

Avian Diversity of Semi-Arid Landscape : A Study from Chitradurga District, Karnataka, India

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Abstract Birds are highly diverse and perceptible biota of the ecosystem. They are the potential bioindicators in each and every ecosystem. The populations of birds presently are decreasing rapidly in semi-arid regions due to several factors such as unplanned development activities, climate change and urbanization. With this regard, documentation of the bird diversity and identifying their habitats in microhabitat level is essential for proper management/conservation of avifaunal species. Keeping this in view, the present study has undertaken. The main objective of this study

is preparing a checklist of avifauna and their status in Chitradurga district, Karnataka, India. We adopted standard methods such as Line transect method, Point count method and Visual observation methods for a survey of bird samplings in the study area. During the study period, 126 avian species belonging to 54 families were identified. The highest feeding guild recorded was insectivorous (38.89%) species compared to the others. One globally endangered one vulnerable and three near-threatened species were recorded. This study will serve as baseline data for further research which will help for decision making to conserve avifauna at microhabitat level in semi-arid regions.

Keywords Avian fauna, Diversity, Feeding guild, Residential status, Semi-arid region.

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Introduction

Birds always play a vital role in the biodiversity study because they created their own importance by having their unique features (Junior et al. 2016), Birds are highly diverse and perceptible biota in every ecosystem. They play many roles in the ecosystem which includes pollinators, scavengers, predators and they also help in seed dispersal (Sekercioglu 2006).

They contribute towards all four types of ecosystem services such as provisioning, regulating, cultural and supporting services that were recognized by Millennium Ecosystem Assessment (2003), Kremen and Ostfeld (2005), Whelan et al. (2008).

Semi-arid regions are a climatic zone which intermediates between humid climates and desert climates in ecological characteristics with the agricultural potential and they have characteristics of scanty rainfall, low precipitation and aridity index is between 0.20-0.50. Semi-arid climate is having tended to support scrubby and grassland vegetation (FAO 1993, Köppen 1884). Arid and semi-arid region comes under dry land and they constitute about 65% of the area of total dry land in the world. Among that 24% of the land area occupied by arid regions and 38% of the land area occupied by the semi-arid region (UN EMG 2011, Nautiyal et al. 2015).

In India, the semi-arid region is a transition zone between desert and dense forests of the Western Ghats, which accounts for 37% (970,530 km²) of the total geographic area of the country (Kalsi 2007). The ghats spread across Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Gujarat, Uttar Pradesh, Haryana, Punjab and Rajasthan States of India (Singh and Joshi 1979). Semi-arid regions are facing several challenges such as climate change, high pressure on resources, water scarcity, habitat change and other anthropogenic pressure (Shin et al. 2012, Souza et al. 2015).

Semi-arid and arid regions are very unique by having 217 Endemic Bird Areas (EBAs) with a large number of endemic bird species which was identified by Birdlife International (Stattersfield et al. 2005). Bird populations are one of the best indicator species of a healthy ecosystem and they show a high endemic rate as compared to other groups of vertebrate (Bibby et al. 1992, Kress 2000, Gajera et al. 2012). Birds are one of the most studied groups of vertebrates in different habitats of the world. Birds have been used to indicate changing environmental conditions (Oster 1978, Reed et al. 2011, Mengesha et al. 2014).

India is one of the mega biodiversity countries which harbor 2.4% of the world's land area and it is a home for 45,000 species of plants and 91,000 species of animals which accounts for 7-8% of world recorded species (<https://www.iucn.org/regions/asia/countries/india> 2018). Among them, India harbors 1263 species of birds which were belonged to 23 orders, 107 families and 498 genera (Praveen et al. 2016).

Preparing a checklist of bird species is a fundamental tool to gain the knowledge of biodiversity in a particular geographical area and also this is a basis for undertaking the further studies such as systematics, taxonomy, distribution, evaluation, conservation (Nunez-Zapata et al. 2016). In addition to that, checklists will help to make policy recommendation for conserving biodiversity in a particular ecosystem/landscape/geographical area. Keeping this in view, the present study was undertaken to understand the diversity of birds in the semi-arid region of Chitradurga district.

Materials and Methods

Study area

The present study area (Chitradurga district) is situated in the southern part of the Deccan peninsula and located in the state of Karnataka, India. The Chitradurga district comprises an area covering 8436 sqkm and lies between 13°34' to 15°03' North latitude and 76°01' to 77°02' East longitude with an elevation of 732 m above MSL (Census of India 2011). This district is bounded with the north by Bellary and Davangere district, on the south-east by Tumkuru district, south-west by Chikamagaluru district, on the east Anantapur district, on the west Davanagere district. This district consists of six Taluks (Challakere, Chitradurga, Hiriyur, Holalkere, Hosadurga and Molakalmaru) (Fig.1). This district falls under the central dry zone of Karnataka which is having the characteristics of the semi-arid region. The district is a dry land characterized by huge undulating plains. The terrain is not uniform among six taluks of this district; most of the district is having bare and stone lands with hilly areas. Chitradurga district experiences the low to moderate rainfall (average rainfall is 744

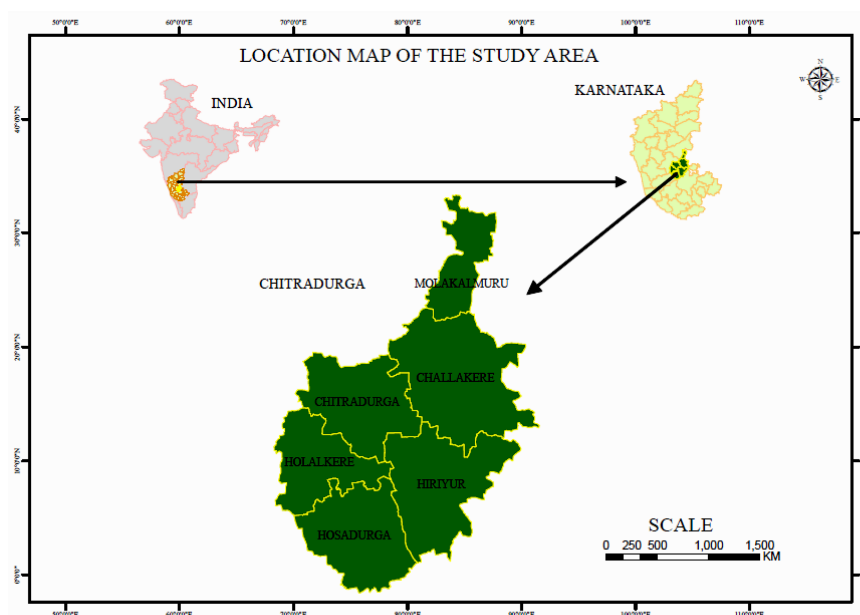


Fig. 1. Location map of study area.

mm), hot summer and pleasant monsoon. Maximum and minimum temperature of the Chitradurga district is 37°C and 15°C respectively. The district has two types of forests i.e. tropical dry deciduous forest and tropical thorn forests (Shiddamallayya et al. 2016).

Methodology

Bird surveys were carried out once in every fortnight from August 2014 to September 2016 in the Chitradurga district. All field surveys were performed twice a day during peak activity time of the birds i.e., between 05.30 to 10.00 Morning hours and 16.00 to 18.30 Evening hours by using standard ecological census techniques. Nikon D3200 camera was used to capture the photographs and Nikon binocular for observations of birds during the survey. The line transects and point count methods were used for surveying the avifauna (Rajashekara and Venkatesha 2015, Rajashekara and Venkatesha 2017a, Rajashekara and Venkatesha 2017b). We used the line transect method as the standard and relevant method with maximum times suitable for open type semi-arid habitat (Sutherland 2006). A straight line of one km is drawn and all birds heard or seen till a range from 15 to 50 m on either side of the line transect were recorded (Koli 2014). Birds were identified by

using standard field guides (Ali 2012, Arlott 2014, Rathod et al. 2015). Wherever it was difficult to use the line transect, we applied the point count method for enumeration of bird species. In this method, the observer will stand in a randomly chosen point and record bird species seen and heard in a 50 m radius for 5 minutes. This observation is recorded in another point at least 300 m from the first point. Apart from the above methods, we applied opportunistic bird sightings for the documentation of species. We used the International Union for the Conservation of Nature (IUCN 2016) status for each bird species to understand avian faunal status at the regional level. Feeding guilds of the species were also recorded during the field investigation (Ali 2012). Along with this above data, we also collected data regarding local threats for avian fauna. Relative abundance (Singh and Rai 2000), Frequency and species distribution ratio (Cottam and Curtis 1956) were calculated by using the following formula :

$$\text{Relative abundance (A)} = \frac{a}{N} \times 100$$

a = Total population of a particular species and N = Total population of all the species.

$$\text{Frequency (F)} = \frac{m}{M} \times 100$$

m = Occurrence of species in given samples, M = Total number of samples.

$$\text{Species distribution ratio} = \frac{\text{Abundance}}{\text{Frequency}}$$

Results

A total of 126 bird species belonging to the 99 Genera, 54 families and 20 Orders were recorded in the entire Chitradurga district (Table 1). Among 20 Orders, Passeriformes are the most dominant Order with the 26 families and 59 species followed by Charadriiformes (five families with eight species), Coraciiformes (three families with five species), Bucerotiformes, Pelecaniformes, Piciformes with two families each

and remaining Anseriformes, Apodiformes, Caprimulgiformes, Ciconiiformes, Columbiformes, Cuculiformes, Falconiformes, Galliformes, Gruiformes, Passeriformes, Podicipediformes, Psittaciformes, Pteroclitiformes, Strigiformes, Suliformes each with one family (Table 2).

Out of the feeding guild-wise analysis of recorded bird species, 49 species were insectivorous (38.89%), 17 species were carnivorous (13.49%), 8

Table 1. Checklist of avian fauna recorded from the Chitradurga district. Ali (2012), Arlott (2014).

Sl.No.	Order/ Family	Common name	Scientific name*	Resi- dential status*	Feeding habit*	IUCN
Order : Anseriformes						
Family : Anatidae						
1		Indian Spot-Billed Duck	<i>Anas Poecilorhyncha</i> (Forster, 1781)	RM	O	LC
2		Lesser Whistling-Duck	<i>Dendrocygna javanica</i> (Horsfield, 1821)	R	O	LC
Order : Apodiformes						
Family : Apodidae						
3		Little Swift	<i>Apus affinis</i> (JE Gray, 1830)	RM	I	LC
4		Asian Palm-Swift	<i>Cypsiurus balasiensis</i> (Gray, 1829)	R	I	LC
Order : Bucerotiformes						
Family : Bucerotidae						
5		Gray Hornbill	<i>Ocyrceros birostris</i> (Scopoli, 1786)	R	F	LC
Family : Upupidae						
6		Common Hoopoe	<i>Upupa epops</i> (Linnaeus, 1758)	RM	I	LC
Order : Caprimulgiformes						
Family : Caprimulgidae						
7		Indian Little Nightjar	<i>Caprimulgus asiaticus</i> (Latham, 1790)	R	I	LC
Order : Charadriiformes						
Family : Burhinidae						
8		Indian Stone-Curlew	<i>Burhinus indicus</i> (Salvadori, 1865)	R	I	LC
Family : Charadriidae						
9		Little Ringed Plover	<i>Charadrius dubius</i> (Scopoli, 1786)	RM	I	LC
10		Red-Wattled Lapwing	<i>Vanellus indicus</i> (Boddaert, 1783)	R	I	LC
11		Yellow-Wattled Lapwing	<i>Vanellus malabaricus</i> (Boddaert, 1783)	R	I	LC
Family : Jacanidae						
12		Bronze-Winged Jacana	<i>Metopidius indicus</i> (Latham, 1790)	R	I & C	LC
Family : Scolopacidae						
13		Common Sandpiper	<i>Actitis hypoleucos</i> (Linnaeus, 1758)	RM	I	LC
14		Wood Sandpiper	<i>Tringoides lareola</i> (Linnaeus, 1758)	M	I	LC
Family : Sternidae						
15		River Tern	<i>Sterna aurantia</i> (Gray, JE, 1831)	R	I & C	NT
Order : Ciconiiformes						
Family : Ciconiidae						
16		Asian Openbill Stork	<i>Anastomus oscitans</i> (Boddaert, 1783)	R	I	LC
17		Painted Stock	<i>Mycteria leucocephala</i> (Pennant, 1769)	RM	C	NT
Order : Columbiformes						
Family : Columbidae						
18		Blue Rock Pigeon	<i>Columba livia</i> (Gmelin, 1789)	R	G	LC
19		Spotted Dove	<i>Streptopelia chinensis</i> (Scopoli, 1768)	R	G	LC
20		Laughing Dove	<i>Streptopelia senegalensis</i> (Linnaeus, 1766)	R	G	LC
21		Eurasian Collared-Dove	<i>Streptopelia decaocto</i> (Frisvaldszky, 1838)	R	F & G	LC

Table 1. Continued.

Sl.No. Order/ Family	Common name	Scientific name*	Resi- dential status*	Feeding habit*	IUCN
Order : Coraciiformes					
Family : Alcedinidae					
22	Small Blue Kingfisher	<i>Alcedo atthis</i> (Linnaeus, 1758)	RM	I & C	LC
23	Pied Kingfisher	<i>Ceryle rudis</i> (Linnaeus, 1758)	R	C	LC
24	White-Throated Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	R	C	LC
Family : Coraciidae					
25	Indian Roller	<i>Coracias benghalensis</i> (Linnaeus, 1758)	R	C	LC
Family : Meropidae					
26	Little Green Bee-Eater	<i>Merops orientalis</i> (Latham, 1801)	R	I	LC
Order : Cuculiformes					
Family : Cuculidae					
27	Gray-bellied Cuckoo	<i>Cacomantis passerinus</i> (Vahl, 1797)	R	I	LC
28	Greater Coucal	<i>Centropus sinensis</i> (Stehens, 1815)	R	O	LC
29	Pied Cuckoo	<i>Clamator jacobinus</i> (Boddaert, 1783)	RM	I	LC
30	Asian Koel	<i>Eudynamis scolopaceus</i> (Linnaeus, 1758)	R	I & F	LC
31	Common Hawk-Cuckoo	<i>Hierococyx varius</i> (Vahl, 1797)	R	I	LC
32	Blue-Faced Malkoha	<i>Phaenicophaeus viridirostris</i> (Jerdon, 1840)	R	I & F	LC
Order : Falconiformes					
Family : Accipitridae					
33	Shikra	<i>Accipiter badius</i> (Gmelin, 1788)	R	C	LC
34	White-Eyed Buzzard	<i>Butastur teesa</i> (Franklin, 1831)	R	C	LC
35	Short-Toed Snake-Eagle	<i>Circaetus gallicus</i> (Gmelin, 1788)	R	C	LC
36	Black-Shouldered Kite	<i>Elanuscaeruleus</i>	R	O	LC
37	Brahminy Kite	<i>Haliaeetus turindus</i> (Boddaert, 1783)	R	C	LC
38	Black Eagle	<i>Ictinaetus malayensis</i> (Temminck, 1822)	R	C	LC
39	Egyptian Vulture	<i>Neophron percnopterus</i> (Linnaeus, 1758)	R	C	E
40	Oriental Honey-Buzzard	<i>Perniptilo rhynchus</i> (Temminck, 1821)	RM	C	LC
Order : Galliformes					
Family : Phasianidae					
41	Gray Francolin	<i>Francolinu sponcierianus</i> (Gmelin, 1789)	R	I & G	LC
42	Painted Spurfowl	<i>Galloperdix lunulata</i> (Valenciennes, 1825)	R	G	LC
43	Indian Peafowl	<i>Pavo cristatus</i> (Linnaeus, 1758)	R	O	LC
44	Rock Bush-Quail	<i>Perdicula argoondah</i> (Sykes, 1832)	R	G	LC
Family : Rallidae					
45	White-Breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	R	I	LC
46	Eurasian Coot	<i>Fulica atra</i> (Linnaeus, 1758)	RM	O	LC
47	Eurasian Moorhen	<i>Gallinu lachloropus</i> (Linnaeus, 1758)	RM	O	LC
48	Purple Swamphen	<i>Porphyrio porphyrio</i> (Latham, 1801)	R	O	LC
Order : Passeriformes					
Family : Acrocephalidae					
49	Blyth's Reed-Warbler	<i>Acrocephalus dumetorum</i> (Blyth, 1849)	RM	I	LC
50	Indian Reed-Warbler	<i>Acrocephalus stentoreus</i> (Ehrenberg, 1833)	R	C	LC
51	Syke's Warbler	<i>Iduna rama</i> (Sykes, 1832)	RM	C	LC
Family : Aegithinidae					
52	Common Iora	<i>Aegithina tiphia</i> (Linnaeus, 1758)	R	O	LC
Family : Alaudidae					
53	Rufous-Tailed Lark	<i>Ammomanes phoenicura</i> (Franklin, 1831)	R	I & G	LC
54	Ashy-Crowned Finch-Lark	<i>Eremopterix griseus</i>	R	I & G	LC
55	Syke's Lark	<i>Galerida deva</i> (Sykes, 1832)	R	I & G	LC
56	Jerdon's Bushlark	<i>Mirafra affinis</i> (Blyth, 1845)	R	I & G	LC
57	Indian Bushlark	<i>Mirafra erythroptera</i> (Blyth, 1845)	R	I & G	LC
Family : Campephagidae					
58	Small Minivet	<i>Pericrocotus cinnamomeus</i> (Linnaeus, 1766)	R	I	LC
Family : Cisticolidae					

Table 1. Continued.

Sl. No. Order/ Family	Common name	Scientific name*	Resi- dential status*	Feeding habit*	IUCN
59	Common Tailorbird	<i>Orthoto mussutorius</i> (Pennant, 1769)	R	I	LC
60	Gray-Breasted Prinia	<i>Prinia hodgsonii</i> (Blyth, 1844)	R	I	LC
61	Plain Prinia	<i>Prinia inornata</i> (Sykes, 1832)	R	I	LC
62	Ashy Prinia	<i>Prinia socialis</i> (Sykes, 1832)	R	I	LC
63	Jungle Prinia	<i>Prinia sylvatica</i> (Jerdon, 1840)	R	I	LC
	Family : Corvidae				
64	Induian Jungle Crow	<i>Corvus macrorhynchos</i> (Sykes, 1832)	R	O	LC
65	House Crow	<i>Corvus splendens</i> (Vieillot, 1817)	R	O	LC
66	Rufous Treepie	<i>Dendracitta vagabunda</i> (Latham 1790)	R	O	LC
	Family : Dicaeidae				
67	Pale-Billed Flowerpecker	<i>Dicaeum erythrorhynchos</i> (Latham, 1790)	R	I & F	LC
	Family : Dicuridae				
68	White-Bellied Drongo	<i>Dicrurus caeruleus</i> (Linnaeus, 1758)	R	I	LC
69	Black Drongo	<i>Dicrurus macrocercus</i> (Vieillot, 1817)	R	I	LC
	Family : Estrildidae				
70	Indian Silverbill	<i>Eudice malabarica</i> (Linnaeus, 1758)	R	I & G	LC
71	Scaly-Breasted Munia	<i>Lonchura punctulata</i> (Linnaeus, 1758)	R	G	LC
	Family : Hirundinidae				
72	Red-Rumped Swallow	<i>Cecropis daurica</i> (Laxmann, 1769)	RM	I	LC
73	Barn Swallow	<i>Hirun dorustica</i> (Linnaeus, 1758)	RM	I	LC
74	Streak-Throated Swallow	<i>Hirun dofluvicola</i> (Blyth, 1855)	R	I	LC
75	Dusky Crag-Martin	<i>Ptyonoprog neconcolor</i> (Sykes, 1832)	R	I	LC
	Family : Laniidae				
76	Long-Tailed Shrike	<i>Lanius schach</i> (Linnaeus, 1758)	R	I	LC
77	Bay-Backed Shrike	<i>Lanius vittatus</i> (Valenciennes, 1826)	R	I	LC
	Family : Leiothrichidae				
78	Yellow-Billed Babbler	<i>Turdoides affinis</i> (Jerdon, 1845)	R	O	LC
79	Large Gray Babbler	<i>Turdoides malcolmi</i> (Sykes, 1832)	R	G	LC
	Family : Motacillidae				
80	Tawny Pipit	<i>Anthus campestris</i> (Linnaeus 1758)	M	I	LC
81	Paddyfield Pipit	<i>Anthus rufulus</i> (Vieillot, 1818)	R	I	LC
82	Tree Pipit	<i>Anthus trivialis</i> (Linnaeus, 1758)	M	G	LC
83	White-Browed wagtail	<i>Motacilla maderaspatensis</i> (Gmelin, 1789)	R	I	LC
	Family : Muscicapidae				
84	Indian Robin	<i>Saxicoloides fulicatus</i> (Linnaeus, 1766)	R	I	LC
85	Oriental Magpie-Robin	<i>Copsychus saularis</i> (Linnaeus, 1758)	R	I	LC
86	Tickell's Blue -Flycatcher	<i>Cyornis tickelliae</i> (Blyth, 1843)	R	I	LC
87	Pied Bushchat	<i>Saxicola caprata</i> (Linnaeus, 1766)	R	I	LC
	Family : Nectariniidae				
88	Purple Sunbird	<i>Cinnyris asiaticus</i> (Latham, 1790)	R	N	LC
89	Crimson-Backed Sunbird	<i>Leptocoma minima</i> (Sykes, 1832)	R	N	LC
90	Purple-Rumped Sunbird	<i>Leptocoma zeylonica</i> (Linnaeus, 1766)	R	N	LC
	Family : Paridae				
91	Great Tit	<i>Parus major</i> (Linnaeus, 1758)	R	I	LC
	Family : Passeridae				
92	House Sparrow	<i>Passer domesticus</i> (Linnaeus, 1758)	R	G	LC
93	Yellow-Throated Sparrow	<i>Petronia xanthocollis</i> (E. Burton, 1838)	R	G	LC
	Family : Ploceidae				
94	Baya Weaver	<i>Ploceus philippinus</i> (Linnaeus, 1766)	R	G	LC
	Family : Pycnonotidae				
95	Red-Yented Bulbul	<i>Pycnono tuscafer</i> (Linnaeus, 1766)	R	F	LC
96	Red-Whiskered Bulbul	<i>Pycnono tusjocosus</i> (Linnaeus, 1758)	R	F	LC
97	White-Browed Bulbul	<i>Pycno notusluteolus</i> (Lesson, 1841)	R	F	LC
98	Yellow-Throated Bulbul	<i>Pycno notusxantholaemus</i> (Jerdon, 1845)	R	I	VU

Table 1. Continued.

Sl. No.	Order/ Family	Common name	Scientific name*	Resi- dential status*	Feeding habit*	IUCN
		Family : Rhipiduridae				
99		Spot-Breasted Fantail	<i>Rhipidura albogularis</i> (Lesson, 1831)	R	I	LC
		Family : Sturnidae				
100		Jungle Myna	<i>Acrida theresfuscus</i> (Wagler, 1827)	R	F	LC
101		Common Myna	<i>Acrida thestristis</i> (Linnaeus, 1766)	R	O	LC
102		Brahminy Starling	<i>Sturnia pagodarum</i> (Gmelin, 1789)	R	I & F	LC
		Family : Sylviidae				
103		Hume's Whitethroat	<i>Sylvia althaea</i> (Hume, 1878)	M	I	LC
		Family : Tephrodornithidae				
104		Common Woodshrike	<i>Tephrodo rnispondicerianus</i> (Gmelin, 1789)	R	I	LC
		Family : Timaliidae				
105		Tawny-Bellied Babbler	<i>Dumetia hyperythra</i> (Franklin, 1831)	R	I	LC
		Family : Turdidae				
106		Orange-Headed Thrush	<i>Geokich lacitrina</i> (Latham, 1790)	RM	I & F	LC
		Family : Zosteropidae				
107		Oriental White-Eye	<i>Zosterop spalpebrosus</i> (Temminck, 1824)	R	O	LC
		Order : Pelecaniformes				
		Family : Ardeidae				
108		Grey Heron	<i>Ardea cinerea</i> (Linnaeus, 1758)	RM	C	LC
109		Indian Pond-Heron	<i>Ardeo lagrayii</i> (Sykes, 1832)	R	C	LC
110		Eastern Cattle Egret	<i>Bubulcus coromandus</i> (Linnaeus, 1758)	RM	I	NE
111		Little Egret	<i>Egretta garzta</i> (Linnaeus, 1766)	RM	I & C	LC
112		Intermediate Egret	<i>Egretta intermedia</i> (Wagler, 1829)	RM	C	LC
		Family : Threskiornithidae				
113		Glossy Ibis	<i>Plegadis falcinellus</i> (Linnaeus, 1766)	RM	I	LC
114		Red-Naped Ibis	<i>Pseudi bispapillosa</i> (Temminck, 1824)	R	I & C	LC
115		Black-Headed Ibis	<i>Threskiornis melanocephalus</i> (Latham, 1790)	R	I & C	NT
		Order : Piciformes				
		Family : Megalaimidae				
116		Coppersmith Barbet	<i>Megalai mahaemacephala</i> (Stadius Muller, 1776)	R	F	LC
		Family : Picidae				
117		Black-Rumped Flameback	<i>Dinopium benghalense</i> (Linnaeus, 1758)	R	I	LC
		Order : Podicipediformes				
		Family : Podicipedidae				
118		Little Grebe	<i>Tachybaptus ruficollis</i> (Pallas, 1764)	R	I	LC
		Order : Psittaciformes				
		Family : Psittaculidae				
119		Vernal Hanging-Parrot	<i>Loriculus vernalis</i> (Sparman, 1787)	R	N	LC
120		Plum-Headed Parakeet	<i>Psittacula cyanocephala</i> (Linnaeus, 1766)	R	F	LC
121		Rose-Ringed Parakeet	<i>Psittacula krameri</i> (Scopoli, 1769)	R	F	LC
		Order : Pteroclitiformes				
		Family : Pteroclitidae				
122		Chestnut-Bellied Sandgrouse	<i>Pterocles exustus</i> (Temminck, 1825)	R	G	LC
123		Painted Sandgrouse	<i>Pterocles indicus</i> (Gmelin, 1789)	R	G	LC
		Order : Strigiformes				
		Family : Strigidae				
124		Spotted Owlet	<i>Athen ebrama</i> (Temminck, 1821)	R	O	LC
125		Indian Eagle-Owl	<i>Bubo bengalensis</i> (Franklin, 1831)	R	C	LC
		Order : Suliformes				
		Family : Phalacrocoracidae				
126		Little Cormorant	<i>Phalacro coraxniger</i> (Vieillot, 1817)	RM	C	LC

species were frugivorous (6.35%), 13 species were granivorous (10.32%), 16 species were omnivorous (12.70%), four species were nectarivorous (3.17%), six species were both insectivorous and carinivorous

(4.76%), five species were both insectivorous and frugivorous (3.97%), seven species were both insectivorous and granivorous (5.56%) and one species was both frugivorous and granivorous (0.79%) (Fig. 2).

Residential status of recorded birds from the semi-arid region of the Chitradurga district indicated that 100 species were residential birds, 22 were resident migrant and four were migrant birds. Among the recorded bird species, one globally endangered (E), one vulnerable (V), three globally near threatened (NT) and 121 least concerned (LC) species found in the semi-arid region of Chitradurga district (Table 3).

A total of 124 species were recorded during the year 2014-15. Among them, relative abundance of *Corvus splendens* was more (5.240) followed by *Passer domesticus* (3.146), *Acrido theerestrictis* (2.314), *Turdoides malcolmi* (2.294) and *Turdoides affinis* (2.164), whereas it was less for *Circaetus gallicus* and *Rhipidura albogularis* (0.020). The frequency of *Corvus splendens* was more (31.944), whereas fre-

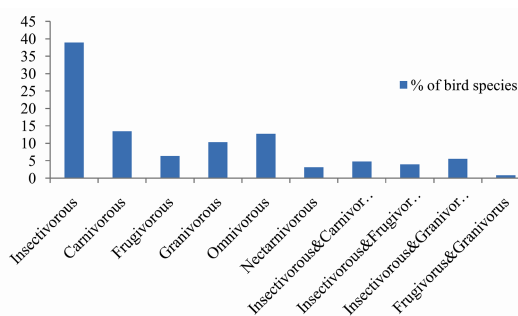


Fig. 2. Feeding guilds of avian species in the Chitradurga district.

quency was least for *Circaetus gallicus* and *Rhipidura albogularis* (0.463). The species distribution ratio of *Passer domesticus* was highest. Similar distribution ratio was found during 2015-16 (Table 3). A total of 125 species were recorded for the year 2015-16 from the study region among them, relative abundance of *Corvus splendens* was more (5.004) whereas it was less for *Psittacula cyanocephala* (0.010) (Table 3).

Table 2. Number of families, genera, species, feeding guilds, residential status and IUCN status of the avian fauna recorded from the Chitradurga district. * I-Insectivorous, C-Carnivorous, F-Frugivorous, G-Granivorous, O-Omnivorous, N-Nectarivorous, R-Resident, RM-Resident migrant, M-Migrant, NE-Not evaluated, LC-Least concern, NT-Near threatened, VU-Vulnerable, E-Endangered .

Order	No.of families	Feeding guilds (No. of species)				Residential status (No. of species)					IUCN status (No. of species)										
		No.of genera	No.of species	I	C	F	G	O	N	C	F	G	R	RM	M	NE	LC	NT	VU	E	
Anseriformes	1	2	2					2					1	1			2				
Apodiformes	1	2	2	2									1	1			2				
Bucerotiformes	2	2	2	1	1								1	1			2				
Caprimulgiformes	1	1	1	1									1				1				
Charadriiformes	5	7	8	6					2				5	2	1		7	1			
Ciconiiformes	1	2	2	1	1								1	1			1	1			
Columbiformes	1	2	4				3							1			4				
Coraciiformes	3	5	5	2	2				1				4	1			5				
Cuculiformes	1	2	6	3				1		2			5	1			6				
Falconiformes	1	8	8		7			1					7	1			7			1	
Galliformes	1	4	4				2	1					4		1		4				
Gruiformes	1	4	4	1				3					2	2			4				
Passeriformes	26	42	59	28	2	4	6	7	3		3	6	51	5	3		58		1		
Pelecaniformes	2	7	8	2	3					3			3	5		1	6	1			
Piciformes	2	2	2	1		1							2				2				
Podicipediformes	1	1	1	1									1				1				
Psittaciformes	1	2	3			2				1			3				3				
Pterocliiformes	1	1	2										2				2				
Strigiformes	1	2	2		1		1						2				2				
Suliformes	1	1	1		1									1			1				
Total	54	99	126	49	17	8	13	16	4	6	5	7	1	100	22	4	1	120	3	1	1

Table 3. Relative abundance frequency and species distribution ratio (SDR) of avian fauna in Chitradurga district. *Species distribution ratio : <0.025–Regular, 0.025 to 0.050 - Random and >0.050 - contiguous (Cottam and Curtis 1956).

Species name	2014-2015			2015-2016		
	Relative abundance	Frequency	Species distribution ratio*	Relative abundance	Frequency	Species distribution ratio*
<i>Accipiter badius</i>	0.321	9.259	0.035	0.361	10.185	0.035
<i>Butas turteesa</i>	0.070	2.315	0.030	0.124	4.630	0.027
<i>Circaetus gallicus</i>	0.020	0.463	0.943	0.000	0.000	0.000
<i>Elanusca eruleus</i>	0.601	12.500	0.048	0.457	11.574	0.039
<i>Haliaeetus turindus</i>	0.511	10.185	0.050	0.590	13.889	0.042
<i>Ictinaetus malayensis</i>	0.250	6.019	0.042	0.400	11.574	0.035
<i>Neophron perenopterus</i>	0.271	6.481	0.042	0.276	7.870	0.035
<i>Pernis ptilorhynchus</i>	0.341	8.333	0.041	0.323	7.870	0.041
<i>Acrocephalus dumetorum</i>	0.631	12.037	0.052	0.723	16.667	0.043
<i>Acrocephalus stentoreus</i>	0.781	15.741	0.050	0.704	14.815	0.048
<i>Iduna rama</i>	0.852	17.593	0.048	0.675	14.352	0.047
<i>Aegithi natiphia</i>	0.812	14.352	0.057	0.609	14.352	0.042
<i>Ammomanes phoenicura</i>	0.882	14.352	0.061	0.656	12.500	0.053
<i>Eremo pterixgriseus</i>	1.423	19.444	0.073	1.037	13.426	0.077
<i>Galerida deva</i>	0.962	14.815	0.065	0.932	14.352	0.065
<i>Mirafra affinis</i>	0.250	4.167	0.060	0.361	7.407	0.049
<i>Mirafra erythroptera</i>	1.312	19.444	0.067	1.170	16.667	0.070
<i>Alcedo atthis</i>	0.120	4.167	0.029	0.219	6.481	0.034
<i>Ceryle rudis</i>	0.651	12.037	0.054	0.609	14.352	0.042
<i>Halcyon smyrnensis</i>	1.122	17.593	0.064	1.142	20.370	0.056
<i>Anaspoe cilorhyncha</i>	0.541	8.796	0.062	0.552	10.185	0.054
<i>Dendro cygnajavanica</i>	0.130	2.778	0.047	0.105	3.241	0.032
<i>Apus affinis</i>	1.212	14.352	0.084	1.065	13.889	0.077
<i>Cypsiurus balasiensis</i>	1.703	16.204	0.105	1.541	17.130	0.090
<i>Ardea cinerea</i>	0.982	13.426	0.073	0.923	13.426	0.069
<i>Ardeo lagrayii</i>	1.062	12.037	0.088	0.970	14.815	0.065
<i>Bubulcus coromandus</i>	1.513	15.278	0.099	1.180	14.352	0.082
<i>Egretta garzetta</i>	1.192	15.278	0.078	1.065	15.741	0.068
<i>Egretta intermedia</i>	0.832	11.111	0.075	1.113	15.278	0.073
<i>Ocyrceros birostitis</i>	0.190	4.630	0.041	0.181	4.630	0.039
<i>Burhinus indicus</i>	0.551	6.019	0.092	0.457	6.481	0.070
<i>Pericro cotuscinnamomeus</i>	0.421	6.944	0.061	0.342	6.944	0.049
<i>Caprimul gusasiaticus</i>	0.331	6.944	0.048	0.428	6.944	0.062
<i>Charadrius dubius</i>	0.271	4.630	0.058	0.314	6.019	0.052
<i>Vanellus indicus</i>	1.623	18.981	0.086	1.170	13.889	0.084
<i>Vanellus malabaricus</i>	1.673	20.833	0.080	1.617	18.519	0.087
<i>Anastomus oscitans</i>	0.311	5.093	0.061	0.361	5.556	0.065
<i>Mycteria leucocephala</i>	0.521	6.944	0.075	0.533	7.407	0.072
<i>Ortho tomussutorius</i>	0.441	8.333	0.053	0.599	11.111	0.054
<i>Prinia hodgsonii</i>	0.281	4.630	0.061	0.333	6.019	0.055
<i>Prinia inornata</i>	0.701	10.648	0.066	0.799	12.500	0.064
<i>Prinia socialis</i>	0.441	7.407	0.060	0.495	9.259	0.053
<i>Prinia sylvatica</i>	0.641	10.648	0.060	0.685	10.648	0.064
<i>Columba livia</i>	1.954	13.426	0.146	2.464	17.130	0.144
<i>Streptopelia chinensis</i>	1.122	13.889	0.081	0.694	11.111	0.063
<i>Streptopelia senegalensis</i>	1.503	18.981	0.079	1.322	16.667	0.079
<i>Streptopelia decaocto</i>	1.092	16.204	0.067	1.161	15.741	0.074
<i>Coracias benghalensis</i>	0.621	12.037	0.052	0.476	10.648	0.045
<i>Corvus macrorhynchos</i>						
<i>culminates</i>	1.343	16.667	0.081	1.275	16.667	0.076
<i>Corvus splendens</i>	5.240	31.944	0.164	5.004	33.333	0.150
<i>Dendro cittavagabunda</i>	0.431	9.259	0.047	0.885	15.741	0.056

Table 3. Continued.

Species name	2014-2015			2015-2016		
	Relative abundance	Frequency	Species distribution ratio*	Relative abundance	Frequency	Species distribution ratio*
<i>Cacomantis passerines</i>	0.080	1.852	0.043	0.114	2.778	0.041
<i>Centropus sinensis</i>	0.551	12.037	0.046	0.438	11.111	0.039
<i>Clamator jacobinus</i>	0.150	3.704	0.041	0.171	3.241	0.053
<i>Eudynamis scolopaceus</i>	0.842	15.741	0.053	0.732	14.352	0.051
<i>Hierococ cyxvarius</i>	0.180	5.093	0.035	0.200	5.093	0.039
<i>Phaenicophaeus viridirostris</i>	0.361	8.333	0.043	0.381	10.185	0.037
<i>Dicaeumery throrhynchos</i>	0.180	2.778	0.065	0.200	5.093	0.039
<i>Dicrurus caerulescens</i>	0.571	11.111	0.051	0.457	9.722	0.047
<i>Dicrurus macrocerus</i>	1.924	23.148	0.083	1.807	19.444	0.093
<i>Euodice malabarica</i>	1.483	15.278	0.097	1.408	17.130	0.082
<i>Lonchura punctulata</i>	0.471	11.574	0.041	0.618	13.426	0.046
<i>Hirundo daurica</i>	0.802	9.259	0.087	0.723	12.037	0.060
<i>Hirundo rustica</i>	0.661	11.574	0.057	0.666	11.574	0.058
<i>Hirundo fluvicola</i>	0.260	4.630	0.056	0.333	6.019	0.055
<i>Ptyono progneconcolor</i>	1.703	14.815	0.115	1.665	16.667	0.100
<i>Metopidius indicus</i>	1.140	2.778	0.050	0.200	2.778	0.072
<i>Lanius schach</i>	0.581	9.722	0.060	0.523	8.796	0.059
<i>Lanius vittatus</i>	0.751	10.648	0.071	0.761	13.889	0.055
<i>Turdo idesaffinis</i>	2.164	16.667	0.130	2.293	18.981	0.121
<i>Turdo idesmalcolmi</i>	2.294	19.907	0.115	2.397	19.444	0.123
<i>Megalaima haemacephala</i>	0.250	7.407	0.034	0.323	9.259	0.035
<i>Merops orientalis</i>	1.653	18.519	0.089	1.893	21.759	0.087
<i>Anthus campestris</i>	1.353	17.593	0.077	1.598	21.296	0.075
<i>Anthus rufulus</i>	1.563	18.519	0.084	1.522	20.370	0.075
<i>Anthus trivialis</i>	1.302	18.981	0.069	1.560	23.611	0.066
<i>Motacilla maderaspatensis</i>	0.771	12.963	0.060	1.018	17.130	0.059
<i>Saxicoloides fulicatus</i>	1.032	16.204	0.064	1.161	20.370	0.057
<i>Copsychus saularis</i>	0.892	15.741	0.057	1.065	18.981	0.056
<i>Cyornis tickelliae</i>	0.110	3.241	0.034	0.076	2.315	0.033
<i>Saxicola caprata</i>	1.162	18.056	0.064	1.008	16.204	0.062
<i>Cinnyris asiaticus</i>	1.102	15.278	0.072	1.027	14.352	0.072
<i>Leptocoma minima</i>	0.511	10.185	0.050	0.400	9.722	0.041
<i>Leptocoma zeylonica</i>	0.751	13.426	0.056	0.799	17.593	0.045
<i>Parus major</i>	0.661	9.722	0.068	0.723	12.963	0.056
<i>Passer domesticus</i>	3.146	15.278	0.206	3.253	18.056	0.180
<i>Petronia xanthocollis</i>	0.892	13.889	0.064	1.132	15.741	0.072
<i>Phala crocoraxniger</i>	1.092	12.963	0.084	0.951	13.426	0.071
<i>Franco linuspondicerianus</i>	0.501	5.093	0.098	0.447	6.481	0.069
<i>Galloper dixlumulata</i>	0.000	0.000	0.000	0.029	0.926	0.031
<i>Pavo cristatus</i>	1.793	14.815	0.121	1.398	15.741	0.089
<i>Perdicula argoondah</i>	0.621	7.407	0.084	0.409	6.944	0.059
<i>Dinopium benghalense</i>	0.711	11.574	0.061	0.666	12.963	0.051
<i>Ploceus philippinus</i>	0.852	7.407	0.115	1.056	10.648	0.099
<i>Tachybaptus ruficollis</i>	0.321	4.630	0.069	0.323	4.630	0.070
<i>Loriculus vernalis</i>	0.070	0.926	0.076	0.162	2.778	0.058
<i>Psittacula cyanocephala</i>	0.000	0.000	0.000	0.010	0.463	0.021
<i>Psittacula krameri</i>	1.803	14.352	0.126	1.826	17.130	0.107
<i>Pterocles exustus</i>	0.281	3.704	0.076	0.352	5.093	0.069
<i>Pterocles indicus</i>	0.150	2.778	0.054	0.381	6.944	0.055
<i>Pycnonotus cafer</i>	0.8922	13.426	0.069	0.980	14.815	0.066
<i>Pycnonotus jocosus</i>	0.331	6.944	0.048	0.323	7.407	0.044
<i>Pycnonotus luteolus</i>	0.311	5.093	0.061	0.400	7.870	0.051
<i>Pycnonotus xantholaemus</i>	0.080	1.389	0.058	0.162	3.241	0.050

Table 3. Continued.

Species name	2014-1015			2015-2016		
	Relative abundance	Frequency	Species distribution ratio*	Relative abundance	Frequency	Species distribution ratio*
<i>Amaur ornisphoenicurus</i>	0.812	8.333	0.097	0.713	9.259	0.077
<i>Fulica atra</i>	0.601	9.259	0.065	0.533	10.185	0.052
<i>Gallinul achloropus</i>	0.822	8.796	0.093	0.685	8.796	0.078
<i>Porphyrio porphyrio</i>	0.852	10.648	0.080	0.780	10.648	0.073
<i>Rhipidura albogularis</i>	0.020	0.463	0.043	0.133	3.241	0.041
<i>Actitis hypoleucos</i>	0.671	9.259	0.072	0.656	9.259	0.071
<i>Tringa glareola</i>	0.581	9.722	0.060	0.495	8.333	0.059
<i>Sterna aurantia</i>	0.391	4.167	0.094	0.466	6.944	0.067
<i>Athene brama</i>	0.812	14.815	0.055	0.723	12.500	0.058
<i>Bubo bengalensis</i>	0.210	6.019	0.035	0.314	8.333	0.038
<i>Acrida theres fuscus</i>	1.272	14.815	0.086	1.265	16.667	0.076
<i>Acridotheres tristis</i>	2.314	22.222	0.104	1.998	19.907	0.100
<i>Temenuchus pagodarum</i>	0.661	14.815	0.045	0.866	16.667	0.052
<i>Sylvia althaea</i>	0.581	8.796	0.066	0.675	12.963	0.052
<i>Tephrodornis pondicerianus</i>	0.691	12.037	0.057	0.713	14.815	0.048
<i>Plegadis falcinellus</i>	0.822	8.796	0.093	0.961	9.259	0.104
<i>Pseudibis papillosa</i>	0.511	6.019	0.085	0.523	7.407	0.071
<i>Threskiornis melanocephalus</i>	0.271	3.241	0.083	0.228	4.167	0.055
<i>Dumetia hyperythra</i>	0.210	3.241	0.065	0.257	5.093	0.050
<i>Zoothera citrine</i>	0.170	3.704	0.046	0.219	3.704	0.059
<i>Upupa epops</i>	0.481	9.259	0.052	0.656	12.963	0.051
<i>Zosterop spalpebrosus</i>	0.050	1.389	0.036	0.143	3.704	0.039

Discussion

A study by Harisha et al. (2008) explored the avian fauna in the region albeit limiting the study to Jogimatti forest in Chitradurga district. The study reported 49 species of birds in the region belonging to 21 families. In this present study, we have recorded a total of 126 bird species belonging to 54 families and 20 orders in Chitradurga district. This encompasses all six taluks of Chitradurga district. While studies on avian fauna are limited in the particular study region, many studies have looked at avian fauna in other similar climatic zones of Karnataka. Basavarajappa and Kanamadi (2002) in their study reported 121 bird species from Bellary district; Manjunath and Joshi (2014) reported 51 species of birds from another in Gulbarga region. Nautiyal et al. (2013) recorded 98 species from semi-arid region of Gulbarga and Yadgir districts. Earlier worker recorded 79 bird species from semi-arid region of Gujarat. Gajera et al. (2012) reported 116 species from other semi-arid region forest of Gujarat.

Understanding the feeding guilds of avian fauna in a particular system is the foremost thing in an ecosystem because distribution of bird feeding guilds is totally dependent on the variation in vegetation structure of an ecosystem (Azman et al. 2011). In this present study six major feeding guilds were identified in the study area accordingly the insectivorous is predominant feeding guild with 49 species (38.89%) of birds followed by carnivorous (17 species, 13.49%), omnivorous (16 species 12.70%), granivorous (13 species, 10.32%), frugivorous (8 species, 6.35%) and nectanivorous (4 species, 3.17%). Similar observations have also been made by other researchers who reported the predominance of insectivorous guild compared to other feeding guilds (Gajera et al. 2012, Rajashekara and Venkatesha 2015, Sharma and Kichloo 2015).

Our documentation of avian fauna provided important information as one globally endangered (*Neophron percnopterus*), one vulnerable (V) (*Pycnonotus xantholaemus*), three globally near threat-

ened (NT) (*Sterna aurantia*, *Mycteria leucocephala*, *Threskiornis melanocephalus*) and remaining 121 least concerned (LC) bird species amongst the 126 bird species recorded from the study area. The study also analyzed that amongst the 126 bird species four species were migrants, 22 species were resident migrant and remaining 100 species were residential birds. Similar results were reported in other parts of semi-arid regions in India (Gajerat et al. 2012, Subramanyam and Khan 2016, Subramanyam 2017).

Our results indicated that the area has rich bird diversity with very few threatened species. In this semi-arid region where temperature levels are high and thereby resulting in excess water scarcity, especially during the hot summer season. Apart from this, there is also excess competition for the natural resources in the region with a large number of human population, who dependent on the same resources for their livelihood in addition to several developmental activities. As these multiple stresses affecting the ecosystem, there is a great need for conserving bird diversity which in its own way is an integral component of the ecosystem providing ecosystem services in the form of seed dispersal, insect pest control and many other pivotal ecological roles. However, a more elaborate data needs to be collected to understand these nuances better.

The study provides a good baseline data but there is a need for detailed micro level studies of various other ecological factors i.e. diversity distribution, ecological causes behind the migratory status of avian fauna and interaction with other species in the semi-arid region. These data help to prepare conservation strategies and management plans to conserve the avian fauna in different ecosystems of semi-arid region of Chitradurga district.

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References

- Ali S (2012) The Book of Indian Birds. Salim Ali Centenary Edition. New Delhi : Oxford University Press.
- Arlott N (2014) Collins Field Guild Birds of India : Pakistan, Nepal, Bhutan, Bangladesh and Srilanka. Harper Collins Publisher, London.
- Azman NM, Latip NSA, Sah SA, Akil MA, Shafie NJ, Khairuddin NL (2011) Avian diversity and feeding guilds in a secondary forest, an oil palm plantation and a paddy field in Riparian area of the Kerian River Basin, Perak, Malaysia. *Trop Life Sci Res* 22 (2) : 45—64.
- Basavarajappa C, Kanamadi RD (2002) Composition and dynamics of the bird community of Tavaragundi Village, Bellary district, Karnataka. *Zoo's Print J* 17 : 820—828.
- Bibby CJ, Burgess ND, Hill DA (1992) Bird census techniques. Academic Press, London.
- Census of India (2011) District Census Handbook Chitradurga, Karnataka, Series -30, PART XII-A. http://www.censusindia.gov.in/2011_census/dchb/2912_PART_A_DCHB_CHITRADURGA.pdf
- Cottam G, Curtis JT (1956) The Use of Distance Measurements in Phyto-sociological Sampling. *Ecol* 37 : 451—460.
- FAO (1963) Land degradation in arid, semi-arid and dry sub-humid areas : Rainfed and irrigated lands, rangelands and woodlands. [http : //www.fao.org/docrep/x5308e/x5308e00.htm#Contents](http://www.fao.org/docrep/x5308e/x5308e00.htm#Contents).
- Gajera NB, Mahato AKR, Kumar VV (2012) Birds in the arid and semi-arid forests of Kachchh : Its status, diversity and composition. *Inter J Res Zool* 2 (4) : 23—27.
- Harisha MN, Ajay GA, Kumar MD, Hosetti BB (2008) Floristic and avifaunal diversity of Jogimatti State forest. Chitradurga, Karnataka. *My fore* 44 (3) : 225—235. <https://www.iucn.org/regions/asia/countries/indiaretrived> on 1 February 2018,11 :18 AM.
- IUCN (2016) Bird Life International. The IUCN Red List of Threatened Species 2016. www.iucnredlist.org. Accessed on 1 December 2016.
- Junior PCAS, Marques FC, Limab MR, Anjos LD (2016) The importance of restoration areas to conserve bird species in a highly fragmented Atlantic forest landscape. *Natureza & conservação* 14 : 1—7.
- Kalsi RS (2007) Status, distribution and management of Galliformes in arid and semi-arid zones of India. In : Sathyakumar S, Sivakumar K, (eds). Galliformes of India. ENVIS Bulletin : Wildlife and Protected Areas 10 (1). Wildlife Institute of India, Dehradun, India, pp 101—104.
- Koli VK (2014) Diversity and status of avifauna in Todgarh-Raoli Wildlife Sanctuary, Rajasthan, India. *J Asia-Pack Biodiver* 7 (4) : 401—407.
- Köppen W (1884) Die W armezonen der Erde, nach der Dauer der heissen, gem- assigten und kalten Zeit und nach der Wirkung der Wärme auf die organische Welt betrachtet (The thermal zones of the earth according to the duration of hot, moderate and cold periods and to the impact of heat on the organic world). *Meteorol Z* 1884 1 : 215—226. (translated and cited by Volken E, Bronnimann S. *Meteorol Z*. 20 (2011) : 351—360).
- Kremen C, Ostfeld RS (2005) A call to Ecologists : Measuring, Analyzing and Managing Ecosystem Services, *Front in*

- Ecol and the Environ 3 (10) : 540–548.
- Kress SW (2000) *Birder's Handbook*. Dorling Kindersley Publishing, Inc, New York.
- Mangesha G, Yosef M, Sahle K, Elphick C, Bekele A (2014) Effects of Landuse on Birds Diversity in and around Lake Zeway, Ethiopia. *J Sci and Dev* 2 (2) : 5–22.
- Manjunath, Joshi BN (2014) Avifauna of Chandrampalli Dam, Chincholi, Gulbarga district Karnataka. *Int J Res Appl Nat Soc Sci* 2 (4) : 1–10.
- Millennium Ecosystem Assessment (2003) *Ecosystem and Human well-being : A frame work for assessment*. Island Press, Washington, DC.
- Nautiyal S, Bhaskar K, Khan YDI (2015) Biodiversity of Semi-arid Landscape : Baseline Study for Understanding the Impact of Human Development on Ecosystems, Springer International Publishing Switzarland.
- Nautiyal S, Bhaskar K, Khan YDI, Venkateshalu (2013) Biodiversity monitoring and its distribution in and around Uranium mining. area of Gogi, Gulbarga (Yadgir), Karnataka : A case study. *J Biod* 4 (2) : 69–77.
- Núñez-Zapata J, Pollack-Velásquez LE, Huamán E, Tiravanti J, Garcia E (2016) A complication of the birds of La Libertad Region, Peru. *Revista Mexicana de Biodiversidad* 87 : 200–215.
- Oster M (1978) *Birds and Culture* Doubleday & Company, Inc : New York.
- Praveen J, Jayapal R, Pittie A (2016) A Checklist of the birds of India. *Ind birds* 11 (5 & 6) : 113–172.
- Rajashekara S, Venkatesha MG (2015) Temporal and spatial avian community composition in urban landscapes of the Bengaluru region, India. *J Environ Biol* 36 (3) : 607–616.
- Rajashekara S, Venkatesha MG (2017a) Seasonal incidence and diversity pattern of avian communities in the Bangalore University Campus, India. *Proc the Zool Soc* 70 (2) : 178–193.
- Rajashekara S, Venkatesha MG (2017b) Impact of threats on avifaunal communities in diversely urbanized landscapes of the Bengaluru city, South India . *Zool and Ecol* 27 (3–4) : 202–222.
- Rathod J, Deshkar S, Gavali D, Sankhwal A (2015) Birds of Coastal Jamnagar and their Feeding Guilds, *Bull Environ Pharmacol and Life Sci* 4 (10) : 15–19.
- Reed JM, Elphick CS, Leno EN, Zuur AF (2011) Long-term population trends of endangered Hawaiian waterbirds. *Popul Ecol* 53 : 473–481.
- Sekercioglu CH (2006) Increasing awareness of avian ecological function. *Trends Ecol Evol* 21 : 464–471.
- Sharma N, Kichloo MA (2015) Avian habitat-use and dietary guilds in different forest communities of Bhaderwah, Jammu and Kashmir, India. *Int J Recent Scient Res* 6 (7) : 5145–5149.
- Shiddamallayya N, Rama Rao V, Doddamani SH, Venkatesh warlu G (2016) A glimpse on forest flora and India system of medicine plants of Chitradurga district, Karnataka. *Int J Herb Med* 4 (1) : 25–33.
- Shin SH, Chung IU, Kim HJ (2012) Relationship between the expansion of drylands and the intensification of Hadley circulation during the late twentieth century. *Meteorol Atmos Phys* 118 : 117–128.
- Singh JS, Joshi MC (1979) Ecology of the semi-arid regions of India with emphasis on land-use. In : Walker BH (ed). *Management of semi-arid ecosystems*. Elsevier Scientific Publishing Company, pp 227–243.
- Singh NN, Rai S (2000) Relative abundance of different Coccinellids in Mustard ecosystem. *Ind J Ent* 62 : 422–426.
- Souza KD, Kituyi E, Harvey B, Leone M, Murali KS, Ford JD (2015) Vulnerability to climate change in three hot spots in Africa and Asia : Key issues for policy-relevant adaptation and resilience building research. *Reg Environ Change* 15 : 747–753.
- Stattersfield AJ, Crosby MJ, Long AJ, Wege DC (2005) *Endemic bird areas of the world : Priorities for biodiversity conservation*. Bird Life International .
- Subramanyam VVB (2017) A preliminary assessment and diversity of birds in Ramagiri east and west forest, Anantapuramu district, Andhrapradesh, India. *Int J Zool Stud* 2 (4) : 21–28.
- Subramanyam VVB, Khan YDI (2016) Avian fauna of proposed wind power project area at Chillavaripalli and Ellutla reserve forests. *J Entomol Zool Stud* 4 (6) : 722–728.
- Sutherland WJ (2006) *Ecological Census Techniques—A Hand Book* 2nd edn. Cambridge University Press, Cambridge, UK.
- UN EMG (2011) *Global drylands : A UN system wide response*. Environment Management group of the United Nations Geneva. Retrieved from [http : // www.unccd.int/Lists/Site_Document_Library_/Publications/Global_Drylands_Full_Report.pdf](http://www.unccd.int/Lists/Site_Document_Library_/Publications/Global_Drylands_Full_Report.pdf)
- Whelan CJ, Wenny DG, Marquis RJ (2008) *Ecosystem Services Provided by Birds*. New York Acad Sci 1134 : 25–60.