		*Eumyias albicaudata*	Nilgiri Flycatcher*	NT	DC	R	VC	SI
62		*Myiomela major*	Nilgiri Blue Robin	EN	DC	R	UC	GLI
63		*Copsychus saularis*	Oriental Magpie Robin	LC	ST	R	C	GLI
64		*Turdus simillimus*	Indian Blackbird	LC	ST	R	VC	FGI
65		*Saxicola caprata*	Pied Bushchat	LC	ST	R	VC	SI
66		*Prinia inornata*	Plain Prinia	LC	ST	R	UC	SI
67		*Cyornis tickelliae*	Tickell's Blue Flycatcher	LC	ST	R	C	SI
68		*Eumyias thalassina*	Verditer Flycatcher	LC	ST	M	UC	SI
69		*Rhipidura aureola*	White-browed Fantail	LC	ST	R	VC	USI
70		*Cyornis pallipes*	White-bellied Blue Flycatcher	LC	DC	R	UC	SI
71	Nectariniidae	*Nectarinia minima*	Small Sunbird*	LC	ST	R	C	NA
72		*Nectarinia asiatica*	Purple Sunbird	LC	ST	R	UC	NAI
73		*Leptocoma zeylonica*	Purple-rumped Sunbird	LC	ST	R	UC	NAI
74		*Leptocoma minima*	Crimson-backed Sunbird	LC	ST	R	UC	NAI
75	Paridae	*Parus aplonotus*	Indian Yellow Tit	LC	ST	R	UC	USI
76		*Parus major*	Great Tit	LC	IN	R	VC	USI
77	Pandionidae	*Pandion haliaetus*	Osprey	LC	IN	M	Ra	SC
78	Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	LC	UN	R	UC	AC
79	Phasianidae	*Perdicula erythrorhyncha*	Painted Bush Quail	LC	ST	R	VC	FGSI

	Family	Species name	Common English name	IUCN status	IUCN population trend	Residential status	Relative abundance	Feeding guild
80	Phasianidae	*Pavo cristatus*	Indian Peafowl	LC	IN	R	Ra	TO
81		*Gallus sonneratii*	Grey Junglefowl	LC	DC	R	C	FGSI
82		*Galloperdix spadicea*	Red Spurfowl	LC	ST	R	UC	FGSI
83		*Galloperdix lunulata*	Painted Spurfowl	LC	ST	R	UC	FGSI
84	Picidae	*Picus xanthopygaeus*	Little Scaly-Bellied Green Woodpecker	LC	UN	R	UC	FGI
85		*Dinopium benghalense*	Lesser Goldenback	LC	ST	R	UC	FGI
86		*Hemicircus canente*	Heart Spotted Woodpecker	LC	DC	R	UC	FGI
87	Ploceidae	*Carpodacus erythrinus*	Common Rosefinch	LC	DC	M	C	GSE
88		*Passer domesticus*	House Sparrow	LC	DC	R	VC	GSE
89		*Prinia inornata*	Plain Munia	LC	UN	R	VC	GLI
90		*Lonchura punctulata*	Scaly-breasted Munia	LC	ST	R	VC	GSE
91	Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	LC	IN	R	UC	FSC
92		*Psittacula columboides*	Malabar Parakeet	LC	ST	R	C	FSC
93		*Psittacula cyanocephala*	Plum headed Parakeet	LC	DC	R	UC	FSC
94	Parulidae	*Acrocephalus dumetorum*	Blyth's Reed-Warbler	LC	IN	M	VC	USI
95		*Lduna coligata*	Booted Warbler	LC	IN	R	C	USI
96		*Phylloscopus trochiloides*	Greenish Warbler	LC	IN	M	UC	USI
97		*Phylloscopus affinis*	Tickell's Warbler	LC	ST	M	UC	USI
98	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	LC	IN	R	VC	FI
99		*Pycnonotus jocosus*	Red-whiskered Bulbul	LC	DC	R	VC	FI
100		*Pycnonotus luteolus*	White-browed Bulbul	LC	ST	R	UC	FI
101		*Iole indica*	Yellow-browed Bulbul	LC	ST	R	UC	FI
102	Rallidae	*Amaurornis phoenicurus*	White-Breasted Waterhen	LC	UN	R	VC	TO
103	Sturnidae	*Acridotheres fuscus*	Jungle Myna	LC	DC	R	VC	TO
104		*Tyto alba*	Barn Owl	LC	ST	R	C	ATC
105		*Ketupa zeylonensis*	Brown Fish Owl	LC	DC	R	UC	ATC

	Family	Species name	Common English name	IUCN status	IUCN population trend	Residential status	Relative abundance	Feeding guild
106	Sturnidae	*Strix leptogrammica*	Brown Wood Owl	LC	DC	R	C	ATC
107		*Tyto longimembris*	Eastern Grass Owl	LC	DC	M	Ra	ATC
108		*Bubo bubo*	Eurasian Eagle Owl	LC	DC	R	UC	ATC
109		*Otus sunia*	Oriental Scoups Owl	LC	ST	R	UC	ATC
110		*Bubo nipalensis*	Spot Bellied Eagle Owl	LC	ST	R	Ra	ATC
111	Sittidae	*Sitta frontalis*	Velvet Fronted Nuthatch	LC	DC	R	C	BGI
112	Rallidae	*Fulica atra*	Common Coot	LC	IN	R	UC	GLI
113	Turdidae	*Brachypteryx major*	Nilgiri Blue Robin *	EN	DC	R	UC	GLI
114		*Luscinia brunnea*	Indian Blue Robin	LC	DC	M	Ra	GLI
115		*Strophocincla cachinnans*	Black-chinned Laughing Thrush	EN	DC	R	VC	GLI
116		*Myophonus horsfieldii*	Malabar Whistling Thrush	LC	UN	R	UC	USI
117		*Monticola saxatilis*	Rufous-tailed Rock-thrush	LC	DC	R	UC	SI
118		*Monticola rupestris*	Blue Caped Rock Thrush	LC	ST	M	Ra	SI
119		*Geokichla wardii*	Pied Thrush	LC	DC	M	Ra	SI
120		*Monticola solitarius*	Blue Rock Thrush	LC	ST	M	Ra	SI
121		*Geokichla citrina*	Orange Headed Thrush	LC	DC	M	Ra	USI
122	Upupidae	*Upupa epops*	Common Hoopoe	LC	DC	R	C	GLI
123	Zosteropidae	*Zosterops palpebrosus*	Oriental White-eye	LC	DC	R	C	USI

IUCN Status: LC-Least Concern, EN-Endangered, VU-Vulnerable, NT-Near Threatened. IUCN Population Trend: DC-Decreasing, ST-Stable, IN-Increasing, UN-Unknown, Residential Status: R-Resident, M-Migratory. Relative Abundance: VC-Very Common, C-Common, UC-Uncommon, Ra-Rare. Feeding guilds: AI-Aerial Insectivore, BGI-Bark Gleaning Insectivore, FGI-Foliage Gleaning Insectivore, SI-Sallying Insectivore, USI-Under-Storey Insectivore, GLI-Grass Land Insectivore, TO-Terrestrial Omnivore, ATO-Arboreal Terrestrial Omnivore, GSE-Granivore Seed Eater, FGS-Frugivore Granivore insectivore seed eater, FSE-Frugivore Seed Eater, FI-Frugivore Insectivore, SC-Sallying Carnivore, ATC-Arboreal Terrestrial Carnivore, TC-Terrestrial Carnivore, WC-Wading Carnivore, NI-Nectarivore Insectivore, N-Nectarivore, AIGSE-Aquatic Insectivore, Granivore, Seed Eater, APEI-Aquatic, Plant Eater, Insectivore, TCI-Terrestrial Carnivore, Insectivore, AC-Aquatic Carnivore

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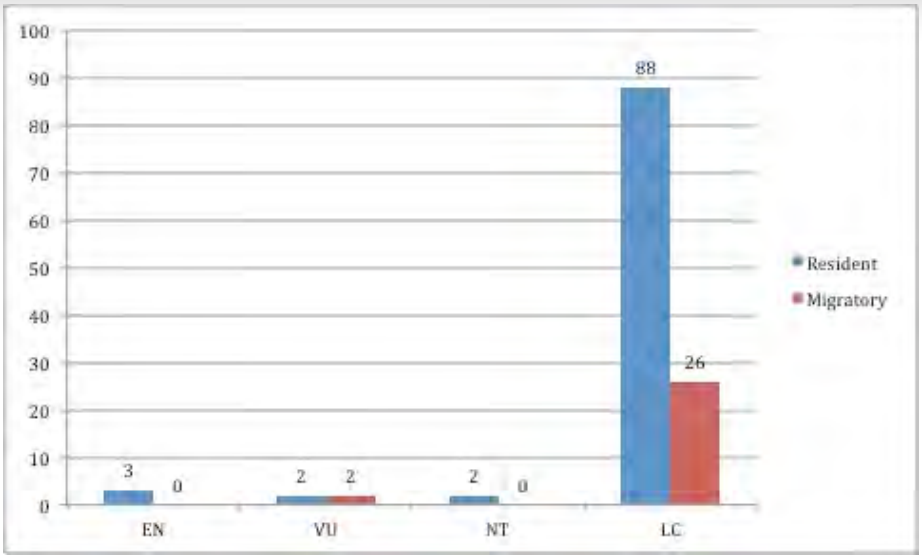
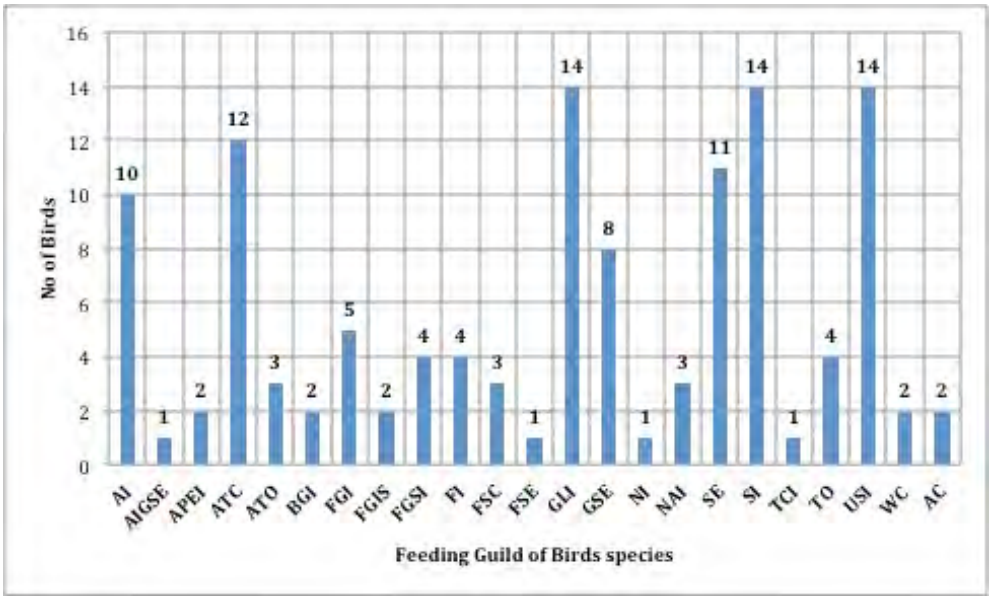


Frequency of sighting of recorded birds species respected to their Resident and Migratory status in Doddabetta Hills, The Upper Nilgiris

carnivore (ATC) (10%) are dominate the profile in guild analysis. Followed by, foliage gleaning Iinsectivore (FGI), frugivore granivore insectivore seed eater (FGSE) (4%) and frugivore insectivore (FI) (3%) and minimum number of feeding guild was observed on aquatic insectivore, granivore, seed eater (AIGSE), terrestrial carnivore, insectivore (TCI), nectarivore insectivore (NI), N = nectarivore, AIGSE= aquatic insectivore, granivore, seed rater (GSE) (1%) respectively. It has been found that there are certain species of birds in the study area that have been classified under different threat categories by the IUCN (version 2017-2). Of these, *Brachypteryx major, Myiomela major* and *Strophocincla cachinnans* was placed in the Endangered category and *Columba elphinstonii, Anthus nilghiriensis, Ciconia episcopus* and *Ficedula subrubra* were placed in the Vulnerable category and two species (*Ficedula nigrorufa, Eumyias albicaudata*) were placed in the Near Threatened category. All the remaining species (n 3/4 114) are placed in the Least Concern category (Table 1) followed by population trend of the species was described by IUCN shows that stable (51 species) followed by decreasing (39 species) increasing



Feeding guild status of recorded birds species in Doddabetta Hills, The Upper Nilgiris

Table 2. Relative Diversity (RDi) of various avian orders and families at Doddabetta Hills, Nilgiri Plateau, Tamil Nadu, India

	Order	Family	No. of species	RDi
1	Accipitriformes	Accipitridae	14	11.38
2	Accipitriformes	Pandionidae	1	0.81
3	Anseriformes	Anatidae	3	2.44
4	Apodiformes	Apodidae	1	0.81
5	Bucerotiformes	Upupidae	1	0.81
6	Caprimulgiformes	Caprimulgidae	2	1.63
7	Charadiiformes	Charadriidae	1	0.81
8	Ciconiiformes	Ciconiidae	1	0.81
9	Columbiformes	Columbidae	4	3.25
10	Coracilformes	Alcedinidae	3	2.44
11	Coracilformes	Meropidae	1	0.81
12	Cuculiformes	Cuculidae	2	1.63
13	Falconiformes	Falconidae	1	0.81
14	Galliformes	Phasianidae	5	4.07
15	Gruiformes	Rallidae	1	0.81
16	Passeriformes	Corvidae	2	1.63
17	Passeriformes	Dicruridae	1	0.81
18	Passeriformes	Estrididae	1	0.81
19	Passeriformes	Hirundinidae	5	4.07
20	Passeriformes	Motacillidae	4	3.25
21	Passeriformes	Monarchidae	1	0.81
22	Passeriformes	Muscicapidae	20	16.26
23	Passeriformes	Nectariniidae	4	3.25
24	Passeriformes	Paridae	2	1.63
25	Passeriformes	Parulidae	4	3.25
26	Passeriformes	Ploceidae	4	3.25
27	Passeriformes	Pycnonotidae	4	3.25
28	Passeriformes	Sittidae	1	0.81
29	Passeriformes	Sturnidae	8	6.50
30	Passeriformes	Turdidae	9	7.32
31	Passeriformes	Zosteropidae	1	0.81
32	Pelecaniformes	Ardeidae	2	1.63
33	Pelecaniformes	Phalacrocoracidae	1	0.81
34	Piciformes	Capitonidae	2	1.63
35	Piciformes	Picidae	3	2.44
36	Psittacidae	Psittacidae	3	2.44

(19 species) and unknown (14 species).

Discussion

The present study shows that Doddabetta Hills of the Nilgiris represents a sound avifaunal diversity. The hills are lies in an important ecological zone in the Western Ghats mountain ranges. Doddabetta hills are the highest peak of the Nilgiri District, Western Ghats, southern India. These hills are located in the centre of the Nilgiri district and receives a high amount of rainfall compare that other part of the Nilgiri. As many as more villages are situated inside the hills and villages are on the periphery. Most people in these villages are chiefly dependent on agriculture for their livelihood. Therefore, a variety of habitats and environments of this hill attract and support a variety of bird species. In this study Muscicapidae is the largest family of birds recorded. In generally

Muscicapidae is the largest family of birds in India with 370 species (Manakadan & Pittie 2001). Similarly, many other investigators such as Sharma (1998), Chhangani (2002a,b), Sankar et al. (2006) and Yaseen et al. (2011) have also found Muscicapidae to be the largest family in the different protected areas in India. A significant number of insectivorous species, present in the study area, are important agents of bio-control of insect pest in agriculture, horticulture, and forests (Mahabal 2005; Thakur et al. 2010). In Nilgiris Plateau the avian diversity are carried out in the lower plateau of the Nilgiris (Gokula 1998). In upper Nilgiri Plateau only few studies were investigating the diversity of birds (Davison 1883; Cardew 1885; Baker & Inglis 1930; Zarri et al. 2005; Peter et al. 2015; Manikandan & Balasubramanian 2016). In Nilgiris Plateau most of the works are focused either on a single species or bird group (Betts 1931; Khan 1979; Islam 1985; Thirumurthi & Balaji 1999; Vijayan et al. 2000; Peter et al. 2015). The present study is the pioneer work on the bird diversity in Upper Nilgiri Plateau. The presence of several villages in and around the hills is another important problem for the fauna of this region. During the study period, it was observed that increasing human population and interference in the forest areas are disturbing many shy and visiting bird species. This is the first report on the avifauna of this area. Furthermore, more field work and scientific studies on birds are necessary to prepare a suitable outline of the conservation plans for the area. In the future, with the improvement of the forest cover, proper management programs and strategies in the hills will not only increase the number of resident bird species but will also attract migratory and vagrant species.

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