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Avifaunal diversity of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

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Abstract: A total of 164 bird species belonging to 53 families were recorded in the Manjeera Wildlife Sanctuary. Of these 107 species were resident, 55 species were winter migrants and 2 species were summer migrants. The population of the each species in different habitats was estimated. Species richness was observed to be more in agriculture habitat followed by scrubland, grassland and marshy areas, whereas species diversity was observed to be more in scrubland habitat followed by agriculture lands, grasslands and marshy areas. Similarity Index analysis showed that the habitats of agriculture land-scrubland are more similar whereas, habitats of scrubland-marshy area show dissimilarity in the sanctuary.

Keywords: Andhra Pradesh, avian diversity, India, Manjeera Wildlife Sanctuary, Medak.

Birds are ideal bio-indicators and useful models for studying a variety of environmental problems as they are very sensitive to the slightest of environmental changes and are important health indicators of the ecological conditions and productivity of an ecosystem (Newton 1995; Desai & Shanbhag 2007; Li & Mundkur 2007). India has a rich avian diversity as it provides for a wide variety of wetland habitats that act as ideal wintering grounds for migratory water birds. The state of Andhra Pradesh is home to as many as 16 sites identified as Important Bird Areas of avifaunal significance (Islam & Rahmani 2005). Manjeera Wildlife Sanctuary is one such Important Bird Area in Andhra Pradesh. Manjeera Wildlife Sanctuary is located 50km northwest of Hyderabad, in Medak District, Andhra Pradesh. It is recognized as an important wetland for migratory birds. The water body provides considerable ecological diversity to support a large population of wetland birds (Islam & Rahmani 2005). One of the important tributaries of the Godavari River system is the river Manjeera. The Manjeera River originates in the Balaghat Hills in Madhya Pradesh, flows thorough Latur District in Maharashtra and Bidar District of Karnataka entering into Medak District of Andhra Pradesh before emptying into the Godavari River at Basara near Nizamabad District (Prasad et al. 2012). The Manjeera basin encompasses an area of 30,914km^2 of

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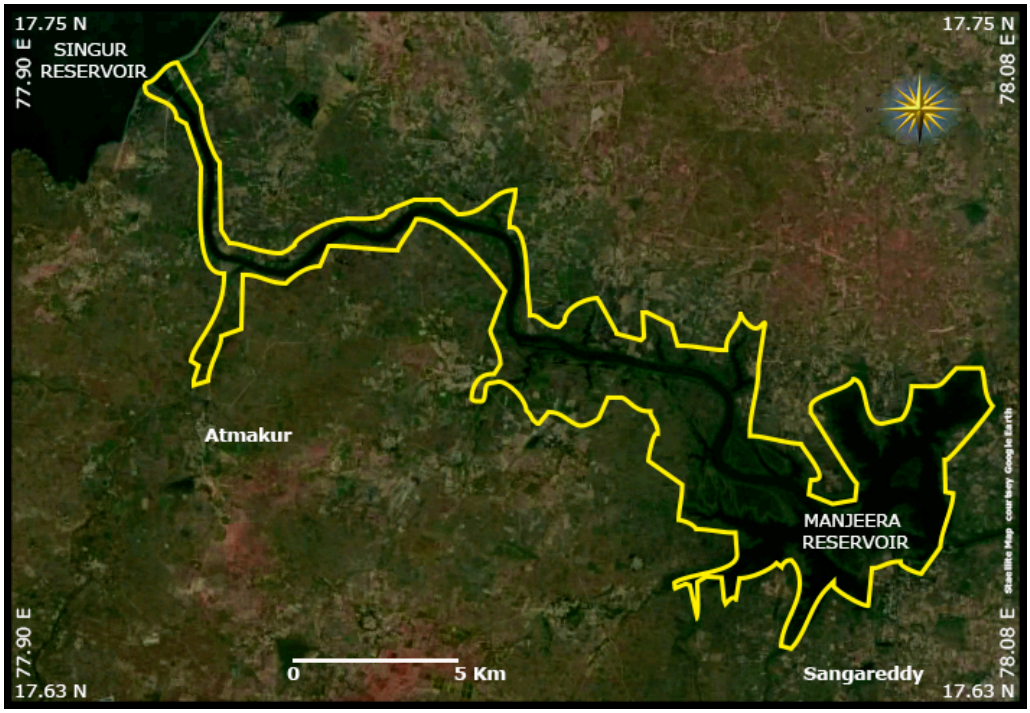

Figure 1. Map of the Manjeera Wildlife Sanctuary, Medak District, Andhra Pradesh, India

which agriculture lands occupy almost 59.4%, followed by pasture lands (39.5%), forest (0.65%) and water (0.45%) (Stalnacke et al. 2012). It is the main source of drinking water to Medak, Nizamabad districts and also to the twin cities of Hyderabad. This is the abode for a number of resident and migratory birds in addition to being home for the Marsh Crocodile *Crocodylus palustris*.

Density and abundance are the essential ecological information required for population ecology (Buckland et al. 1993, 2001). In the present study, we studied the population density, diversity and distribution of avian fauna in different habitats of the Manjeera Wildlife Sanctuary, Andhra Pradesh, India.

Material and Methods

Study Area: The Manjeera Wildlife Sanctuary located at 17^{0}57'52"N & 78^{0}02'22"E (Fig. 1) in Medak District, Andhra Pradesh. An area of 2,800 ha between Singoor and Manjeera Barrage was declared as a sanctuary. The sanctuary follows the course of river Manjeera over a length of 36km. The Manjeera Wildlife Sanctuary has nine islands with extensive marshy fringes, which provide good nesting sites for waterbirds. The reservoir supports submergent and emergent vegetation. A narrow margin of *Typa* sp., *Ipomoea* sp. and *Acacia* sp. fringe the waterline, while agriculture lands surround the reservoir and the river. The forest tracts are a typical tropical scrub forest type (Champion & Seth 1968) with *Acacia* sp., *Prosopis juliflora*, *Pithecelobium dulce*, *Tamarindus indicus*, *Butea monosperma* and *Azadirachta indica* as the major species. Other plant species found here are *Chrozophora rottleri*, *Nymphoides hydrophylla*, *Polygonum glabrum*, *Leucas aspera*, *Centella asiatica*, *Abutilon indicum*, *Ipomea cornea*, *Ipomea cairica*, *Argemone mexicana*, *Xanthium strumarium*, *Spilanthus calva*, *Pistia stratiotes*, *Eichhornia crassipes*, *Hydrilla verticillata*, *Vallisneria spiralis* and *Marsilea quadrifolia*. Grass species like *Bothriochloa pertusa*, *Chloris barbata*, *Cynodon dactylon*, *Cyperus rotundus*, *Heteropogon contortus*, *and Dactyloctenium aegyptium* are present in the sanctuary and its surroundings. This wetland, apart from being the abode for the mugger crocodile, is home to five species of cultured fishes; 60 species of butterflies, 10 species of amphibians; 26 species of reptiles, 18 species of mammals (Prasad et al. 2012). The Manjeera Wildlife Sanctuary experiences a tropical climate with temperatures ranging between 42^{0}C in the summers to 15^{0}C in the winters and receives about 1000–1100 mm of rainfall annually. The soil type here is red loamy, sandy and black cotton soil, fertile for growing cotton, rice, jowar, maize and sugarcane.

Data Collection: Surveys were conducted between December 2010 and October 2012. The line transect method (Burnham et al. 1980) was used for conducting surveys to estimate abundance of different species of birds, their diversity and to calculate richness indices.

The number of transects was based on the relative extents of the habitats. Separate transects were established in each habitat and data was collected and analyzed. Observations were carried out both in the mornings and evenings when the birds were the most active between 06:00–10:00 hr and 16:00–18:00 hr. Four habitat types were chosen namely marshy areas, grassland, agriculture lands and scrubland. Surveys were conducted along 2km long transects with an average nine transects per habitat (6–12 transects per habitat). Birds were detected and count was kept using binoculars. Photographic record of the birds detected was maintained using a 14.5 mega pixels digital camera (Canon Power Shot 35X). Species identification was done using standard literature (Grimmett et al. 2002) and the listing follows Manakadan & Pittie (2001).

We assigned the abundance of the species observed during the study based on the frequency and number of individuals sighted. The data is presented as ACOR ratings, with abundant being those species which were sighted in many numbers during all transect surveys, common being those species which were sighted in good numbers during all transect surveys, occasional being those species which were sighted in low numbers during some transect surveys and rare being those species which were sighted in very low numbers throughout the study period. Alpha and beta diversities are key concepts for understanding the functioning of ecosystems, for the conservation of biodiversity and for ecosystem management (Magurran 2004). We measured the alpha and beta diversities of the habitats of the sanctuary using the below given formulae

$$D = [ni(ni\text{-}1)/N(N\text{-}1)]$$

ni = the total number of organisms of a particular species

N = the total number of organisms of all species

$$Cs = 2C/ (2C + S1 + S2)$$

where, S1 = the total number of species recorded in the first community

S2= the total number of species recorded in the second community

c = the number of species common to both communities

All statistical analysis was carried out using ecological analysis package Biodiversity-Pro (Biodiversity professional beta version 2.0.0.0), (McAleece et al. 1997).

Results and Discussion

During the present study a total of 164 species of birds belonging to 53 families were recorded, of which 107 species were resident, 55 species were winter migrants and two species were summer migrants (Table 1; Images 1–84). A total of three Vulnerable species (Lesser Adjutant *Leptoptilos javanicus*, Greater Spotted Eagle *Aquila clanga* and Indian Skimmer *Rynchops albicollis*) and three Near Threatened species (Painted Stork *Mycteria leucocephala*, Oriental White Ibis *Threskiornis melanocephalus* and Darter *Anhinga melanogaster*) were recorded. The relative abundance of species in the four different habitats indicated that the birds showed high preference for marsh land habitat followed by agriculture lands in comparison to scrubland and grassland habitats (Table 2). The Simpson's Diversity and Shannon's Diversity Indices show that diversity of birds was high in scrubland followed by agricultural lands, grasslands and marshy area (Table 3), while evenness and equitability indices were high in grassland and scrub land habitats (Table 3). The comparison of species richness of the birds and the number of individuals in the different habitats in the sanctuary indicates that the species richness is high in agriculture lands then followed by scrubland, grassland and marshy area while the number of individuals of birds is high in marshy areas then agriculture lands, scrubland and grassland. The Sorensen's similarity index indicates that habitats of agriculture lands-scrubland, grassland-agriculture lands and grassland-scrubland are more similar (Fig. 2) where as, habitats of scrubland-marshy

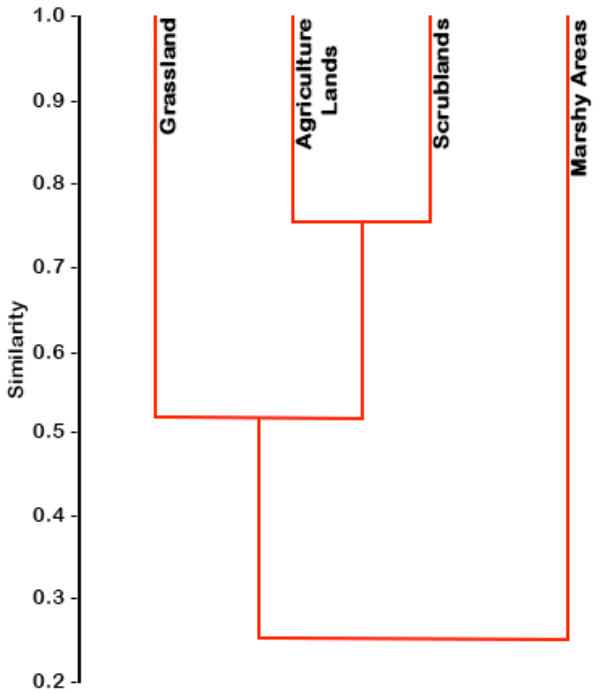

Figure 2. Similarity between habitats with respect to species richness at Manjeera Wildlife Sanctuary, Medak District, Andhra Pradesh, India

Table 1. List of birds of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

	Common Name	Scientific Name	Status*	Abundance**
	Podicipedidae			
1	Little Grebe	*Tachybaptus ruficollis*	R	C
	Phalacrocoracidae			
2	Great Cormorant	*Phalacrocorax carbo*	R	A
3	Indian Shag	*Phalacrocorax fuscicollis*	R	C
4	Little Cormorant	*Phalacrocorax niger*	R	C
	Anhingidae			
5	Darter	*Anhinga melanogaster*†	R	C
	Ardeidae			
6	Black-crowned Night Heron	*Nycticorax nycticorax*	R	C
7	Indian Pond Heron	*Ardeola grayii*	R	C
8	Purple Heron	*Ardea purpurea*	WM	C
9	Grey Heron	*Ardea cinerea*	R	C
10	Cattle Egret	*Bubulcus ibis*	R	C
11	Little Egret	*Egretta garzetta*	R	C
12	Median Egret	*Mesophoyx intermedia*	R	C
13	Large Egret	*Casmerodius albus*	R	C
14	Chestnut Bittern	*Ixobrychus cinnamomeus*	R	R
	Ciconiidae			
15	Painted Stork	*Mycteria leucocephala*†	R	A
16	Asian Openbill-Stork	*Anastomus oscitans*	SM	C
17	White-necked Stork	*Ciconia episcopus*	WM	C
18	Lesser Adjutant-Stork	*Leptoptilos javanicus*††	WM	O
	Threskiornithidae			
19	Oriental White Ibis	*Threskiornis melanocephalus*†	R	A
20	Black Ibis	*Pseudibis papillosa*	R	A
21	Glossy Ibis	*Plegadis falcinellus*	SM	A
22	Eurasian Spoonbill	*Platalea leucorodia*	WM	C
	Anatidae			
23	Lesser Whistling-Duck	*Dendrocygna javanica*	R	C
24	Bar-headed Goose	*Anser indicus*	WM	C
25	Brahminy (Ruddy) Shelduck	*Tadorna ferruginea*	WM	C
26	Comb Duck	*Sarkidiornis melanotos*	WM	C
27	Cotton Teal	*Nettapus coromandelianus*	R	C
28	Eurasian Wigeon	*Anas penelope*	WM	C
29	Spot-billed Duck	*Anas poecilorhyncha*	R	A
30	Northern Pintail	*Anas acuta*	WM	C
31	Northern Shoveler	*Anas clypeata*	WM	O
32	Common Teal	*Anas crecca*	R	C
33	Garganey	*Anas querquedula*	WM	C
34	Red-crested Pochard	*Rhodonessa rufina*	WM	C
35	Common Pochard	*Aythya ferina*	WM	C
36	Tufted Pochard	*Aythya fuligula*	WM	O
	Accipitridae			
37	Brahminy Kite	*Haliastur indus*	R	C
38	Western Marsh-Harrier	*Circus aeruginosus*	WM	R
39	Greater Spotted Eagle	*Aquila clanga*††	WM	R
40	Black Kite	*Milvus migrans*	R	C
41	Black-Shouldered Kite	*Elanus caeruleus*	R	C
42	Shikra	*Accipiter badius*	R	O
43	Short-toed Snake-Eagle	*Circaetus gallicus*	WM	R
	Pandionidae			
44	Osprey	*Pandion haliaetus*	WM	R
	Falconidae			
45	Common Kestrel	*Falco tinnunculus*	R	R
	Phasianidae			
46	Indian Peafowl	*Pavo cristatus*	R	C
47	Grey Francolin	*Francolinus pondicerianus*	R	C
	Rallidae			
48	White-breasted Waterhen	*Amauronis phoenicurus*	R	C
49	Common Moorhen	*Gallinula chloropus*	R	C
50	Purple Moorhen	*Porphyrio porphyrio*	R	C
51	Common Coot	*Fulica atra*	R	C
	Jacanidae			
52	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	C
53	Bronze-winged Jacana	*Metopidius indicus*	R	C
	Charadriidae			
54	Yellow-wattled Lapwing	*Vanelles malabaricus*	R	R
55	Red-wattled Lapwing	*Vanelles indicus*	R	C
56	Kentish Plover	*Charadrius alexandrinus*	WM	O
57	Little Ringed Plover	*Charadrius dubius*	WM	O
	Scolopacidae			
58	Common Redshank	*Tringa totanus*	WM	O
59	Marsh Sandpiper	*Tringa stagnatilis*	WM	C

	Common Name	Scientific Name	Status*	Abundance**
60	Common Greenshank	*Tringa nebularia*	WM	C
61	Green Sandpiper	*Tringa ochropus*	WM	C
62	Wood Sandpiper	*Tringa glareola*	WM	C
63	Common Sandpiper	*Actitis hypoleucos*	WM	C
64	Common Snipe	*Gallinago gallinago*	WM	O
65	Little Stint	*Calidris minuta*	WM	R
66	Black tailed Godwit	*Limosa limosa*	WM	O
67	Ruff	*Philomachus pugnax*	WM	R
	Recurvirostridae			
68	Black-winged Stilt	*Himantopus himantopus*	R	C
	Glareolidae			
69	Small Pratincole	*Glareola lactea*	R	R
	Laridae			
70	Brown-headed Gull	*Larus brunnicephalus*	WM	C
71	Black-headed Gull	*Larus ridibundus*	WM	C
72	Whiskered Tern	*Chlidonias hybridus*	WM	C
73	Gull-billed Tern	*Gelochelidon nilotica*	WM	C
74	River Tern	*Sterna aurantia*	R	C
75	Little Tern	*Sterna albifrons*	R	C
	Rynchopidae			
76	Indian Skimmer	*Rynchops albicollis*††	WM	O
	Columbidae			
77	Eurasian Collared-Dove	*Streptopelia decaocto*	R	C
78	Little Brown Dove	*Streptopelia senegalensis*	R	C
79	Spotted Dove	*Streptopelia chinensis*	R	C
80	Blue Rock Pigeon	*Columba livia*	R	C
	Psittacidae			
81	Rose-ringed Parakeet	*Psittacula krameri*	R	C
82	Plum-headed Parakeet	*Psittacula cyanocephala*	R	C
	Cuculidae			
83	Small Green-billed Malkoha	*Phaenicophaeus viridirostris*	R	O
84	Asian Koel	*Eudynamys scolopacea*	R	C
85	Greater Coucal	*Centropus sinensis*	R	C
86	Brainfever Bird	*Hierococcyx varius*	R	C
87	Pied-crested Cuckoo	*Clamator jacobinus*	WM	C
88	Rufous-bellied Plaintive Cuckoo	*Cacomantis merulinus*	WM	R
	Strigidae			
89	Spotted Owlet	*Athene brama*	R	C
	Caprimulgidae			
90	Common Indian Night jar	*Caprimulgus asiaticus*	R	R
	Apodidae			
91	Asian Palm-Swift	*Cypsiurus balasiensis*	R	C
92	House Swift	*Apus affinis*	R	C
	Alcedinidae			
93	Small Blue Kingfisher	*Alcedo atthis*	R	C
94	White-breasted Kingfisher	*Halcyon smyrnensis*	R	C
95	Lesser Pied Kingfisher	*Ceryle rudis*	R	O
	Meropidae			
96	Small Bee-eater	*Merops orientalis*	R	C
97	Blue-tailed Bee-eater	*Merops phillippinus*	WM	C
	Coraciidae			
98	Indian Roller	*Coracias benghalensis*	R	C
	Upupidae			
99	Common Hoopoe	*Upupa epops*	R	C
	Bucerotidae			
100	Indian Grey Hornbill	*Ocyceros birostris*	R	C
	Capitonidae			
101	Coppersmith Barbet	*Megalaima haemacephala*	R	C
	Picidae			
102	Lesser Golden-backed Woodpecker	*Dinopium benghalense*	R	R
	Alaudidae			
103	Ashy-crowned Sparrow-Lark	*Eremopterix grisea*	R	C
104	Syke's Crested Lark	*Galerida deva*	R	C
	Hirundinidae			
105	Common Swallow	*Hirundo rustica*	R	C
106	Wire-tailed Swallow	*Hirundo smithii*	R	A
107	Red-rumped Swallow	*Hirundo daurica*	R	A
108	Dusky Crag-Martin	*Hirundo concolor*	R	C
	Motacillidae			
109	Large Pied Wagtail	*Motacilla maderaspatensis*	R	C
110	Citrine Wagtail	*Motacilla citreola*	WM	C
111	Yellow Wagtail	*Motacilla flava*	WM	C
112	Grey Wagtail	*Motacilla cinerea*	WM	C
113	White Wagtail	*Motacilla alba*	R	C
114	Paddyfield Pipit	*Anthus rufulus*	R	C
	Campephagidae			
115	Large Cuckoo Shrike	*Coracina macei*	R	C

	Common Name	Scientific Name	Status*	Abundance**
116	Black headed Cuckoo Shrike	*Coracina melanoptera*	R	O
117	Small Minivet	*Pericrocotus cinnamomeus*	R	R
	Pycnonotidae			
118	Red-vented Bulbul	*Pycnonotus cafer*	R	C
119	White-browed bulbul	*Pycnonotus luteolus*	R	C
	Irenidae			
120	Common Iora	*Aegithina tiphia*	R	C
	Laniidae			
121	Bay-backed Shrike	*Lanius vittatus*	R	C
122	Rufous-backed Shrike	*Lanius schach*	WM	C
123	Brown Shrike	*Lanius cristatus*	WM	O
	Sylviidae			
124	Common Babbler	*Turdoides caudatus*	R	C
125	Large Grey Babbler	*Turdoides malcolmi*	R	C
126	White-headed Babbler	*Turdoides affinis*	R	C
127	Jungle Babbler	*Turdoides striatus*	R	C
128	Rufous-bellied Babbler	*Dumetia hyperythra*	R	C
129	Blyth's Reed-Warbler	*Acrocephalus dumetorum*	WM	C
130	Booted Warbler	*Hippolais caligata*	WM	C
131	Common Tailor Bird	*Orthotomus sutorius*	R	C
	Cisticolidae			
132	Plain Prinia	*Prinia inornata*	R	C
133	Ashy Prinia	*Prinia socialis*	R	C
	Muscicapidae			
134	Indian Robin	*Saxicoloides fulicata*	R	C
135	Oriental Magpie-Robin	*Copsychus saularis*	R	C
136	Common Stonechat	*Saxicola torquata*	R	C
137	Pied Bushchat	*Saxicola caprata*	R	C
138	Tickell's Blue-Flycatcher	*Cyornis tickelliae*	R	O
139	Asian Brown Flycatcher	*Muscicapa dauurica*	WM	O
	Monarchidae			
140	Asian Paradise-Flycatcher	*Terpsiphone paradisi*	WM	O
	Nectariniidae			
141	Purple-rumped Sunbird	*Nectarinia zeylonica*	R	C
142	Purple Sunbird	*Nectarinea asiatica*	R	C
	Zosteropidae			
143	Oriental White-eye	*Zosterops palpebrosus*	R	R
	Emberizidae			
144	Red-headed Bunting	*Emberiza bruniceps*	WM	C
145	Black-headed Bunting	*Emberiza melanocephala*	WM	C
	Estrildidae			
146	Spotted Munia	*Lonchura punctulata*	R	C
147	White-throated Munia	*Lonchura malabarica*	R	C
148	Black-headed Munia	*Lonchura malacca*	WM	C
149	Red Munia (Red Avadavat)	*Amandava amandava*	WM	C
	Passeridae			
150	House Sparrow	*Passer domesticus*	R	C
151	Yellow-throated Sparrow	*Petronia xanthocollis*	R	C
	Ploceidae			
152	Baya Weaver	*Ploceus philippnius*	R	C
153	Black-breasted Weaver	*Ploceus benghalensis*	R	C
154	Streaked Weaver	*Ploceus manyar*	WM	C
	Sturnidae			
155	Brahminy Starling	*Sturnus pagodarum*	WM	C
156	Rosy Starling	*Sturnus roseus*	WM	C
157	Asian Pied Starling	*Sturnus contra*	WM	C
158	Common Myna	*Acridotheres tristis*	R	C
	Oriolidae			
159	Eurasian Golden Oriole	*Oriolus oriolus*	R	C
	Dicruridae			
160	Black Drongo	*Dicrurus macrocercus*	R	C
161	White-bellied Drongo	*Dicrurus caerulescens*	R	C
	Corvidae			
162	House Crow	*Corvus splendens*	R	C
163	Jungle Crow	*Corvus macrorhynchos*	R	C
164	Indian Treepie	*Dendrocitta vagabunda*	R	C

*Status: R - resident, WM - winter migrant, SM - summer migrant; **Abundance: A - Abundant, C - Common, O - Occasional, R - Rare
Scientific Name with † symbol - Near Threatened, Scientific Name with †† symbol - Vulnerable

Table 2. Habitat-wise species richness and other statistical parameters of birds of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

Variables	Marshy Area	Grassland	Agriculture Lands	Scrubland
Species Richness	80	87	136	108
Total Individuals Range (Mean±SE)	9841 0–750 (60.00±11.27)	1901 0–140 (11.59±1.7)	8425 0–640 (51.37±7.41)	4964 0–322 (30.26±4.2)
Variance	20837.24	473.99	9017.30	2892.28
Mean Confidence Interval	3189.14	72.54	1380.10	442.66

Table 3. Diversity indices values of birds in different habitats of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

Indices	Marshy Area	Grassland	Agriculture Lands	Scrubland
Simpson Index (D)	0.04	0.03	0.03	0.02
Simpson's Index of Diversity (1 – D)	0.96	0.97	0.97	0.98
Simpson's Reciprocal Index (1 / D)	24.35	37.08	37.46	39.94
Shannon's Index (H)	3.54	3.98	4.12	4.11
Evenness Index	0.43	0.61	0.45	0.57
Equitability Index (J)	0.81	0.89	0.84	0.88

Table 4. Sorensen's similarity index values for birds species richness in different habitats of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

Habitats	Sorensen's Similarity Index
Marshy Area - Grassland	0.30
Grassland - Agriculture Lands	0.41
Agriculture Lands - Scrubland	0.46
Scrubland - Marshy Area	0.21
Marshy Area - Agriculture Lands	0.34
Grassland - Scrubland	0.40

Table 5. Correlation coefficient values for birds species richness in different habitats of Manjeera Wildlife Sanctuary, Andhra Pradesh, India

Habitat	Marshy Area	Grassland	Agriculture Lands	Scrubland
Marshy Area	1	*	*	*
Grassland	0.09	1	*	*
Agriculture Lands	0.1386	0.208	1	*
Scrubland	-0.1768	0.0793	0.4285	1

areas show dissimilarity (Table 4). The correlation of bird diversity was high in agriculture lands-scrubland, agriculture lands-grasslands and marshy area-agriculture lands, while was low in scrubland-grassland and marshy area-grassland (Table 5). The relationship between the marshy area and scrubland showed inverse correlation indicating that the marshy area habitats have higher bird diversity compared to scrubland habitat.

Manjeera Wildlife Sanctuary is known for its rich avian diversity and has been accorded Important Bird Area (IBA) status (Kumar 1994a; Kumar & Choudhury 1994, 1999; Islam & Rahmani 2005). Published records list around 73 species of birds from this site (Kumar 1994a; Kumar & Choudhury 1994, 1999), including many species of Biome-11, the Indo-Malayan Tropical Dry Zone. We recorded 164 bird species belonging to 53 families in the sanctuary and its immediate surroundings. The family Anatidae had the highest value of species richness (14 species) and was followed by the families Scolopacidae (10 species) and Ardeidae (nine species). Anatidae and Scolopacidae have most of all winter migratory birds except the resident birds like Lesser Whistling-Duck *Dendrocygna javanica,* Cotton Teal *Nettapus coromandelianus,* Spot-billed Duck *Anas poecilorhyncha,* and Common Teal *Anas crecca*. Family Ardeidae has all resident birds, with an exception of Purple Heron *Ardea purpurea* which is a winter migrant. Members of the family Scolopacidae are all winter migrants. Asian Openbill-Stork *Anastomus oscitans* (Ciconiidae) and Glossy Ibis *Plegadis falcinellus* (Threskiornithidae) are only the summer migratory birds.

Kumar & Choudhury (1994, 1999) and Kumar (1994b) reported 14 species of birds breeding in the Manjeera Wildlife Sanctuary. Darter *Anhinga melanogaster*, Asian Openbill *Anastomus oscitans*, Painted Stork *Mycteria leucocephala*, Coot *Fulica atra* and Black-crowned Night

Heron *Nycticorax nycticorax* being the most significant breeders (Kumar 1994b; Kumar & Choudhury 1999). We observed all resident birds to be breeding at Manjeera Wildlife Sanctuary (Table 1).

The Manjeera Wildlife Sanctuary is a bird haven (Choudhury & Pittie 1983; Taher 1998; Moorty 1999). As the Manjeera Reservoir is the main source of drinking water to Greater Hyderabad, water is always stored and properly managed ensuring that water is present throughout the dry season too. The backwaters of the reservoir, as well as the main area, have several islands with extensive marshy fringes, which provide good nesting sites for water birds. The availability of fishes in the river for water birds and availability of grains and insects in the agriculture lands and grass lands, fleshy fruits in the scrubland and secure shelter for nesting are attractive to birds in the sanctuary. Agriculture affects natural ecosystems in more diverse ways, including modifications of landscape, soils, and water supply through deforestation, erosion, channeling, flooding, draining, etc., as well as the elimination or propagation of selected species of plants and animals (Steadman 1996). Compared to the last two decades, increasing of agriculture lands by the irrigation facility from Manjeera River in the area surrounding the sanctuary attracts more bird diversity.

Species like the Bar-headed Goose, Ruddy Shelduck and Demoiselle Crane that visit the Manjeera Wildlife Sanctuary represent 1–3 % of their bio-geographic population threshold determined by Wetlands International (Finlayson et al. 2002) thus leading to its recognition as an Important Bird Area (Islam & Rahmani 2005). Past records denote that the Manjeera wildlife sanctuary is very suitable for winter migratory birds. According to Kumar (1994a), a Greater Flamingo *Phoenicopterus ruber*, ringed in 1971–74 in Lake Rezaiyeh, Azerbaijan, Iran was recovered at Manjeera Wildlife Sanctuary in the winter of 1986–87. In January 1987, about 3,000 Demoiselle cranes were seen in Manjeera (Kumar 1994c) which according to recent population estimates by Finlayson et al. (2002), would be 3% of the total population of this species wintering in the Indian subcontinent. Large congregations of Common Teal *Anas crecca*, Cotton Pygmy-goose *Nettapus coromandelianus* and Ruddy Shelduck *Tadorna ferruginea* were also reported from Manjeera (Kumar & Choudhury 1999). During the present study period, no such large congregation was observed. The Lesser Adjutant *Leptoptilos javanicus* and Indian Skimmer *Rynchops albicollis*, both vulnerable species, that have been sighted at Manjeera Wildlife Sanctuary in the past have not been reported or sighted during recent times.

Habitat loss is the major factor affecting the population of migratory and resident birds directly or indirectly. The populations of farmland birds like buntings, larks, weavers etc. are very low, compare to waterbirds population because of loss of habitat and excessive use of pesticides in agriculture lands as compared to the last two decade in the sanctuary surroundings (C. Srinivasulu unpub. data). Pesticides can affect farmland birds in a number of different ways and use of pesticides within different farming systems have led to a decline in farmland bird populations (Burn 2000). Waterbirds which were nesting on the *Prosopis juliflora* plants in the sanctuary decreased because of the habitat loss, due to the collection of firewood by the villagers. Hence, habitat reserves are an essential element in an ecosystem to conserve biological diversity.

These four types of habitats of the Manjeera Wildlife Sanctuary support large numbers of migratory and resident species of birds. Availability of food in different seasons, different types of vegetation, agricultural lands, accessibility of water in the area, field activities and good weather conditions were observed for favorable conditions for birds to survive in this area. Birds are a good medium for dispersing seeds, pollinating plants, biological control and they are important to continue the ecological cycle. Long term assessment of bird species richness will help in understanding the impact of changing environment on birds and also support in creating a scientific database for proper management of the ecosystem to ensure better conservation, both of the habitats and the avian diversity.

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Finlayson, C.M., G.W. Begg, J. Howes, J. Davies, K. Tagi & J. Lowry

Image 1. Great Cormorant *Phalacrocorax carbo*

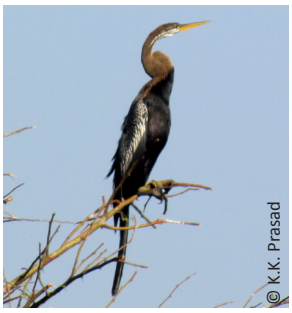

Image 2. Darter *Anhinga melanogaster*

Image 3. Indian Pond Heron *Ardeola grayii*

Image 4. Purple Heron *Ardea purpurea*

Image 5. Grey Heron *Ardea cinerea*

Image 6. Cattle Egret *Bubulcus ibis*

Image 7. Painted Stork *Mycteria leucocephala*

Image 8. Asian Openbill-Stork *Anastomus oscitans*

Image 9. White-necked Stork *Ciconia episcopus*

Image 10. Oriental White Ibis *Threskiornis melanocephalus*

Image 11. Glossy Ibis *Plegadis falcinellus*

Image 12. Lesser Whistling-Duck *Dendrocygna javanica*

Image 13. Cotton Teal *Nettapus coromandelianus*

Image 14. Eurasian Wigeon *Anas penelope*

Image 15. Nothern Pitail *Anas acuta*

Image 16. Garganey *Anas querquedula*

Image 17. Brahminy Kite *Haliastur indus*

Image 18. Greater Spotted Eagle *Aquila clanga*

Image 19. Black-Shouldered Kite *Elanus caeruleus*

Image 20. Shikra *Accipiter badius*

Image 21. Indian Peafowl *Pavo cristatus*

Image 22. White-breasted Waterhen *Amauronis phoenicurus*

Image 23. Common Moorhen *Gallinula chloropus*

Image 24. Purple Moorhen *Porphyrio porphyrio*

Image 25. Pheasant-tailed Jacana *Hydrophasianus chirurgus*

Image 26. Bronze-winged Jacana *Metopidius indicus*

Image 27. Yellow-wattled Lapwing *Vanelles malabaricus*

Image 28. Little Ringed Plover *Charadrius dubius*

Image 29. Wood Sandpiper *Tringa glareola*

Image 30. Black-winged Stilt *Himantopus himantopus*

Image 31. Whiskered Tern *Chlidonias hybridus*

Image 32. River Tern *Sterna aurantia*

Image 33. Eurasian Collared-Dove *Streptopelia decaocto*

Image 34. Little Brown Dove *Streptopelia senegalensis*

Image 35. Spotted Dove *Streptopelia chinensis*

Image 36. Rose-ringed Parakeet *Psittacula krameri*

Image 37. Plum-headed Parakeet *Psittacula cyanocephala*

Image 38. Small Green-billed Malkoha *Phaenicophaeus viridirostris*

Image 39. Brainfever Bird *Hierococcyx varius*

Image 40. Pied-crested Cuckoo *Clamator jacobinus*

Image 41. Small Blue Kingfisher *Alcedo atthis*

Image 42. White-breasted Kingfisher *Halcyon smyrnensis*

Image 43. Small Bee-eater *Merops orientalis*

Image 44. Blue-tailed Bee-eater *Merops phillippinus*

Image 45. Indian Roller *Coracias benghalensis*

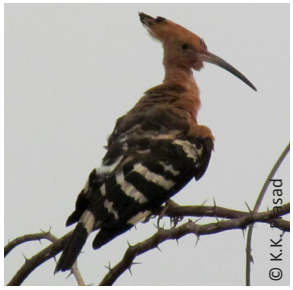

Image 46. Common Hoopoe *Upupa epops*

Image 47. Indian Grey Hornbill *Ocyceros birostris*

Image 48. Coppersmith Barbet *Megalaima haemacephal*

Image 49. Lesser Golden-backed Woodpecker *Dinopium benghalense*

Image 50. Ashy-crowned Sparrow-Lark *Eremopterix grisea*

Image 51. Wire-tailed Swallow *Hirundo smithii*

Image 52. Red-rumped Swallow *Hirundo daurica*

Image 53. Large Pied Wagtail *Motacilla maderaspatensis*

Image 54. Yellow Wagtail *Motacilla flava*

Image 55. Grey Wagtail *Motacilla cinerea*

Image 56. Paddyfield Pipit *Anthus rufulus*

Image 57. Red-vented Bulbul *Pycnonotus cafer*

Image 58. White-browed Bulbul *Pycnonotus luteolus*

Image 59. Rufous-backed Shrike *Lanius schach*

Image 60. Jungle Babbler *Turdoides striatus*

Image 61. Common Tailor Bird *Orthotomus sutorius*

Image 62. Ashy Prinia *Prinia socialis*

Image 63. Common Stonechat *Saxicola torquata*

Image 64. Pied Bushchat *Saxicola caprata*

Image 65. Tickell's Blue-Flycatcher *Cyornis tickelliae*

Image 66. Purple-rumped Sunbird *Nectarinia zeylonica*

Image 67. Purple Sunbird *Nectarinea asiatica*

Image 68. Red-headed Bunting *Emberiza bruniceps*

Image 69. Black-headed Bunting *Emberiza melanocephala*

Image 70. Spotted Munia *Lonchura punctulata*

Image 71. White-throated Munia *Lonchura malabarica*

Image 72. Black-headed Munia *Lonchura malacca*

Image 73. Red Munia *Amandava amandava*

Image 74. Yellow-throated Sparrow *Petronia xanthocollis*

Image 75. Black-breasted Weaver *Ploceus benghalensis*

Image 76. Streaked Weaver *Ploceus manyar*

Image 77. Brahminy Starling *Sturnus pagodarum*

Image 78. Rosy Starling *Sturnus roseus*

Image 79. Asian Pied Starling *Sturnus contra*

Image 80. Common Myna *Acridotheres tristis*

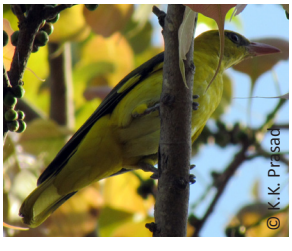

Image 81. Eurasian Golden Oriole *Oriolus oriolus*

Image 82. Black Drongo
Dicrurus macrocercus

Image 83. House Crow
Corvus splendens

Image 84. Indian Treepie
Dendrocitta vagabunda

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