Research Article

Avian Species Diversity in Different Habitats of Shivamogga, Karnataka, India

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ABSTRACT

Background: Avifaunal diversity and its abundance measures the quality of the ecosystem. Diversified landscapes were assumed to furnish more niches or supportive resources which in turn helps to increase diversity of avifauna. **Aim:** To assess the diversity of avifauna and its status in different habitats of Shivamogga taluk. **Materials and Methods:** Field exploration for assessing the bird diversity was undertaken in the four different habitats of Shivamogga Taluk. Point count method and line transects was used for gathering data on abundance and diversity of birds in all the four different habitats. **Results:** The present study was conducted in the study site for a period of one year. A total of 6,866 individual birds of 137 species representing 53 families and 18 orders was observed and 4 Near Threatened species and 3 Vulnerable species was recorded from the study area. Significant variation in avian species richness was observed from the four study sites ($F=10.36$, $p<0.0001$, $df=5$). Fisher alpha indices which consider both richness and abundance was higher in Site 1 (18.36) and lowest was observed Site 2 (11.32). The order Passeriformes dominated the bird community with 26 families and 57 species. Seven foraging guilds were observed in the study area. Insectivorous birds with 46 species were found to be dominant. Principal Component Analysis (PCA) was used to find the positive correlation between the Near threatened, Vulnerable species and the study sites. **Conclusion:** These findings implicate that the study area has a good number of avian species diversity. Each habitat has its own specialist species. Avian species richness was found to be higher in forest ecosystem while the dominance and abundance was more in Agrarian ecosystem. Alpha diversity was measured to comprehensively evaluate the quality of the different habitats.

Keywords: Vulnerable species, Foraging Guilds, Fisher alpha indices, Specialist species, PCA.

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INTRODUCTION

Birds are the most common inhabitants of the ecosystem and they have been contemplated as an indicator species of a particular environment.[1] The diverseness and the abundance of avifauna measures the quality of the ecosystem. Birds play a dominant role as pest controlling agents of agricultural crops, predators of rodents, pollinating agents, scavengers and seed dispensers. Bird, thus form principal component of the environment and important for ecological balance. Protection and maintenance of avifaunal diversity is important in maintaining species diversity of plants and animals. They are an integral component of biological diversity and have colossal aesthetic, lucrative and ecological values.[2] Population studies has been used to evaluate long term changes in bird community structure and also to assess both the quality of the habitat and the response of birds to both natural and anthropogenic changes.[3] Diversified landscapes were assumed to furnish more niches or supportive resources which in turn helps to increase diversity of avifauna. Recent studies illustrated that higher biological diversity assists species viability and also a key indicator of human contentment.[4,5] Species richness is directly proportional to the availability of food, atmospheric conditions, evolutionary history and predation pressure.[6] As the south Asia has a

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serried population, the avifauna which has the ability to acclimatize themselves to human environment prosper well.[7] India houses 1,341 avian species belonging to 26 orders, 113 families, and 489 genus.[8] Bird community evaluation has become an essential tool in biodiversity conservation which is necessary for documenting the present status for future monitoring and conservation of avifaunal species.[9] The present research is focused on the evaluation of distribution pattern, richness and abundance of the avifauna in the different landscapes of Shivamogga Taluk which will impart the baseline information for conserving and managing their habitats.

MATERIALS AND METHODS

Study area

Field exploration for assessing the bird diversity was undertaken in the four different habitats of Shivamogga Taluk. Shivamogga taluk lies between 13°48'0"N to 14°6'0"N and 75 °18'0"E to 75°45'0" E. It is one of the taluks of Shivamogga District. The Study area receives an average yearly rainfall of 104.2 mm and has an average annual temperature of 24.2°C.

Four Sites such as Site 1 (14°04'45"N and 75°19'42"E– bounded by Moist Deciduous Forest Ecosystem), Site 2 (14°00'59"N and 75°39'52"E- Covered with Agrarian Ecosystem). Site 3 (13°56'55"N and 75°36'59"E – consists of Riverine Ecosystem) and Site 4 (13°47'42"N and 75°29'29"E- consists of Wetland Ecosystem) were Selected in the Shivamogga Taluk (Figure 1).

Methods

The field exploration for bird survey was done periodically from March 2020 to February 2021. Transects were used to record the avian species. Five transects of 500 meters length was applied in every habitat. 200 meters gap was made between 2 alternative transects. Point count method was employed for collecting the data on diversity and abundance of avifauna in all the four habitats. Four-point count stations of 50 meters circumference was marked on every transect. Point counts of the birds was carried out from 06:00 A.M to 10:00 A.M and 4:00 P.M to 6:30 P.M as the bird activity was found to be the highest during these hours. Counts was not carried out during raining misty or windy and other unfavourable weather conditions to avoid biases. 40-min Timed Species Counts (TSCs) was performed for 5 times during each day of field observation. Each TSCs was separated by at least 100 meter or 10-min walk from the next.[10] In agricultural and forest areas line transects using distance sampling was performed to sample avian species. Birds are sighted with the help of 10X50 wide angle Nikon Action binocular and the birds are photographed by using Nikon D5600 camera with three different lens (i)18-55mm (ii) 70-300 (iii) 200-500mm telescopic lens. Birds are identified by using the book of Indian birds by Dr. Salim Ali.[11] and Birds of The Indian Subcontinent by Tim Inskipp, Richard Grimmett, Carol Inskipp.[12]

Birds have been categorised based on migratory status as Resident (R), Resident Migratory (RM) and Migratory (M). Based on the number of sightings made throughout the study period, the presence of each species in the study site is reported as Very Common (≥8 sightings), Common (5-7 sightings), Uncommon (3-4 sightings) and Rare (1-2 Sightings).[13] Recorded birds have been Categorised into Vulnerable (VU), Neat Threatened (NT) and Least Concern (LC) Category (IUCN 2023). Dominance D, Menhinick, Margelef, Shannon entropy (H), Brilluoin, Simpson's 1-dominance (1–λ), Fisher's Alpha (αF) and Berger Parker (1/d) indexes have been used to measure the traditional alpha diversity of bird species.[14] PCA was analysed using XLSTAT. One-way ANOVA was analysed using GraphPad Prism 9.

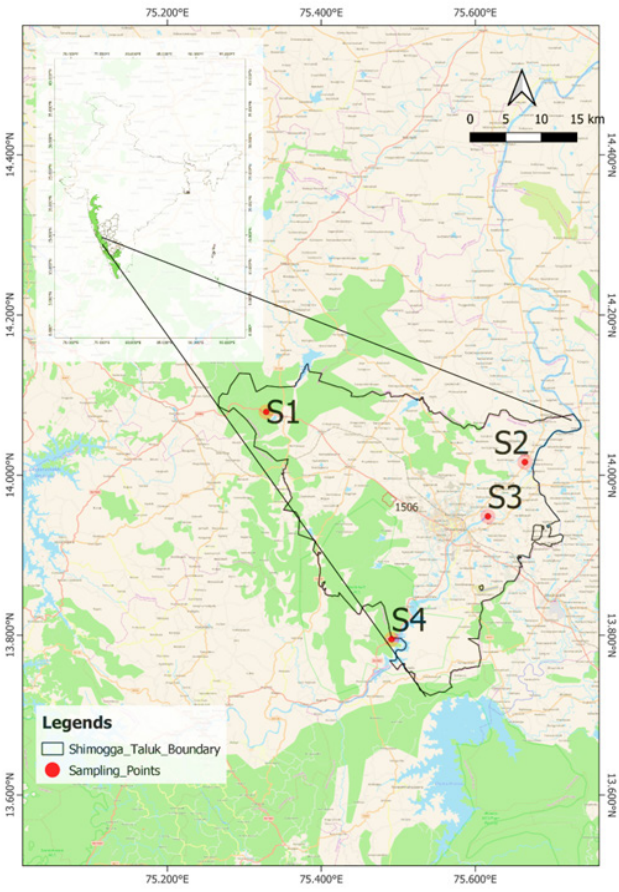

Figure 1: Map Showing the sampling location for assessing the avifaunal diversity in the study area.

Table 1: Checklist of the avifauna in the study area.

Sl. No	Common Name	Scientific Name	Family	Order	Migratory status	IUCN Status	Abundance
1	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	Podicipediformes	R	LC	VC
2	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae		RM	LC	VC
3	Little cormorant	*Microcarbo niger*			RM	LC	VC
4	Oriental Darter	*Anhinga melanogaster*	Anhingidae	Suliformes	RM	NT	C
5	Cattle Egret	*Bubulcus ibis*	Ardeidae		RM	LC	VC
6	Median Egret	*Ardea intermedia*			RM	LC	VC
7	Little Egret	*Egretta garzetta*			R	LC	VC
8	Indian Pond Heron	*Ardeola grayii*			R	LC	VC
9	Black-Crowned Night Heron	*Nycticorax nycticorax*			R	LC	VC
10	Purple heron	*Ardea purpurea*			RM	LC	VC
11	Grey heron	*Ardea cinereal*			RM	LC	VC
12	Oriental White Ibis	*Threskiornis melanocephalus*	Threskiornithidae	Pelecaniformes	R	NT	VC
13	Black Ibis	*Pseudibis papillosa*			R	LC	VC
14	Common teal	*Anas crecca*	Anatidae	Anseriformes	M	LC	VC
`15	Lesser Whistling duck	*Dendrocygna javanica*			R	LC	VC
16	Indian spot-billed duck	*Anas poecilorhyncha*			R	LC	VC
17	Asian Openbill Stork	*Anastomus oscitans*	Ciconiidae	Ciconiiformes	RM	LC	VC
18	White Necked Stork	*Ciconia episcopus*			R	NT	VC
19	Yellow footed green pigeon	*Treron phoenicoptera*	Columbidae	Columbiformes	R	LC	VC
20	Rock Pigeon	*Columba livia*			R	LC	VC
21	Spotted dove	*Spilopelia chinensis*			R	LC	VC
22	Emerald dove	*Chalcophaps indica*			R	LC	UC
23	Laughing dove	*Spilopelia senegalensis*			R	LC	C
24	Indian Peafowl	*Pavo cristatus*	Phasianidae		R	LC	VC
25	Grey Francolin	*Francolinus pondicerianus*	Galliformes		R	LC	VC
26	Lesser coucal	*Centropus bengalensis*	Cuculidae	Cuculiformes	R	LC	VC
27	Greater Coucal	*Centropus sinensis*			R	LC	VC
28	Indian cuckoo	*Cuculus Micropterus*			M	LC	VC
29	Common hawk cuckoo	*Hierococcyx varius*			R	LC	VC
30	Jacobin cuckoo	*Clamator jacobinus*			M	LC	VC
31	Asian koel	*Eudynamys scolopaceus*			R	LC	VC
32	White breasted waterhen	*Amaurornis phoenicurus*	Rallidae	Gruiformes	R	LC	VC
33	Purple Moorhen	*Porphyrio porphyrio*			R	LC	VC
34	Indian moorhen	*Gallinula chloropus*			R	LC	VC
35	Common coot	*Fulica atra*			M	LC	VC

continued...

Table 1: Cont'd.

Sl. No	Common Name	Scientific Name	Family	Order	Migratory status	IUCN Status	Abundance
36	Red wattled lapwing	*Vanellus indicus*	Charadriidae	Charadriiformes	R	LC	VC
37	yellow wattled lapwing	*Vanellus malabaricus*			R	LC	VC
38	Little ringed Plover	*Charadrius dubius*			RM	LC	UC
39	common Sandpiper	*Actitis hypoleucos*			M	LC	C
40	Wood Sandpiper	*Tringa glareola*			M	LC	C
41	Indian river Tern	*Sterna aurantia*	Laridae		M	VU	VC
42	Small Pratincole	*Glareola lactea*	Glariolidae		R	LC	VC
43	Indian spotted eagle	*Clanga hastata*			M	VU	R
43	White bellied sea eagle	*Haliaeetus leucogaster*			R	LC	R
45	Pariah Kite/Black Kite	*Milvus migrans*			R	LC	VC
46	Black shouldered Kite	*Elanus axillaris*	Accipitridae	Accipitriformes	R	LC	VC
47	Brahminy Kite	*Haliastur Indus*			R	LC	VC
48	Oriental Honey Buzzard	*Pernis ptilorhynchus*			R	LC	VC
49	Shikra	*Accipiter badius*			R	LC	VC
50	Changeable Hawk-Eagle	*Nisaetus cirrhatus*			R	LC	UC
51	Crested Serpent-Eagle	*Spilornis cheela*			R	LC	UC
52	Spotted owlet	*Athene brama*	Strigidae	Strigiformes	R	LC	VC
53	Malabar Trogan	*Harpactes fasciatus*	Trogonidae	Trogoniformes	R	LC	R
54	MalabarPied Hornbill	*Anthracoceros coronatus*			R	NT	UC
55	Malabar Grey Hornbill	*Ocyceros griseus*	Bucerotidae	Bucerotiformes	R	VU	C
56	Indian Grey Hornbill	*Ocyceros birostris*			R	LC	VC
57	Common hoopoe	*Upupa epops*	Upupidae		RM	LC	VC
58	Common Flameback	*Dinopium javanense*			R	LC	VC
59	Black Rumped Flameback	*Dinopium benghalense*			R	LC	VC
60	Brown-Capped Pygmy Woodpecker	*Yunipipicus nanus*	Picidae	Piciformes	R	LC	UC
61	Yellow-Crowned Woodpecker	*Leiopicus mahrattensis*			R	LC	UC
62	White-bellied woodpecker	*Dryocopus javensis*			R	LC	R
63	Heart-spotted woodpecker	*Hemicircus canente*			R	LC	R
64	Coppersmith Barbet	*Megalaima haemacephala*			R	LC	VC
65	White Cheeked Barbet	*Megalaima viridis*			R	LC	VC
66	Blue throated Barbet	*Megalaima asiatica*	Megalaimidae		R	LC	VC
67	Green Bee eater	*Merops orientalis*			R	LC	VC
68	Blue tailed Bee eater	*Merops philippinus*	Meropidae		RM	LC	VC
69	Chest nut headed Bee eater	*Merops leschenaultia*		Coraciiformes	R	LC	VC

continued...

Table 1: Cont'd.

Sl. No	Common Name	Scientific Name	Family	Order	Migratory status	IUCN Status	Abundance
70	White-throated kingfisher	*Halcyon smyrnensis*	Alcedinidae	Psittaciformes	R	LC	VC
71	Blue-Eared Kingfisher	*Alcedo meninting*			R	LC	VC
72	Common Kingfisher	*Alcedo atthis*			R	LC	VC
73	Pied Kingfisher	*Ceryle rudis*			R	LC	VC
74	Indian Roller	*Coracias benghalensis*	Coraciidae		R	LC	VC
75	Plum-Headed Parakeet	*Psittacula cyanocephala*	Psittaculidae		R	LC	VC
76	Rose-Ringed Parakeet	*Psittacula krameri*			R	LC	VC
77	Malabar Parakeet	*Psittacula columboides*			R	LC	R
78	Vernal Hanging parrot	*Loriculus vernalis*			R	LC	VC
79	Asian Palm swift	*Cypsiurus balasiensis*	Apodidae	Apodiformes	R	LC	VC
80	House swift	*Apus nipalensis*			R	LC	VC
81	Small minivet	*Pericrocotus cinnamomeus*	Campephagidae	Passeriformes	R	LC	VC
82	Scarlet Minivet	*Pericrocotus speciosus*			R	LC	VC
83	Orange Minivet	*Pericrocotus flammeus*			R	LC	VC
84	Black headed Cuckooshrike	*Coracina melanoptera*			R	LC	VC
85	Eurasian Golden oriole	*Oriolus oriolus*	Oriolidae		R	LC	VC
86	Black Naped Oriole	*Oriolus chinensis*			R	LC	VC
87	Black-hooded oriole	*Oriolus xanthornus*			R	LC	VC
88	Common Woodshrike	*Tephrodornis pondicerianus*	Vangidae		R	LC	VC
89	Indian Pitta	*Pitta brachyuran*	Pittidae		R	LC	VC
90	Grey Wagtail	*Motacilla cinerea*	Motacillidae		M	LC	VC
91	White Browed Wagtail	*Motacilla maderaspatensis*			R	LC	VC
92	Tree pipit	*Anthus trivialis*			M	LC	VC
93	Red vented Bulbul	*Pycnonotus cafer*	Pycnonotidae		R	LC	VC
94	Red Whiskered Bulbul	*Pycnonotus jocosus*			R	LC	VC
95	White-Browed Bulbul	*Pycnonotus luteolus*			R	LC	VC
96	Jerdon's Chloropsis	*Chloropsis jerdoni*	Chloropseidae		R	LC	VC
97	Bay- Backed Shrike	*Lanius vittatus*	Laniidae		R	LC	VC
98	Rufous backed Shrike	*Lanius schach*			R	LC	VC
99	Indian Robin	*Saxicoloides fulicatus*			R	LC	VC
100	Pied Bushchat	*Saxicola caprata*			R	LC	VC
101	White-Rumped Shama	*Copsychus malabaricus*	Muscicapidae		R	LC	UC
102	Oriental Magpie Robin	*Copsychus saularis*			R	LC	VC

continued...

Table 1: Cont'd.

Sl. No	Common Name	Scientific Name	Family	Order	Migratory status	IUCN Status	Abundance
103	Asian Paradise Fly Catcher	*Terpsiphone paradisi*	Monarchidae		R	LC	VC
104	Jungle Babbler	*Turdoides striata*	Leiothrichidae		R	LC	VC
105	Barn Swallow	*Hirundo rustica*			R	LC	VC
106	Pacific Swallow	*Hirundo tahitica*			R	LC	VC
107	Wire tailed Swalow	*Hirundo smithii*			R	LC	VC
108	Red-Rumped swallow	*Cecropis daurica*	Hirundinidae		R	LC	VC
109	Common Tailor Bird	*Orthotomus sutorius*	Cisticolidae		R	LC	VC
110	Ashy Prinia	*Prinia socialis*			R	LC	VC
111	Common Iora	*Aegithina tiphia*	Aegithinidae		R	LC	VC
112	Black Drongo	*Dicrurus macrocercus*			R	LC	VC
113	Ashy Drongo	*Dicrurus leucophaeus*			R	LC	VC
114	Greater racket tailed Drongo	*Dicrurus paradiseus*	Dicruridae		R	LC	UC
115	White bellied drongo	*Dicrurus caerulescens*			R	LC	C
116	Rufous Tree Pie	*Dendrocitta vagabunda*	Corvidae		R	LC	VC
117	House crow	*Corvus splendens*			R	LC	VC
118	Indian Jungle crow	*Corvus culminates*			R	LC	VC
119	Baya Weaver	*Ploceus philippinus*	Ploceidae		R	LC	VC
120	Loten's Sunbird	*Cinnyris lotenius*			R	LC	VC
121	Small Sunbird	*Leptocoma minima*	Nectariniidae		R	LC	VC
122	Purple-Rumped Sunbird	*Leptocoma zeylonica*			R	LC	VC
123	Red Munia/Red Avadavat	*Amandava amandava*			R	LC	VC
124	Black Headed Munia/ Tricolored Munia	*Lonchura atricapilla*	Estrildidae		R	LC	VC
125	White Throated Munia/ Indian silverbill	*Euodice malabarica*			R	LC	VC
126	Spotted Munia/ Scaly breasted Munia	*Lonchura punctulate*			R	LC	VC
127	Oriental White Eye	*Zosterops palpebrosus*	Zosteropidae		R	LC	UC
128	Brahminy Starling	*Sturnia pagodarum*			R	LC	VC
129	Common Hill Myna	*Gracula religiose*			R	LC	VC
130	Jungle Myna	*Acridotheres fuscus*	Sturnidae		R	LC	VC
131	Common Myna	*Acridotheres tristis*			R	LC	VC
132	Blyth's Reed Warbler	*Acrocephalus dumetorum*	Acrocephalidae		M	LC	VC
133	Great Tit	*Parus major*	Paridae		R	LC	VC
134	Black Lored Yellow Tit	*Parus xanthogenys*			R	LC	C
135	House Sparrow	*Passer domesticus*	Passeridae		R	LC	VC
136	Sykes's Lark	*Galerida deva*	Alaudidae		R	LC	VC
137	Orange Headed Thrush	*Geokichla citrina*	Turdidae		R	LC	UC

Table 2: Comparative Avian diversity in different habitats of Shivamogga.

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4
Little Grebe	*Tachybaptus ruficollis*	_	_	_	+
Great Cormorant	*Phalacrocorax carbo*	_	_	+	+
Little cormorant	*Microcarbo niger*	_	_	+	+
Cattle Egret	*Bubulcus ibis*	_	+	+	+
Median Egret	*Ardea intermedia*	_	+	+	+
Little Egret	*Egretta garzetta*	_	+	+	+
Indian Pond Heron	*Ardeola grayii*	_	_	+	+
Black-Crowned Night Heron	*Nycticorax nycticorax*	_	_	+	+
Purple heron	*Ardea purpurea*	_	_	+	+
Grey heron	*Ardea cinerea*	_	_	+	+
Oriental White Ibis	*Threskiornis melanocephalus*	_	+	+	_
Black Ibis	*Pseudibis papillosa*	_	+	_	+
Asian Openbill Stork	*Anastomus oscitans*	_	+	+	+
White Necked Stork	*Ciconia episcopus*	_	+	+	+
Yellow footed green pigeon	*Treron phoenicoptera*	_	+	_	_
Rock Pigeon	*Columba livia*	_	+	_	_
Spotted dove	*Spilopelia chinensis*	_	+	_	_
Indian Peafowl	*Pavo cristatus*	+	+	_	_
Grey Francolin	*Francolinus pondicerianus*	_	+	_	_
Lesser coucal	*Centropus bengalensis*	+	_	_	_
Greater Coucal	*Centropus sinensis*	+	_	_	_
Indian cuckoo	*Cuculus Micropterus*	+	_	_	_
Jacobin cuckoo	*Clamator jacobinus*	+	_	_	_
Asian koel	*Eudynamys scolopaceus*	+	_	_	_
White breasted waterhen	*Amaurornis phoenicurus*	_	_	+	+
Purple Moorhen	*Porphyrio porphyrio*	_	_	_	+
Indian moorhen	*Gallinula chloropus*	_	_	_	+
Common coot	*Fulica atra*	_	_	_	+
Red wattled lapwing	*Vanellus indicus*	_	_	+	+
yellow wattled lapwing	*Vanellus malabaricus*	_	_	+	+
common Sandpiper	*Actitis hypoleucos*	_	+	+	+
Indian river Tern	*Sterna aurantia*	_	_	+	+
Indian spotted eagle	*Clanga hastata*	+	_	_	_
Pariah Kite/Black Kite	*Milvus migrans*	+	_	+	_
Black shouldered Kite	*Elanus axillaris*	+	+	_	_
Brahminy Kite	*Haliastur Indus*	+	+	+	+
Oriental Honey Buzzard	*Pernis ptilorhynchus*	+	_	_	_
Shikra	*Accipiter badius*	+	_	_	_
Spotted owlet	*Athene brama*	+	_	_	_
Indian Grey Hornbill	*Ocyceros birostris*	+	_	_	_
Common hoopoe	*Upupa epops*	+	+	+	_
Common flameback	*Dinopium javanense*	+	_	_	_
Black-rumped flameback	*Dinopium benghalense*	+	_	_	_
Coppersmith Barbet	*Megalaima haemacephala*	+	_	_	_
White Cheeked Barbet	*Megalaima viridis*	+	_	_	_
Blue throated Barbet	*Megalaima asiatica*	+	_	_	_
Green Bee eater	*Merops orientalis*	_	+	_	_
Blue tailed Bee eater	*Merops philippinus*	_	+	_	_
White-throated kingfisher	*Halcyon smyrnensis*	_	+	+	+

Table 2: Cont'd.

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4
Blue-Eared Kingfisher	*Alcedo meninting*	_	_	+	_
Common Kingfisher	*Alcedo atthis*	_	_	+	+
Pied Kingfisher	*Ceryle rudis*	_	_	+	+
Indian Roller	*Coracias benghalensis*	+	+	_	_
Plum-headed Parakeet	*Psittacula cyanocephala*	+	_	_	_
Rose-ringed Parakeet	*Psittacula krameria*	+	+	_	_
Vernal Hanging parrot	*Loriculus vernalis*	+	_	_	_
Asian Palm swift	*Cypsiurus balasiensis*	_	_	+	_
House swift	*Apus nipalensis*	_	_	+	+
Small minivet	*Pericrocotus cinnamomeus*	+	_	_	_
Scarlet Minivet	*Pericrocotus speciosus*	+	_	_	_
Orange Minivet	*Pericrocotus flammeus*	+	_	_	_
Black headed Cuckooshrike	*Coracina melanoptera*	+	_	_	_
Eurasian Golden oriole	*Oriolus oriolus*	+	_	_	_
Black Naped Oriole	*Oriolus chinensis*	+	_	_	_
Black-hooded oriole	*Oriolus xanthornus*	+	_	_	_
Common Woodshrike	*Tephrodornis pondicerianus*	+	_	_	_
Grey Wagtail	*Motacilla cinerea*	_	+	+	+
White Browed Wagtail	*Motacilla maderaspatensis*	_	+	+	+
Tree pipit	*Anthus trivialis*	_	+	_	_
Red vented Bulbul	*Pycnonotus cafer*	+	+	+	+
Red Whiskered Bulbul	*Pycnonotus jocosus*	+	+	+	+
Jerdon's Chloropsis	*Chloropsis jerdoni*	+	_	_	_
Bay- Backed Shrike	*Lanius vittatus*	_	+	_	_
Rufous backed Shrike	*Lanius schach*	_	+	_	_
Indian Robin	*Saxicoloides fulicatus*	_	+	_	_
Pied Bushchat	*Saxicola caprata*	_	+	_	_
White-rumped Shama	*Copsychus malabaricus*	+	_	_	_
Oriental Magpie-Robin	*Copsychus saularis*	+	+	+	_
Asian Paradise Fly Catcher	*Terpsiphone paradisi*	+	_	_	_
Jungle Babbler	*Turdoides striata*	+	_	_	_
Barn Swallow	*Hirundo rustica*	_	+	+	_
Wire tailed Swalow	*Hirundo smithii*	_	+	+	_
Red-rumped swallow	*Cecropis daurica*	_	+	+	_
Common Tailor Bird	*Orthotomus sutorius*	_	+	_	_
Ashy Prinia	*Prinia socialis*	_	+	_	+
Common Iora	*Aegithina tiphia*	+	_	_	_
Black Drongo	*Dicrurus macrocercus*	+	+	_	_
Ashy Drongo	*Dicrurus leucophaeus*	+	+	_	_
Rufous Tree Pie	*Dendrocitta vagabunda*	+	_	_	_
House crow	*Corvus splendens*	+	+	_	_
Indian Jungle crow	*Corvus culminates*	+	_	_	_
Baya Weaver	*Ploceus philippinus*	_	+	_	_
Loten's Sunbird	*Cinnyris lotenius*	_	_	+	+
Purple Rumped Sunbird	*Leptocoma zeylonica*	_	_	+	+
Red Munia/Red Avadavat	*Amandava amandava*	_	+	_	_
Black-headed Munia	*Lonchura atricapilla*	_	+	_	_
White-throated Munia	*Euodice malabarica*	_	+	_	_
Scaly breasted Munia	*Lonchura punctulata*	_	+	_	_

continued...

Table 2: Cont'd.

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4
Brahminy Starling	*Sturnia pagodarum*	+	_	_	_
Jungle Myna	*Acridotheres fuscus*	+	+	_	_
Common Myna	*Acridotheres tristis*	_	+	_	_
Yellow-eyed babbler	*Chrysomma sinense*	_	_	+	_
Blyth Reed Warbler	*Acrocephalus dumetorum*	_	_	+	_
Great Tit	*Parus major*	_	+	_	_
Black Lored Yellow Tit	*Parus xanthogenys*	+	_	_	_
House Sparrow	*Passer domesticus*	_	+	_	_
Sykes Crested Lark	*Galerida deva*	_	+	+	_
Wood Sandpiper	*Tringa glareola*	_	_	+	+
Small Pratincole	*Glareola lactea*	_	_	+	_
Changeable Hawk-Eagle	*Nisaetus cirrhatus*	+	_	_	_
Oriental darter	*Anhinga melanogaster*	_	_	_	+
Common teal	*Anas crecca*	_	_	_	+
Crested Serpent-Eagle	*Spilornis cheela*	+	_	_	_
Brown-Capped Pygmy Woodpecker	*Yunipipicus nanus*	+	_	_	_
Lesser whistling duck	*Dendrocygna javanica*	_	_	_	+
Yellow-Crowned Woodpecker	*Leiopicus mahrattensis*	+	_	_	_
Indian spot billed duck	*Anas poecilorhyncha*	_	_	+	+
white-bellied woodpecker	*Dryocopus javensis*	+	_	_	_
Emerald dove	*Chalcophaps indica*	+	_	_	_
Laughing dove	*Spilopelia senegalensis*	_	_	+	_
Heart-spotted woodpecker	*Hemicircus canente*	+	_	_	_
White-Browed Bulbul	*Pycnonotus luteolus*	_	_	+	_
White bellied drongo	*Dicrurus caerulescens*	+	_	_	_
Orange Headed Thrush	*Geokichla citrina*	+	_	_	_
Common hawk cuckoo	*Hierococcyx varius*	+	_	_	_
Little ringed plover	*Charadrius dubius*	_	_	_	+
White bellied sea eagle	*Haliaeetus leucogaster*	+	_	_	_
Malabar trogan	*Harpactes fasciatus*	+	_	_	_
Malabar Pied hornbill	*Anthracoceros coronatus*	+	_	_	_
Malabar Grey hornbill	*Ocyceros griseus*	+	_	_	_
Chestnut headed bee eater	*Merops leschenaultia*	_	_	_	+
Malabar Parakeet	*Psittacula columboides*	+	_	_	_
Indian Pitta	*Pitta brachyuran*	+	_	_	_
Greater racket tailed drongo	*Dicrurus paradiseus*	+	_	_	+
Small sunbird	*Leptocoma minima*	+	_	_	_
Oriental White eye	*Zosterops palpebrosus*	+	_	_	_
Common hill myna	*Gracula religiose*	_	_	_	+

Diversity index and Bray Curtis cluster analysis was analysed using Past 4.03. One-way ANOVA (Analysis of Variance) was performed to test the correlation of bird richness in the four study sites at 5% significance level ($p \leq 0.05$).

RESULTS

A total of 6,866 individual birds of 137 species representing 53 families and 18 orders was ascertained from the four sampling points of the study area. The checklist of recorded bird species along with their scientific name, family, order, migratory and IUCN status is depicted in Table 1. Order Passeriformes dominated the study area with 26 families and 57 species. Accipitridae family contributes 9 species which is the highest among all the families, Ardeidae family recorded with 7 species and Picidae and cuculidae recorded with 6 species each. All the four sites are found to be the

Table 3: Alpha diversity index values of four different study sites.

Study Sites	Site 1	Site 2	Site 3	Site 4
Shannon-H	4.222	3.731	3.765	3.827
Simpson- 1-D	0.9844	0.9736	0.9732	0.9764
Dominance- D	0.01563	0.02645	0.02162	0.02361
Evenness e^H/S	0.9336	0.8873	0.8912	0.9183
Brillouin	4.061	3.589	3.631	3.678
Menhinick	2.355	1.766	1.738	1.87
Margalef	10.48	7.01	7.187	7.456
Fisher alpha	18.36	11.32	11.54	12.24
Berger-Parker	0.02914	0.06085	0.05792	0.04755
Taxa S	73	47	49	50

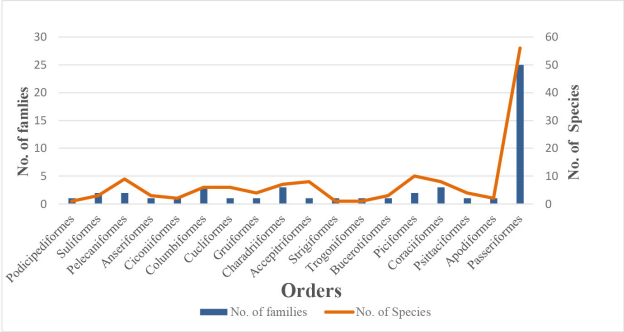

Figure 2: Order wise distribution of Avian fauna.

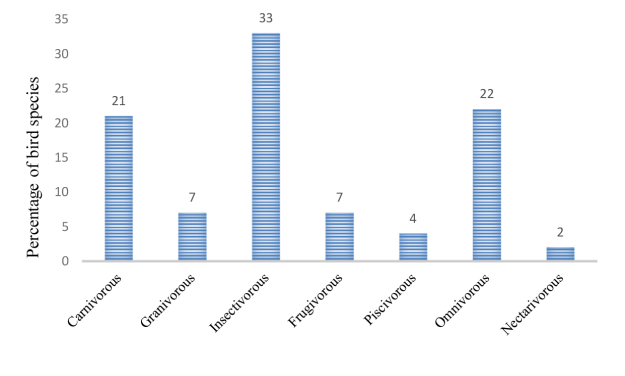

Figure 3: Guild-based classification of avian species recorded in different habitats of Shivamogga, Karnataka.

home for several migratory birds, 115 are Resident birds (R), 11 Resident Migratory birds (RM) and 11 Migratory birds (M). Site wise distribution of avifauna is depicted in Table 2.

There was a significant variance in the species richness across the four study sites (One-way ANOVA, F=10.36, p<0.0001, df=5).

Shannon diversity index H for avian community varying from 3.7 to 4.2 implicating a fairly diverse avian community. Shannon diversity was found to be high in

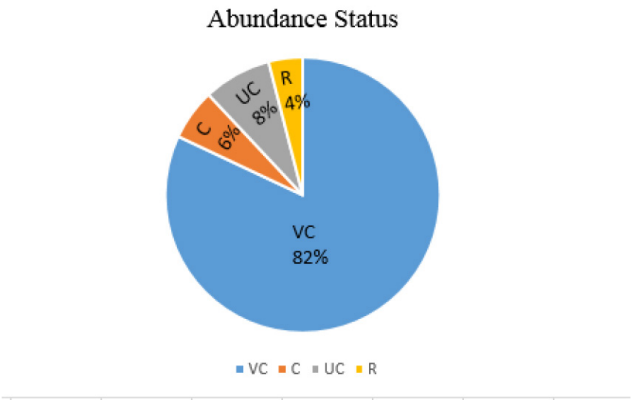

Figure 4: Abundance status of avifauna.

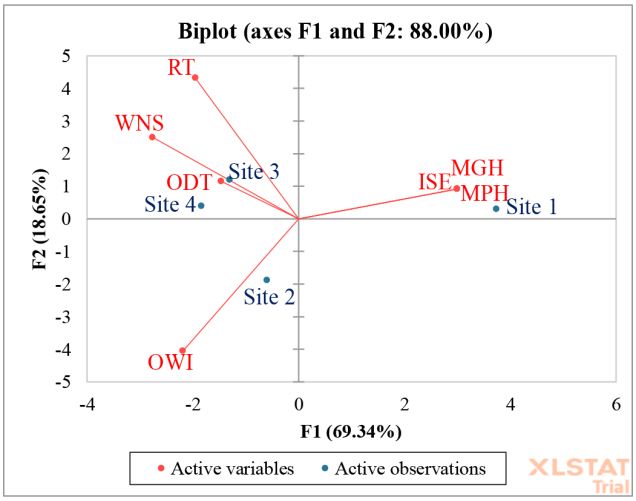

Figure 5: PCA ordination diagram (biplot) showing species response with the different study sites. (WNS- white Necked stork, RT- River Tern, ODT- Oriental darter, ISE-Indian Spotted Eagle, MGH-Malabar Grey Hornbill, MPH- Malabar Pied Hornbill and OWI-Oriental White Ibis.)

Site 1 (4.222) and lowest was observed in Site 2 (3.849). Shannon H, Dominance D, Simpson 1-D, Evenness e^H/S, Brillouin, Maegalef, Menhinick, Fisher-alpha, Beger- parker values of four different study sites were calculated as shown in Table 3.

The order Passeriformes dominated the bird community with 26 families and 57 species followed by Charadriiformes and Coraciiformes with 3 families respectively (Figure 2).

Seven foraging guilds were observed in the study area. Insectivorous birds (46 species, 33%) was found to be dominant followed by Omnivorous birds (30 species, 22%) Whereas, Nectarivorous (3 species, 2%) was the lease represented feeding guild (Figure 3).

As per the abundance status of the avifaunal diversity, 82% of species were categorised as Very Common (VC),

8% of species as Uncommon (UC), 6% of species as Common and 4% of species were Rare (R) (Figure 4).

Principal Component Analysis (PCA) was performed between the study sites and the threatened, vulnerable species. 88.00% of total variation was observed. PC1 explains 69.34% of variation and PC2 explains 18.65% of the variation in the data. River tern, white necked stork and oriental darter shows positive increment with Site 3 and Site 4. Indian spotted eagle, Malabar pied hornbill and Malabar grey hornbill Shows positive correlation with Site 1. Oriental White Ibis show positive correlation with site 2 (Figure 5).

DISCUSSION

A total of 137 Species representing 18 orders and 53 families were recorded in the study area. During the present study four Near threatened species such as oriental darter (*Anhinga Melanogaster),* White Necked Stork (*Ciconia episcopus*), oriental white ibis (*Threskiornis melanocephalus*) and Malabar Pied Hornbill (*Anthracoceros coronatus*) and three Vulnerable species such as Indian river tern (*Sterna aurantia*), Indian spotted eagle (*Clanga hastata*) and Malabar grey hornbill (*Ocyceros griseus*) were recorded. The order Passeriformes dominated the bird community with 26 families and 57 species followed by Charadriiformes and Coraciiformes with 3 families respectively. The study sites were selected based on different habitats so that the birds which are restricted to a specific habitat are assessed properly. The highest bird diversity was observed in Site 1 (Moist deciduous forest) having a Shannon diversity of 4.222, due to high vegetation cover. Highest Taxa-S of 73 individual species was found in Forest ecosystem. Isaac MM 2019 found that higher vegetation cover support higher diversity of birds.[15] Yair Parker in 2014 found that floral species richness positively correlates with the diversity of the avifaunal diversity.[16] Higher dominance was observed in the Site 2 (Dominance-0.02645). The site 2 encompasses the farmland which depicts that few species of Passeriformes birds dominated this particular habitat this is due to the dependency of Passeriformes bird on agrarian ecosystem for food. J. David Blount in 2021 found that Songbirds (Passeriformes) opt agrarian ecosystem as they provide good roosting site and also provide the protection from predators.[17] Site 2 has less diversity but have high value of dominance and the abundance of avifauna was found to be more in this site due to the presence of Native and generalist species like sparrows, weavers, munias, parakeet, egrets and dove. Each of the habitats has its own specialist species. Higher the values of Shannon, Simpson, Fisher alpha, Magalef and Brillouin was found to be higher in Site 1 and lowest was observed in Site 2. Dominance and Berger Parker were higher Site 2 and Lowest in Site 1. Thus, Dominance and Berger Parker show negative correlation with Shannon, Simpson, Fisher alpha, Magalef and Brillouin diversity indices. William Fernando in 2012 also found that Dominance and Berger Parker indices are negatively correlated with species richness indices.[18]

One-way ANOVA was applied between the study sites which resulted in the significant variation ($F=10.36$, $p<0.0001$, $df=5$). This is due to the presence of distinct habitats in each study sites. The order Passeriformes dominated the bird community with 26 families and 57 species. Out of the seven foraging guilds, Insectivorous birds (46 species, 33%) was found to be predominant in the study sites. Insectivorous birds dominated the forest ecosystem due to the abundance of folivorous arthropodan species in forest habitat.[19] Granivorous birds found to be predominant in agrarian ecosystem as they feed on the rice grains in paddy fields. Mohd-Taib found in 2018 that as the rice ripens before the harvesting season attracts the granivorous species.[20] Biplot analysis showed 88.00% of total variation. PCA was performed to observe the interdependency of Vulnerable, threatened species with the habitat. Out of four NT (Near Threatened) birds and 3 Vu (Vulnerable) Species, Site 1 has 2 Vu and 1 NT Species, Site 2 has only one NT species, Site 3 and Site 4 shows Positive correlation with 1 Vu and 2 NT species.

CONCLUSION

This study shows that, the study area has a good number of avian species diversity. Four species of Near Threatened and Three Vulnerable species were observed in the study area. Each habitat has its own specialist species. Order Passeriformes dominated the study area. The avian richness was found to be maximum in Site 1 but the dominance was found to be higher in Site 2. Alpha diversity was measured to comprehensively evaluate the quality of the different habitats. The present research will provide information regarding the diversity of birds in this study area which will be helpful for future monitoring of the avifaunal status in this particular region.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

VU: Vulnerable; **NT:** Near threatened; **LC:** Least concern; **R:** Resident; **RM:** Resident migratory; **VC:** Very common; **C:** Common; **UC:** Uncommon; **R:** Rare; **WNS:** White Necked Stork; **RT:** River Tern; **ODT:** Oriental Darter; **ISE:** Indian Spotted Eagle; **MGH:** Malabar Grey Hornbill; **MPH:** Malabar Pied Hornbill; **OWI:** Oriental White Ibis; **PCA:** Principal Component Analysis; **PC1:** Principal Component axis 1; **PC2:** Principal Component axis 2; **+:** Presence of avifauna; **-:** Absence of avifauna.

SUMMARY

The diverseness and the abundance of avifauna measures the quality of the ecosystem. The field exploration for assessing the diversity of avifauna in Shivamogga taluk was done from March 2020 to February 2021. The study area shows a good number of avifauna due the presence of diverse landscape elements. Different ecosystem such as forest, agrarian, riverine and wetland has been chosen to assess the avifaunal diversity so that birds which are confined to a particular habitat are assessed properly. The order Passeriformes dominated the bird community with 26 families and 57 species. All the four sites are found to be the home for several migratory birds, 115 are Resident birds (R), 11 Resident Migratory birds (RM) and 11 Migratory birds (M). Avian species richness was found to be higher in forest ecosystem while the dominance and abundance was more in Agrarian ecosystem. Indigenous forest supports high avian richness whereas high avian abundance was found in farmlands.[8] Each ecosystem has its own specialist species. The study area houses some of the endemic species such as Malabar Trogon, Malabar grey hornbill, white-bellied woodpecker and White-cheeked barbet. Thus, conservation of such habitats is the need of the hour. Conservation of these habitats will help to preserve the Avifaunal diversity of Shivamogga taluk, Karnataka, India as they are the integral part of an ecosystem.

REFERENCES

1. Blair RB. Land use and avian species diversity along an urban gradient. Ecol Appl. 1996;6(2):506-19. doi: 10.2307/2269387.
2. Pschorn-Walcher H. Biological control of forest insects. Annu Rev Entomol. 1977;22(1):1-22. doi: 10.1146/annurev.en.22.010177.000245.
3. Temple SA, Weins JA. Bird Populations and environmental changes: can birds be bio-indicators? Am Birds. 1989;43:260-70.
4. Fuller RA, Irvine KN, Devine-Wright P, Warren PH, Gaston KJ. Psychological benefits of greenspace increase with biodiversity. Biol Lett. 2007;3(4):390-94. doi: 10.1098/rsbl.2007.0149, PMID 17504734.
5. Luck GW, Davidson P, Boxall D, Smallbone L. Relations between urban bird and plant communities and human well-being and connection to nature. Conserv Biol. 2011;25(4):816-26. doi: 10.1111/j.1523-1739.2011.01685.x, PMID 21535147.
6. Jayson EA, Mathew DN. Seasonal changes of tropical forest birds in Southern Western Ghats. J Bombay Nat Hist Soc. 2000;97(1):52-61.
7. Manjunath BJ. Avifaunal diversity in Gulbarga region, north Karnataka. Recent Res Sci Technol. 2012;4(7):27-34.
8. Praveen J, Jayapal R, Pittie A. Checklist of the birds of India (V 5.1); 2021 [cited 6/4/2023]. Available from: https://www.indianbirds.in/india/.
9. Islam MZ, Rahmani AR. Important bird area in India: priority Sites for conservation. IBCN, Bombay Natural History Society. UK: Bird Life International. 2004; xviii + 1133pp.
10. Bett MC, Muchai M, Waweru C. Avian species diversity in different habitat types in and around North Nandi Forest, Kenya. Afr J Ecol. 2016;54(3):342-8. doi: 10.1111/aje.12338.
11. Ali S. The book of Indian birds. 13th ed, Bombay Natural History Society. Mumbai; 2002.
12. Grimmett R, Inskipp C, Inskipp T. Birds of the Indian subcontinent. 2nd ed. Oxford: Oxford University Press and Christopher Helm Publishers; 2011. p. 1-528.
13. Vyas MA, Raval JV. A Comparative Study of Avian Diversity at three Selected Sites of Porbandar, Gujarat, India. Asian J Biol Life Sci. 2023;11(3):662-77. doi: 10.5530/ajbls.2022.11.88.
14. Özkan K, Bileşenleri BÇ (α, β ve γ) Nasıl Ölçülür? Süleyman Demirel Üniversitesi, orman Fakültesi yayın. 2016;98:142.
15. Isaac MM, Muya SM, Kiiru W, Muchai M. Avian abundance, diversity and conservation status in Etago sub-county Kisii County Kenya. Open J Ecol. 2019;09(5):157-70. doi: 10.4236/oje.2019.95013.
16. Paker Y, Yom-Tov Y, Alon-Mozes T, Barnea A. The effect of plant richness and urban garden structure on bird species richness, diversity and community structure. Landsc Urban Plan. 2014;122:186-95. doi: 10.1016/j.landurbplan.2013.10.005.
17. Blount JD, Joshua JH, Kyle DK, Montague HC, Neate-CleggÇHŞ. Avian use of agricultural areas as migration stopover Sites: a review of crop management practices and ecological correlates. Front Ecol Evol. 2021;09:650641. doi: 10.3389/fevo.2021.65064.
18. Bonfim MGCP, Antonialli JWF. Community structure of social wasps (Hymenoptera: Vespidae) in riparian forest in Batayporã, Mato Grosso DO Sul, brazil. Sociobiology. 2012;59(3):755-65.
19. Kelvin SHP, Richard TC, Yves B. Routledge handbook of forest ecology. 1st ed. London: Routledge Press; 2015. p. 281-96.
20. Mohd-taib FS, kamaruddin HA. The rice-growing cycle influences diversity and species assemblages of birds in the paddy field ecosystem in east peninsular Malaysia. Pertanika J Trop Agric Sci. 2018;41(4):1-16.

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