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Diversity, Distribution and Status of Birds of Kolleru Lake - A Ramsar Site in Andhra Pradesh

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ABSTRACT: Kolleru is one of the most important and a large fresh water ecosystem situated between the two important rivers of Krishna and Godavari. It has achieved fame as a birds' heaven mainly due to high bird diversity and abundance that it supports especially in winter season. Kolleru lake which is declared as a wildlife sanctuary is a Ramsar site and also an Important Bird Area. Excellent bird reserve provides refuge for internationally important populations of wetland birds. An ornithological survey was carried out for three consecutive years 2010 - 2013 for assessing the status, diversity and distribution of avifauna. Attempts were made to cover the representative areas, in order to cover migratory and resident species, highlighting the threatened species. The lake was threatened due to demographic pressures and it is over- exploited. Fortunately, the lake has been given due protection in recent years and it resulted in improving the habitat. The lake is regaining its splendour after the state government demolished illegal fish ponds, backed by a standing order from the Hon'ble Supreme Court of India. There is an increase in the number of migratory birds after demolition of fish tanks. The international migratory birds like Pelicans, a variety of Ducks, Waders etc., are back at Kolleru lake. The lake is serving as refuge for threatened water fowl and waders. The survey was aimed at the specific problems pertaining to conservation and diversity of the birds. Altogether 232 species of birds belonging to 138 Genera distributed in 17 Orders are recorded. The lake has been observed to be rich abode of an array of avifauna. Out of 232 species of birds, 6 are globally threatened and 20 are near threatened and 100 are migratory. During the study 10 major wetland bird congregation sites were selected and over 75000 birds were recorded, utilizing this lake annually for feeding breeding and nesting. The research findings are presented. The lake area is environmentally conscious segment of ecotourism and provides the economic growth for the local community.

KEYWORDS: Kolleru Lake, Ramsar site, Migratory birds, Waders, % species diversity, % species composition, Conservation.

I. INTRODUCTION

Birds play an important role in the maintenance of natural ecosystem. Having realized the importance of birds and wildlife in general, the Government of India has created several Protected Areas (PAs) such as national parks and sanctuaries where the wildlife including birds receives protection against poaching and destruction of habitat. Kolleru Lake has achieved fame as a bird's heaven mainly due to high bird diversity and abundance that it supports, especially in winter season. In 1999, an extent of 308 km² of the Kolleru lake falling below +5 MSL contour line was declared as Kolleru Wildlife Sanctuary (KWS). Kolleru wetland which is declared as a wildlife sanctuary is a Ramsar Site as well as an important Bird Area (IBA). Kolleru Lake is one of the jewels, justifying its status as a Site of Special Scientific Interest (SSSI). Excellent reserve provides refuge for internationally important populations of wetland birds and also as Fisherman's Paradises.

Kolleru, one of the biggest shallow water & fresh water lakes in Asia is located between the alluvial plains of Krishna and Godavari rivers in Andhra Pradesh. It is an ideal habitat to more than 200 local and migratory bird species,



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including rare, endangered, vulnerable & threatened birds like Spotbill Pelicans (*Pelecanus philippinus*), Painted storks (*Mycteria leucocephala*), Oriental Darters (*Anhinga melanogaster*), Spoonbill Sandpipers (*Platalea leucorodia*), River Terns (*Sterna aurantia*), Blackbellied Terns (*Sterna acuticauda*), Greyheaded Lapwings (*Vanellus cinereus*), Bartailed Godwits (*Limosa Lapponica*), Large whistiling Teals (*Dendrocygna bicolor*), Lesser Flamingos (Phoenicopterus minor), Raptors (*Aquila clanga, Circus macrurus*), Vultures (*Gyps benghalunsis, Gyps indicus*), Siberian crane (*Grus leucogeranus*) and Sarus crane (*Grus antigone*).

Being a wetland of international importance this area has been declared as a Ramsar site in 2002 and the government of A.P earlier declared the lake as a wildlife sanctuary in 1999. The lake area was exploited by people who dugout thousands of fish tanks illegally, thus converting the lake into a drain. Extensive encroachments of the lake for intensive agriculture, using chemical fertilizers and pesticides, piciculture using animal wastes for fish feeding and flow of municipal sea wage and industrial effluents into the lake made the water so much polluted that it was difficult for fauna to survive. Most of the lake was getting eutrophic due to discharge of nutrients rich water with high quantity of fertilizers and highly toxic pesticides. The process of formation of fish tanks fragmented the lake, which lost hydrological contact, leading to uncontrolled flooding in rainy season.

Kolleru Lake represents one of the largest and natural lacustrine systems in the country. Kolleru and its surroundings have 148 rural settlements (50 in the lake bed and 98 belt Villages). Kolleru is a large natural, shallow, fresh water lake with associated marshes, situated between Krishna and Godavari rivers, c.55 km east of Vijayawada and c. 255 km northwest of the coastline. The surface area of the lake is determined by the volume of monsoon run-off, and is subjected to wide fluctuation as water levels rise and fall. At maximum flooding of 3m, the area of the lake is over 90,000 ha, and at 1m, it may fall to 13,000 ha. The lake drains into the Bay of Bengal through the Upputeru river. Occasionally, small quantities of salt water enter the freshwater lake through this river. It regularly supports more than 50,000 waterfowl, hence selected as an IBA[24]. The Ministry of Environment and Forests, Government of India has identified Kolleru as a wetland of special importance under the Wetland Conservation Programme.

Birds are ubiquitous animals that frequent both terrestrial and aquatic ecosystems. They have fantastic ability to move and most species are found only in particular regions and habitats. The birds are widespread due to their adaptability and feasibility of movements. The living species of birds are grouped into 27 Orders and these in turn have been grouped into 155 Families [29]. The number of Grey Pelicans, Painted Storks, White Ibis, Glossy Ibis, Openbill Storks, Teals, Egrets, Stilts, Pochards, Pintails, Ruddy Shell Ducks, Spotbills and Coots in the study area is high. Twelve percent of the bird species are threatened with extinction all over the world [46] [17] [18]. The reports have led to irrational persecution of wild birds in places, where they are now perceived as health risk, some people even destroying nests to discourage migratory birds from nesting [49].

II. BACKGROUND OR RELATED WORK

Any natural and anthropogenic disturbance altering the habitat and distribution of plant community may seriously affect the bird diversity and this modification will affect the relative abundance of the species. Global biodiversity is getting degraded at an alarming rate due to human activities [40].

The site contains about 232 species of birds. Once it was famous for a breeding colony of the Spot-billed Pelicans, *Pelicanus philippensis* at Aredu-Sarepalle, with about 1500 nests [21] [37] [38]. The Aredu village near Kolleru had the largest known breeding population of the Spot-billed Pelicans in India, protection provided by the villagers[33]. But unfortunately, this Pelicanry disappeared during 1970s due to various reasons. In 1968, less than 400 remained and by 1974, the entire colony disappeared [5] [7]. The Spot-billed Pelicans now reappears in Kolleru. The lake attracts thousands of other waterfowl. During the mid-winter waterfowl count of more than 17,000 birds were reported from around 30% of the lake area[47] and the following year 25,000 waterfowl were recorded, but this was probably due to adapting better methodology and coverage of area [5] [7] [9]. The most abundant duck was the Garganey *Anas querquedula*, with upto 10,000 [49]. According to Wetlands International (2006), 1% biogeographic



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population threshold for this species is 3,500, so about 3% of the total non-breeding Garganeys of South Asia winter in this site. Similarly, about 1500 Asian Openbill Storks *Anastomus oscitans* were counted.

III. SCOPE OF RESEARCH

The lake is threatened due to demographic pressure and it is over exploited. The avifauna has been subjected to the adverse impact, resulting in dwindling of certain species and populations. Fortunately the lake has been given due protection now, but it also needs restoration and rehabilitation. Since the lake is ecologically sensitive and a biological hotspot of the world, protecting it as the bioreserve because of the economic and ecological functions, shall be our concern. Now the lake is regaining its splendour after the State government demolished illegal fish ponds backed by a standing order from the Supreme Court of India. According to the Asian waterfowl census report, an increase in the number of migratory birds has been noticed suddenly after the demolition of fish tanks. During the study period, over 75,000 birds of about 100 species have flocked to the lake during migratory season. Slowly the local inhabitants are reaping benefits through traditional fishing.

IV. METHODS AND MATERIALS

Avifaunal surveys were carried out at regular intervals during Pre-monsoon, monsoon and Post-monsoon periods of the year, in order to cover migratory and resident species. The study includes identification of different birds viz., Aquatic, Terrestrial and Water dependent avian species. Observations were made over a period of three years from October 2010-March 2013 with an aid of field binoculars (10x50) and telescope (60x). Identification was based on standard scientific procedures. Field identification by direct visual sighting and calls. Photographs were taken whenever feasible and possible by using Nikon 35 mm digital camera with appropriate zoom lens. Birds seen were recorded with habitat type, season and frequency of occurrence [19] [32]. Monitored the crepuscular activities in the study area such as bird number, activity and factors of presence were recorded [20].

Bird survey was conducted, when birds are most active during day from 07:00 to 11:00 hrs and from 16:00 to 19:00 hrs. Field visits have been conducted weekly twice in all three seasons and habitat wise (both the wet and dry seasons). Opportunistic observations were made during other timings and species recorded during these observations included in the checklist [6] [30] [31]. The birdlife in the study area were documented by direct observations, random walks and opportunistic encounters following Bibby et al [14] [15]. Identification manuals and field guides [1] [3] [4] [29] [31] [23] were used during survey. Common, scientific names, Classification and nomenclature of the birds following [22] [23] [24] [36] [1] [25] were adopted. The birds were categorized as Resident (R) and Migratory (M); Aquatic (A) and Terrestrial (T) [23]. All the birds species recorded during the present study were tabulated giving their scientific name, family, IUCN status & W(P)A legal status. Abundance of the recorded species are documented based on the total sightings during the study period as common (more than 10 sightings), uncommon (3-5 sightings), and rare (1-2 sightings) [45]. The representative blocks are identified to census the bird populations. The birds in the blocks were counted using a spotting scope (20 - 60X). The checklist of species with their status was given [27] [28].

The survey covered ten major waterbird congregation sites. The representative areas are Atapaka, Potunuru, Bhimadole, Kolletikota, Upputeru creek, Gudivadalanka, Agadalalanka, Kaikaluru, Akiveedu, and Jayapuram etc. including wildlife bird sanctuary area. The numbers of migratory birds are maximum during December and January and starts declining from February onwards.

V. RESULTS AND DISCUSSION

In total 232 bird species belonging to 138 genera, 17 orders and over 52 families were recorded. This included 224 species that were directly observed and rest of species were based on secondary information. Of the 232 bird species, 132 species were aquatic, 100 species terrestrial and 132 species migratory (both winter and summer visitors and locally migratory) [33] [34] [41]. *Leptoptilos javanicus* (Lesser Adjutant) falls under "Vulnerable" category [28]. The species *Anhinga melanogaster* (Darter), *Numenius arquata* (Eurasian Curlew), *Pelecanus philippensis* (Spot-billed Pelican), *Pelicanus onocrotalus* (White Pelican), *Threskiornis melanocephalus* (Black headed Ibis), *Pseudibis*



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papillosa (Black Ibis), Plegadis falcinellus, (Glossy Ibis) Mycteria leucocephala (Painted Stork), Platalea leucorodia (Eurasian Spoonbill), Sterna acuticauda (Black-bellied Tern), Aythya nyroca (White Eyed Pochard) and Circus macrourus (Pallid Harrier), Vanellus cinereus (Grey Headed Lapwing), Gallinago nemoricola (Wood Snipe), Anastomus oscitans (Open billed Stork) and Limosa limosa (Black tailed Godwit) are under 'Near Threatened' category (IUCN) were also recorded [27] [35]. Birds such as Platalea leucorodia (Eurasian Spoonbill), Haliaeetus leucogaster (White-bellied Sea Eagle) and Dendrocygna bicolor (Large Whistling Teal) and Raptors fall under Schedule-I of the Wildlife Protection Act [49]. Bird species such as Barn Swallow (Hirundo rustica), Jack Snipe (Lymnocryptes minimus), Indian Pitta (Pitta brachyura), Small Minivet (Pericrocotus cinnamomeus), Pied Harrier (Circus melanoleucos), and Lesser-crested Terns (Sterna bengalensis) were spotted, but rarely. Eurasian Spoonbill (Platalea leucorodia) and Flamingos (Phoenicopterus ruber), Mallards (Anas platyrhnches), Grey Lag goose (Anser anser), Bar headed Geese, Grey Lapwing (Vanellus cinereus) and Spoonbilled Sandpipers (Eurynorhynchus pygmeus) were sighted only twice during the entire study period (Table -1).

Kolleru lake has given the status of "Ramsar site" considering the wetland is of international importance especially as a waterfowl habitat. It was listed as most seriously threatened wetlands in Asia. Once it was known as Bird's Paradise and the place offers successful, breeding and nesting ground for several species of migratory waterfowl and waders. The physical landscape is rich in its diversity with water everywhere hence there is rich diversity of wild fowl. It is the unique nature reserve of international importance and innumerable waterfowl used to visit the lake every year. The international migratory birds migrate back and forth between the northern and southern latitudes flying over immense distances and obstacles undertaking perilous journeys finding their way unerringly to Kolleru Lake to spend the winter. The lake used to support bird populations in thousands in the peak migratory season (December-February). The migratory birds undertake well defined seasonal movements arriving during winter from October- March period as the lake is abound in migratory water birds.

	Common Name	Scientific Name	Family	Order	IUCN	W(P)A
S.No					2014.3	status
1	Little Grebe	Tachybaptus ruficollis	Podicipedidae	Podicipediformes	LC	Sch-IV
2	Spot-billed Pelican GT	Pelecanus philippensis	Pelecanidae	Pelecaniformes	NT	Sch-IV
3	Great White pelican	Pelecanus onocrotalus			LC	Sch-IV
4	Little Cormorant	Phalacrocorax niger	Phalacrocoracidae		LC	Sch-IV
5	Great Cormorant	Phalacrocorax carbo			LC	Sch-IV
6	Indian Shag	Phalacrocorax fuscicollis			LC	Sch-IV
7	Darter	Anhinga melanogaster	Anhingidae		NT	Sch-IV
8	Flamingo	Phoenicopterus ruber	Phoenicopteridae	Ciconiiformes	LC	Sch-IV
9	Lesser Flamingo	Phoenicopterus Minor			NT	Sch-IV
10	Little Egret	Egretta garzetta	Ardeidae		LC	Sch-IV
11	Median Egret	Mesophoyx intermedia			LC	Sch-IV
12	Large Egret	Casmerodius albus			LC	Sch-IV
13	Cattle Egret	Bubulcus ibis			LC	Sch-IV
14	Indian Pond-Heron	Ardeola grayii			LC	Sch-IV
15	Purple Heron	Ardea purpurea			LC	Sch-IV
16	Grey Heron	Ardea cinerea			LC	Sch-IV
17	Night – Heron	Nycticorax nycticorax			LC	Sch-IV
18	Little Green Heron	Butorides striatus			LC	Sch-IV
19	Yellow Bittern	Ixobrychus sinensis			LC	Sch-IV
20	Chestnut Bittern	Ixobrychus cinnamomeus			LC	Sch-IV
21	Painted Stork	Mycteria leucocephala			NT	Sch-IV
22	Indian Reef Heron	Egretta gularis			LC	Sch-IV
23	Asian Openbill-Stork	Anastomus oscitans	Ciconiidae		LC	Sch-IV
24	Lesser Adjutant Stork GT	Leptoptilos dubius			EN	Sch-IV
25	Oriental White Ibis	Threskiornis melanocephalus	Threskiornithidae		NT	Sch-IV

Table: 1. List Of Birds And Their Orders, Family, Genera, Species, Common Name, Iucn And W (P)A Status.



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26	Glossy Ibis	Plegadis falcinellus			LC	Sch-IV
27	Black Ibis	Pseudibis papillosa			LC	Sch-IV
28	Spoonbill	Platalea leucorodia				Sch-I
20	Lesser Whistling-Teal	Dendrocygna javanica	Anatidae	Anseriformes		Sch-IV
30	Cotton Teal	Nettanus coromandelianus	Tillatioac	7 miser normes		Sch-IV
31	Northern Pintail	Anas acuta				Sch-IV
32	Garganay Teal	Anas quarquadula				Sch IV
22	Spot hill	Anas querqueauta				Sch-IV
33	Spot-bill	Ands poecilornyncha			NT	Sch-Iv
25	Distance Disch	Te dema ferma in an				Sch-IV
35		Tadorna ferruginea				Sch-IV
36	Common Teal	Anas crecca				Scn-IV
37	Mallard	Anas platyrhynchos				Sch-IV
38	Gadwall	Anas strepera			LC	Sch-IV
39	Shoveller	Anas clypeata			LC	Sch-IV
40	Wigeon	Anas penelope			LC	Sch-IV
41	Red crested Pochard	Rhodonessa rufina			LC	Sch-IV
42	White eyed Pochard GT	Aythya nyroca			NT	Sch-IV
43	Tufted Pochard	Aythya fuligula			LC	Sch-IV
44	Common Pochard	Aythya ferina			LC	Sch-IV
45	Falcated Duck	Anas falcata			NT	Sch-IV
46*	Scaup Duck	Aythya marila			LC	Sch-IV
47	Grey lag Goose	Anser anser			LC	Sch-IV
48	Bar Haeded Goose	Anser Indicus			LC	Sch-IV
49	Comb Duck	Sarkidiornis melanotos			LC	Sch-IV
50	Honey-Buzzard	Pernis ptilorhynchus	Accinitridae	Falconiformes	LC	Sch-I
51	Black Kite	Milvus migrans	neenprerioue	i dicomformes		Sch-I
52	Brahminy Kite	Haliastur indus				Sch-I
53	White bellied sea Fagle GT	Haliaeetus leucoaaster			NT	Sch-I
54	Marsh Harrier	Circus aeruginosus				Sch I
55	Crosted Serment Fagle	Spilomis check				Sch-I
55	Ledian Chilen	A solution landing				Sch-I
50		Accipiter baalus				Sch-I
57	Blackwinged Kite	Elanus caeruleus				Sch-I
58	Sparrow Hawk	Accipiter nisus				Sch-I
59	Short-toed Snake- Eagle	Circaetus gallicus			VU	Sch-I
60*	Lesser Spotted Eagle	Aquila pomarina			LC	Sch-I
61	Pale Harrier	Circus macrourus			NT	Sch-I
62	Pied Harrier	Circus melanoleucos			LC	Sch-I
63*	Redheaded Merlin	Falco chicquera	Falconidae		NT	Sch-I
64	Kestrel	Falco tinnunculus			LC	Sch-IV
65**	White Rummped Vulture (Old Record)	Gyps benghalensis			CR	Sch-I
66**	Longbilled Vulture (Old Record)	Gyps indicus			CR	Sch-I
67**	Scavenger Vulture	Neophron percnopterus			EN	Sch-I
68	Grey Patridge	Francolinus pondicerianus	Phasianidae	Galliformes	LC	Sch-IV
69*	Sarus Crane	Grus antigone	Gruidae	Gruiformes	VU	Sch-IV
70**	Siberian Crane (Old	Grus leucogeranus			CR	Sch-I
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Record)	a a a a a a a a a a a a a a a a a a a				
71	Common Crane	Grus grus			LC	Sch-IV
72	White-Breasted Waterhen	Amaurornis phoenicurus	Kallidae		LC	Sch-IV
73	Water Cock	Gallicrex cinerea			LC	Sch-IV
74	Purple Moorhen	Porphyrio porphyrio			LC	Sch-IV
75	Common Moorhen	Gallinula chloropus			LC	Sch-IV
76	Common Coot	Fulica atra			LC	Sch-IV



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77	Water Rail	Rallus aquaticus			LC	Sch-IV
78	Slaty breasted Rail	Rallus striatus			LC	Sch-IV
79	Little Crake	Porzana fusca			LC	Sch-IV
80	Brown Crake	Amaurornis akool			LC	Sch-IV
81	Pheasant-tailed Jacana	Hydrophasianus chirurgus	Jacanidae	Charadriiformes	LC	Sch-IV
82	Bronze-Winged Jacana	Metopidius indicus			LC	Sch-IV
83	Black-Winged Stilt	Himantopus himantopus	Recurvirostridae		LC	Sch-IV
84	Avocet	Recurvirostra avosetta			LC	Sch-IV
85	Little Ringed Plover	Charadrius dubius	Charadriidae		LC	Sch-IV
86	Kentish Plover	Charadrius alexandrinus			LC	Sch-IV
87	Red-Wattled Lapwing	Vanellus indicus			LC	Sch-IV
88	Yellow-Wattled Lapwing	Vanellus malabaricus			LC	Sch-IV
89	Grey Headed Lapwing	Vanellus cinereus			NT	Sch-IV
90	Golden Plover	Pluvialis fulva			LC	Sch-IV
91	Sand Plover	Charadrius leschenaultii			LC	Sch-IV
92	Whimbrel	Nemenius phaeopus			LC	Sch-IV
93	Spotted Red Shank	Tringa erythropus			LC	Sch-IV
94	Curlew	Numenius arguata			NT	Sch-IV
95	Red Shank	Tringa totanus			LC	Sch-IV
96	Green Shank	Tringa nebularia			LC	Sch-IV
97	Wood Sandpiper	Tringa glareola			LC	Sch-IV
98	Common Sandpiper	Tringa hypoleucos				Sch-IV
99	Spoonbill Sandpiper	Furwnorhynchus nygmeus			CR	Sch-I
100	Bar tailed Godwit	Limosa Lapponica			NT	Sch-IV
101	Blacktailed Godwit	Limosa limosa			NT	Sch-IV
101	Painted Spine	Rostratula honoahlonsis	Rostratulidae			Sch-IV
102	Wood Snipe GT	Gallinago nemoricola	Scolonacidae		VII	Sch-IV
103	Great Knot	Calidris tanuirostris	Scolopacidae		VU	Sch IV
104	Dintail Spipe	Callingo stanura				Sch IV
105	I man Sinpe	Callinggo minima				Sch-IV
100	Little Stint	Galidais minuta				Sch-IV
107	Tamminalia Stinta	Calidris minuta				Sch-IV
100	Common Spins					Sch-IV
109	March Sandainan	Gallinago gallinago				Sch-IV
110	The standpiper	Tringa stagnatius				Sch-IV
111	Terek Sandpiper	Xenus cinereus				Sch-IV
112	Collared Pratincole	Glareola pratincola	Glareolidae			
113	Small Indian Pratincole	Glareola lactea				
114	Black Headed Gull	Larus ridibundus	Laridae		LC	Sch-IV
115	Brown Headed Gull	Larus brunnicephalus			LC	Sch-IV
116	Lesser Black-backed Gull	Larus argentatus			LC	Sch-IV
117	Palla's Gull	Larus ichthyaetus			LC	Sch-IV
118	Whiskered Tern	Chlidonias hybrida			LC	Sch-IV
119	LittleTern	Sterna albifrons			LC	Sch-IV
120	Gull billed Tern	Gelochelidon nilotica			LC	Sch-IV
121	River Tern	Sterna aurantia			NT	Sch-IV
122	Black bellied Tern GT	Sterna acuticauda			EN	Sch-IV
123	Caspian Tern	Sterna caspia			LC	Sch-IV
124	Blue Rock Pigeon	Columba livia	Columbidae	Collumbiformes	LC	Sch-IV
125	Spotted Dove	Streptopelia chinensis			LC	Sch-IV
126	Ring Dove	Streptopelia decaocto			LC	Sch-IV
127	Little Brown Dove	Streptopelia senegalensis			LC	Sch-IV
128	Rose-ringed Parakeet	Psittacula krameri	Psittacidae	Psittaciformes	LC	Sch-IV
129	Brain Fever Bird	Hierococcyx varius	Cuculidae	Cuculiformes	LC	Sch-IV
130	Indian Cuckoo	Cuculus micropterus			LC	Sch-IV



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131	Common Cuckoo	Cuculus canorus			LC	Sch-IV
132	Asian Koel	Eudynamys scolopacea			LC	Sch-IV
133	Greater Coucal	Centropus sinensis			LC	Sch-IV
134	Lesser Coucal	Centropus bengalensis			LC	Sch-IV
135	Pied Crested Cuckoo	Clamator jacobinus			LC	Sch-IV
136	Spotted Owlet	Athene brama	Tytonidae	Strigiformes	LC	Sch-IV
130	Brown Fish-Owl	Katupa zavlonansis	Strigidae	Strightines		Sch-IV
129*	Brown Howk Owl	Ninor soutulata	Strigitat			Sch-IV
130	Biowii Hawk-Owi	Ninox scutulata				Sch-IV
139	Eagle Owl	Tylo aba				Sch-IV
140	Eagle Owl	Bubo bubo	Contra Inthe			Sch-IV
141		Caprimulgus asiaticus	Caprimulgidae	Caprimuigiformes		Sch-IV
142	Largetailled Nightjar	Caprimulgus macrurus				Sch-IV
143	Indian Jungle Nightjar	Caprimulgus indicus				Sch-IV
144	Asian Palm-Swift	Cypsiurus balasiensis	Apodidae	Apodiformes	LC	
145	House Swift	Apus affinis			LC	
146*	Alpine Swift	Apus melba			LC	
147	Small Blue Kingfisher	Alcedo atthis	Alcedinidae	Coraciformes	LC	Sch-IV
148	Blackcapped Kingfisher	Halcyon pileata			LC	Sch-IV
149	White-breasted Kingfisher	Halcyon smyrnensis			LC	Sch-IV
150	Lesser Pied Kingfisher	Ceryle rudis			LC	Sch-IV
151	Small Bee-eater	Merops orientalis	Meropidae		LC	
152	Blue-tailed Bee-eater	Merops philippinus			LC	
153	Chestnut headed Bee eater	Merops leschenualti			LC	
154	Indian Roller	Coracias benghalensis	Coraciidae		LC	Sch-IV
155	Common Hoopoe	Upupa epops	Upupidae		LC	
156	Grey Hornbill	Ocyceros birostris	Bucerotidae		LC	Sch-IV
157	Coppersmith Barbet	Megalaima haemacephala	Capitonidae	Piciformes	LC	Sch-IV
158	Lesser Golden-backed	Dinopium benghalense	Picidae		LC	Sch-IV
100	woodpecker	2 moptimi congitatorise	- Teraute		20	Sen 11
159	Greater Golden-backed	Chrysocolantes lucidus			LC	Sch-IV
157	woodpecker	en ysocorapies raciaus			Le	ben I v
160	Ashy wood Swallow	Artamus fuscus	Artamidae	Passeriformes	LC	
161	Wire tailed Swallow	Hirundo smithii	711 tainituae		LC	
162*	Red winged Bush lark	Mirafra erythrontera	Alaudidaa			Sch-IV
163	Ashy crowned Finchlark	Eramontarix arisaa	Alaudidat			Sch IV
103	Asily clowled Finchlark	Annuan an an the anioung				Sch-IV
104	Chart Trad lark	Ammomanes proenicura				Sch-IV
105	Short Toed lark	Galanarella cinera				Sch-IV
160		Galandrella cristate				Sch-IV
16/	SKY Iark	Alldudd guluguld	G(1)			Sch-IV
168	Rosy pastor	Sturnus roseus	Sturnidae		LC	Sch-IV
169	Common Starling	Sturnus vulgaris			LC	Sch-IV
170	Pied Myna	Sturnus contra			LC	Sch-IV
171	Common Myna	Acridotheres tristis			LC	Sch-IV
172	Brahminy Myna	Sturnia pagodarum			LC	Sch-IV
173	Jungle Myna	Acridotheres fuscus			LC	Sch-IV
174	Bank Myna	Acridotheres ginginianus			LC	Sch-IV
175	Indian Treepie	Dendrocitta vagabunda	Corvidae		LC	Sch-IV
176	House Crow	Corvus splendens			LC	Sch-V
177	Jungle Crow	Corvus macrorhynchos			LC	Sch-IV
178	Small Minivet	Pericrocotus cinnamomeus	Campephagidae		LC	Sch-IV
179	Common Wood Shrike	Tephrodornis pondicerianus			LC	Sch-IV
180	Spotted Babbler	Pellorneum ruficeps	Muscicapidae		LC	Sch-IV
181	Common Babbler	Turdoides caudata			LC	Sch-IV
182	Rufous bellied Babbler	Dumetia hyperythra			LC	Sch-IV



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183	Jungle Babbler	Turdoides striatus		LC	Sch-IV
184	Tickells Blue Flycatcher	Musccicapa tickelliale		LC	Sch-IV
185	Paradise Flycatcher	Terpsiphone paradisi		LC	Sch-IV
186	Large Bush warbler	Cettia major		LC	Sch-IV
187	Striated Marsh Warbler	Megalurus palustris		LC	Sch-IV
188	Ashy wren Warbler	Prinia socialis		LC	Sch-IV
189	Tailor bird	Orthotomus sutorius		LC	Sch-IV
190	Brown leaf Warbler	Phylloscopus sps		LC	Sch-IV
191	Blyths leaf Warbler	Phylloscopus reguloides		LC	Sch-IV
192	Indian great reed Warbler	Acrocephalus stentoreus		LC	Sch-IV
193	Paddy field Warbler	Acrocephalus agricola		LC	Sch-IV
194	Magpie Robin	Copsychus saularis		LC	Sch-IV
195	Stone Chat	Saxicola torquata		LC	Sch-IV
196	Pied Bush chat	Saxicola caprata		LC	Sch-IV
197	Indian Robin	Saxicola fulicata		LC	Sch-IV
198	Grey Bush chat	Saxicola ferrea		LC	Sch-IV
199	Indian Tree Pipit	Anthus hodgsoni	Motacillidae	LC	Sch-IV
200	Paddyfield Pipit	Anthus rufulus		LC	Sch-IV
201	Yellow Wagtail	Motacilla flava		LC	Sch-IV
202	Grey Wagtail	Motacilla cinerea		LC	Sch-IV
203	White-browed Wagtail	Motacilla sps.		LC	Sch-IV
204	Forest Wagtail	Motacilla indica		LC	Sch-IV
205	Yellow Headed Wagtail	Motacilla citreola		LC	Sch-IV
206	Large Pied Wagtail	Motacilla maderaspatensis		LC	Sch-IV
207	Tickelles Flower Pecker	Dicaeum erythrorhynchos	Dicaeidae	LC	Sch-IV
208	Purple Sunbird	Nectarinia asiatica	Nectariniidae	LC	Sch-IV
209	White-Backed Munia	Lonchura striata	Ploceidae	LC	Sch-IV
210	Spotted Munia	Lonchura punctulata		LC	Sch-IV
211	Black-Headed Munia	Lonchura Malacca		LC	Sch-IV
212	House Sparrow	Passer domesticus		LC	
213	Streaked Weaver	Ploceus manyar		LC	Sch-IV
214	Baya Weaver	Ploceus philippinus		LC	Sch-IV
215	Red Munia	Estrilda amandava		LC	Sch-IV
216	White Throated Munia	Lonchura malabarica		LC	Sch-IV
217	Red-Vented Bulbul	Pycnonotus cafer	Pycnonotidae	LC	Sch-IV
218	Red-whiskered Bulbul	Pycnonotus jocosus		LC	Sch-IV
219	Common Swallow	Hirundo rustica	Hirundinidae	LC	
220	Dusky Crag Martin	Hirundo concolor		LC	
221	Brown Shrike	Lanius cristatus	Daniidae	LC	Sch-IV
222	Grey Shrike	Lanius excubitor		LC	Sch-IV
223	Bay-backed Shrike	Lanius vittatus		LC	Sch-IV
224	Common Iora	Aegithina tiphia	Irenidae	LC	Sch-IV



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225	Gold-fronted Chloropsis	Chloropsis aurifrons	Chloropseidae	LC	Sch-IV
226	Eurasian Golden Oriole	Oriolus oriolus	Oriolidae	LC	Sch-IV
227	Black-headed Oriole	Oriolus xanthornus		LC	Sch-IV
228*	Blacknaped Oriole	Oriolus chinensis		LC	Sch-IV
229	Black Drongo	Dicrurus macrocercus	Dicruridae	LC	Sch-IV
230	Ashy Drongo	Dicrurus leucophaeus		LC	Sch-IV
231*	Greater Racket-tailed	Dicrurus paradiseus		LC	Sch-IV
	Drongo				
232	White Bellied Drongo	Dicrurus caerulescrns		LC	Sch-IV

A total of 232 species of birds belonging to 138 genera, over 50 families and 17 orders were recorded in the study area. The threatened species of birds status are summarized. Status of the birds as per Wildlife (protection) Act 1972 and IUCN status. IUCN Criteria for assigning threat status and category based on rates of declines, population levels and range sizes [18]. 6 forms are globally threatened, 20 near threatened, 04 vulnerable, and 03 endangered. Many of these are also listed in Red Data Book IUCN (1990).

Wildlife (Protection) Act - 1972:Schedule-ISchedule-IVSchedule-V

W (P) A, 1972 updated up to 2010. Protected birds listed in Schedule-I and IV of the Wildlife (Protection) Act and Schedule - IV refer to genera, many of which have several species. Schedule - V, Vermins. Many birds are legally protected.

*Based on secondary source of information (Forest officials, field officers and Bird watchers)

**Vultures (Old Records), Siberian Crane (Old Record)

<u>IUCN Status:</u> CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern. GT: Globally Threatened



The number and percentage composition of families and species under different orders are shown in Table 2 and Fig 1,2. Among the 17 orders of birds recorded, order Passeriformes is dominant with 76 species contributing 32.759% of the total species followed by Charadriiformes with 40 (17.241%), Anseriformes and Ciconiformes each 21 (9.052%), Falconiformes 18 (7.759%), Gruiformes 12 (5.172%), Coraciformes 10 (4.310%), Cuculiformes 07 (3.017%), Pelecaniformes 06 (2.586%), Strigiformes 05 (2.155%), Collumbiformes 04 (1.724%), Apodiformes, Caprimulgiformes and Piciformes each with 03 (1.232%), Galliformes, Podicipediformes and Psittaciformes each with 01 (0.431%). Of the total 57 recorded families, Passeriformes 04 (7.843%), Falconiformes, Gruiformes, Pelecaniformes, Piciformes 05 (9.809%), Ciconiformes 04 (7.843%), Falconiformes, Gruiformes, Pelecaniformes, Piciformes each with 02 (3.922%), Anseriformes, Apodiformes, Caprimulgiformes, Collumbiformes, Cuculiformes, Podicipediformes and Psittaciformes and Psittaciformes, Cuculiformes, Calliformes, Podicipediformes, Collumbiformes, Collumbiformes, Collumbiformes, Podicipediformes, Collumbiformes, Collumbiformes, Podicipediformes, Podicipediformes, Collumbiformes, Collumbiformes, Collumbiformes, Collumbiformes, Podicipediformes, Podicipediformes, Podicipediformes, Podicipediformes, Podicipediformes, Collumbiformes, Collumbiformes, Collumbiformes, Podicipediformes, Po



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Table: 2. Order-wise Avifaunal diversity (Families and Species)

Sl No	Orders	Families	% Representation	Species	% Representation
01	Anseriformes	01	1.961	21	9.052
02	Apodiformes	01	1.961	03	1.239
03	Caprimulgiformes	01	1.961	03	1.232
04	Charadriiformes	07	13.725	40	17.241
05	Ciconiformes	04	7.843	21	9.052
06	Collumbiformes	01	1.961	04	1.724
07	Coraciformes	05	9.809	10	4.310
08	Cuculiformes	01	1.961	07	3.017
09	Falconiformes	02	3.922	18	7.759
10	Galliformes	01	1.961	01	0.431
11	Gruiformes	02	3.922	12	5.172
12	Passeriformes	17	33.333	76	32.759
13	Pelecaniformes	02	3.922	06	2.586
14	Piciformes	02	3.922	03	1.232
15	Podicipediformes	01	1.961	01	0.431
16	Psittaciformes	01	1.961	01	0.431
17	Strigiformes	02	3.922	05	2.155
	Total	5 1		232	





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Wetland birds have a wide variety of food habits. Basing on the nature of feeding activities and food compositions, the birds have been grouped as carnivorous, insectivorous, omnivorous, and herbivorous etc.. The migrating birds are subjected to greater ecological diversity and have a greater range of adaptability [42] [50] [51]. The richness of species is mainly due to the presence of adequate food supply, water quality and large water spread area without human disturbance. The lake supports a rich biodiversity with a high biomass that form the principal food for the different birds and fish form the major food for waterfowl. The members of the family Anatidae are herbivore in nature depend on aquatic flora. Overall, Insectivorous birds dominated the bird community about 60% and Carnivores, Granivores and Frugivores contributed equally. Bird species richness based on their food habits. Vegetation and habitat variables correlated positively with bird community parameter.

The rare and endangered species, many of which are now threatened throughout Europe and Asia [8] [16]. The highest species diversity was observed during the wet period. The large group of water birds consists mainly of ducks, diving birds like Grebes, Rails, Coots and Moorhens, other birds with aquatic life style and a variety of ducks and waders used to visit the lake. The population of Family Anatidae was the maximum among the winter migrants.

Wading birds include Plovers, Sandpipers, Snipes, Curlews, Avocets, Godwits, Lapwings, Pratincoles, Shanks, Stilts, Stints, etc. The long legged birds that wade in shallow waters include Herons, Storks, Ibises, Bitterns, Spoonbills and Flamingos. The migratory birds are mostly seen in large flocks or small parties and in mixed flocks. The study focused on the population characteristics of the dominant birds over a period of three years. The Pelican's population was dominant followed by Painted Storks, Openbill Storks, White Ibis, Black winged Stilts, Glossy Ibis, Cormorants, Herons, variety of Ducks, Variety of Waders along with other miscellaneous groups. The lake is frequented by the wetland dependent birds which include Raptors, Kingfishers, Swallows, Wagtails, Baya etc. Sand Pipers, Lapwings, Avocets, Curlews, Whimbrels, Reef Herons, Jacanas, Water Cocks, Water hens are reduced due to environmental conditions. Depletion or disappearance of bird diversity and population can be ascribed to the shrinkage of habitat and various threats the lake is confronting with. The population of many species has declined alarmingly. Extremely rare species and rare winter visitors (Spoon bills, Siberian Cranes, Adjutant storks, Pelican etc.,) which used to visit Kolleru lake slowly disappeared and the diversity as well as population size have reduced.

Once common resident birds species like the White backed Vulture (*Gyps benghalensis*), Long billed Vulture (*Gyps indicus*), Scavenger Vulture (*Neophron percnopterus*), have already disappeared from the lake area. Similarly winter migratory birds such as Siberian Crane, (*Grusleucogeranus*) and Sarus Crane (*Grus antigone*) were also not



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recorded during the study period. The reappearance of variety of ducks and waders after two decates is also a significant finding during the study. Grey Headed Lapwing, Black Ibis, White Pelican, Spoonbilled Sandpiper, Ferruginous Pochard, Falcatad Ducks, Flamingos, Rosy Pastors, were recorded the for the first time during the study period (Table:3).

	TABLE: 3. LIST OF BIRDS AND THEIR DISTRIBUTION STATUS, HABITAT, FOOD HABITS AND ABUNDANCE						
S. No	Common Name	Scientific Name	Distribution Status	Habitat	Food Habits	Abundance	
1	Little Grebe	Tachybaptus ruficollis	R/LM/ WV	WL	Pis/Cru/Inc	Com	
2	Spot-billed Pelican	Pelecanus philippensis	WV Br.V	WL	Pis	Com	
3	Great White pelican	Pelecanus onocrotalus	WV	WL	Pis	R	
4	Little Cormorant	Phalacrocorax niger	R/LM	WL	Pis/Cru/Car	Com	
5	Great Cormorant	Phalacrocorax carbo	R/LM	WL	Pis	UnCom	
6	Indian Shag	Phalacrocorax fuscicollis	R/LM	WL	Pis	R	
7	Darter	Anhinga melanogaster	R/LM Br	WL	Pis	Com	
8	Flamingo	Phoenicopterus ruber	WV	WL	Crus/ Pis/ Veg/ Se	R	
9	Lesser Flamingo	Phoenicopterus minor	WV	WL	Al/ D /Co	R	
10	Little Egret	Egretta garzetta	R/LM	WL IL	Pis/ Cru/ Inc/ Car	Com	
11	Median Egret	Mesophovx intermedia	R/LM	WL	Pis/ Car/Inc	Com	
12	Large Egret	Casmerodius albus	R/LM	WL	Pis/ Car	Com	
13	Cattle Egret	Bubuleus ibis	R/LM	WL.	Inc/ Car	Com	
13	Indian Pond-Heron	Ardeola gravii	R/LM	WL.	Car	Com	
15	Purple Heron	Ardea purpurea	R/IM	WI	Pis/ Car/ Omn	Com	
16	Grev Heron	Ardea cinerea	R/LM	WI	Car/ Pis/ Cru	Com	
10	Night Heron	Nyeticorax nyeticorax		WI	Pie/ Car/Omn	Com	
17	Little Green Horon	Putoridas striatus		WL	Pis/Car/Cru/Inc	UnCom	
10	Vallary Bittam	Buiorides siriaids		WL Ed Spa	Pis/Cai/Citu/Inc	UnCom	
20	Tellow Bittern		R/LM	WL Ed.Sps		Cam	
20	Chestnut Bittern	Ixoychus cinnamomeus		WL Ed.Sps	Pis/ Moll/ Inc/Car	Com	
21			LM Br.v	WL	Pis/ inc/Cru/ Car	Com	
22	Indian Reef Heron	Egretta gularis	K/LM	WL	Cru/Moll/Pis	UnCom	
23	Asian Openbill-Stork	Anastomus oscitans	R/LM Br.V	WL	Moll/ Pis/Car	Com	
24	Lesser Adjutant Stork	Leptoptilos dubius	WV	WL	Car/ Pis	R	
25	Oriental White Ibis	Threskiornis melanocephalus	R/LM/WM Br.V	WL	Car/ Pis/ Aqu.Inc	Com	
26	Glossy Ibis	Plegadis falcinellus	R/LM	WL	Car	Com	
27	Black Ibis	Pseudibis papillosa	LM/WV	WL	Car/Inc/Cru	UnCom	
28	Spoonbill	Platalea leucorodia	WV	WL	Pis/ Car/Omn	R	
29	Lesser Whistling-Teal	Dendrocygna javanica	WV / LM Br.V	WL	Veg/Pis/Car	Com	
30	Cotton Teal	Nettapus coromandelianus	R/ LM	WL	Veg/Cru/Inc	Com	
31	Northern Pintail	Anas acuta	WV/ LM	WL	Veg/Moll/Inc	Com	
32	Garganey Teal	Anas querquedula	WV/ LM	WL	Veg/Se/Aqu.inc	Com	
33	Spot-bill	Anas poecilorhyncha	WV/ LM	WL	Veg/Aqu.inc/Moll	Com	
34	Large Whistling-Teal	Dendrocygna bicolor	WV Br.V	WL	Aqa. Veg	UnCom	
35	Brahminy Duck	Tadorna ferruginea	WV/ LM/R	WL	Omn	Com	
36	Common Teal	Anas crecca	WV	WL/ IL	Veg / Se	Com	
37	Mallard	Anas platyrhynchos	WV	WL	Veg	R	
38	Gadwall	Anas strepera	WV	WL	Se/Aqu.Veg/ Inc	Com	
39	Shoveller	Anas clypeata	WV	WL	Cru/Inc/Veg	Com	
40	Wigeon	Anas penelope	WV	WL	Veg/Inc/Moll	Com	
41	Red crested Pochard	Rhodonessa rufina	WV	WL	Veg/ Aqu.Inc/Moll	Com	
42	White eyed Pochard	Aythya nyroca	WV	WL	Veg/Omn	R / SC	
43	Tufted Pochard	Aythya fuligula	WV	WL	Aqua.Veg/Moll	Com	
44	Common Pochard	Aythya ferina	WV	WL	Veg/Cru/Inc/Moll	Com	
45	Falcated Duck	Anas falcata	WV	WL.	Veg/	R / SC	
46*	Scaup Duck	Aythya marila	WV	WL	Veg	R	
47	Grev lag Goose	Anser anser	WV	WL.	Veg	UnCom	
48	Bar Haeded Geese	Anser indicus	WV	WI.	Veg	UnCom	
49	Comb Duck	Sarkidiornis melanotos	WV	WL.	Veg/ Aqua Inc	Com	
50	Honey-Buzzard	Pernis ptilorhynchus	R	T	Car/ P	UnCom	
51	Black Kite	Mibus migrans	R	т	Omn Off P	Com	
52	Brahminy Kite	Haliastur indus		WD	Dis/ Cru/Car D	Com	
54	Draining Kite	nullasini thads	IV LIVI	WD I	TIS/ CIU/Cal r	Com	



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53	White bellied sea Eagle	Haliaeetus leucogaster	R	WD	Pis / Sn /P	UnCom
54	Marsh-Harrier	Circus aeruginosus	WV	T	Car /Pis/ Inc P	UnCom
55	Crested Serpent-Eagle	Spilornis cheela	R/LM	Ť	Car/Sn/P	UnCom
56	Indian Shikra	Acciniter hadius	R	Ť	Car/ P	Com
57	Blackwinged Kite	Elanus caeruleus	R	T	Car/ Inc / P	Com
58	Sparrow Hawk	Accipiter nisus	R/LM/WM	T	Car P	UnCom
59	Short-toed Snake-Fagle	Circaetus gallicus	R/LM/WM	T	Car P	R
60*	Lesser Spotted Fagle	Aquila pomarina	R/LM/WM	T	Car P	R
61	Pale Harrier	Circus macrourus	LM/WM	T	Car P	R
62	Pied Harrier	Circus melanoleucos	WV	T	Car P	R
63*	Redheaded Merlin	Ealco chicauera	WV	T	Car	R
64	Kestrel	Falco tinnunculus	R/I M	T	Car/ Inc/ P	Com
65**	White Rumped Vulture (Old	Gyns henghalensis	R	T		- Com
05	Record)	Gyps bengnatensis	K	1	Car/ Cars/	
66**	Longhilled Vulture	Gyps indicus	R	т	Car/ Cars/	-
00	(Old Record)	Gyps indicus	K	-	Carly Carls	
67**	Scavenger Vulture	Neonhron perchapterus	R	т	Car/ Cars/	
68	Grev Patridge	Francolinus pondicerianus	R	T	Se/Inc / Omn/ Gra	Com
69*	Sarus Crane	Grus antigone	WV	WI.	-	-
70**	Siberian Crane (Old	Grus laucogeranus	WV	WI		
70	Record)	Grus leucogerunus	** *	WL		
71	Common Crane	Grus grus	WV	WI		
72	White-Breasted Waterben	Amaurornis phoenicurus	R	WL	Omn	Com Sc
72	Water Cock	Gallicrer cinerea	R/I M	WL	Veg/Omn	UnCom / Sc
73	Purple Moorhen	Pornhurio pornhurio	D	WL	Veg/Moll/Inc	Com
74	Common Moorhon	Callinula chloropus	D	WI		Com
75	Common Coot	Eulion atm		WL	Vag/ Omn	Com
70	Water Dail			WL		Com
//	Water Kall	Ratius aquancus	W V	WL		Com
/8*	Slaty breasted Rail	Rallus striatus	WV WV	WL	Omn	Com
/9	Little Crake	Porzana fusca	W V	WL	Umn	UnCom
80	Brown Crake	Amaurornis akool	WV	WL WL	Inc/Omn	UnCom
81	Pheasant-Tailed Jacana	Hydrophasianus chirurgus	R	WL/ IL	Veg/ Inc/ Moll	Com
82	Bronze-Winged Jacana	Metopidius indicus	R	WL	Veg/Inc/ Moll	Com
83	Black-Winged Stilt	Himantopus himantopus	R/LM Br	WL Ed.Sps	Moll /Aqa.Veg/Inc	Com
84	Avocet	Recurvirostra avosetta	WV	WL Ed.Sps	Cru/ Moll/ Inc	UnCom SC
85	Little Ringed Plover	Charadrius dubius	WV/LM/R	WL Ed.Sps	Car/ Inc/Cru/Moll	UnCom
86	Kentish Plover	Charadrius alexandrinus	R/WV/LM	WL Ed.Sps	Cru/ Inc	Com/
87	Red-Wattled Lapwing	Vanellus indicus	R/ LM	WD/ T Ed.Sps	Inc/ Veg/ Moll	Com
88	Yellow-Wattled Lapwing	Vanellus malabaricus	R/ LM	WD/T Ed.Sps	Inc/ Veg/ Moll	Com
89	Grey Headed Lapwing	Vanellus cinereus	WV	WD/T Ed.Sps	Inc/ Moll/	R Sc
90	Golden Plover	Pluvialisfulva	WV	WL Edg.Sps	Inc/Moll/ Cru/Se	UnCom
91	Sand Plover	Charadrius leschenaultii	WV	WL Ed.Sps	Car/ Inc/ Cru	UnCom
92	Whimbrel	Numenius phaeopus	WV	WL Edg.Sps	Car/Cru/ Moll	UnCom
93	Curlew	Numenius arquata	WV/ LM	WL Edg.Sps	Car / Cru/ Inc	UnCom
94	Red Shank	Tringa totanus	WV	WL Edg.Sps	Moll/ Cru/Inc	Com
95	Spotted Red Shank	Tringa erythropus	WV	WL Edg.Sps	Car/Moll/ Cru/Inc	UnCom
96	Green Shank	Tringa nebularia	WV	WL IL	Moll/Cru/Inc	Com
97	Wood Sandpiper	Tringa glareola	WV	WL Edg.Sps	Moll/ Inc/ Pis	Com
98	Common Sandpiper	Tringa hypoleucos	WV/ R	WL SC/IL	Moll/ Cru/Aqu.Inc	Com
99	Spoonbill Sandpiper	Eurynorhynchus pygmeus	WV	WL Edg.Sps	Aqu.Inc	R Sc
100	Bar tailed Godwit	Limosa Lapponica	WV	WL Edg.Sps	Car/Aqu.Se	UnCom
101	Blacktailed Godwit	Limosa limosa	WV	WL Edg.Sps	Car/Moll/ Cru	Com
102	Painted Snipe	Rostratula benghalensis	LM	WL Edg. Sps	Omn	UnCom
103	Wood Snipe	Gallinago nemoricola	WV/ R	WL Edg.Sps	Omn	R
104	Great Knot	Calidris tenuirostris	WV	WL Edg.Sps	Car/Cru/Moll	UnCom
105	Pintail Snipe	Gallingo stenura	WV	WL Edg.Sps	Car/ Moll	R
106	Jack Snipe	Gallinago minima	WV	WL Edg.Sps	Car/ Omn	UnCom
107	Little Stint	Calidris minuta	WV/ R	WL Edg.Sps	Moll/ Crus/ Aqua.	Com
					Veg/Inc	
108	Temminck's Stint	Calidris temmincki	WV	WL Edg.Sps	Moll/Cru/Inc/Veg	Com
109	Common Snipe	Gallinago gallinago	LM/ WM	WL Edg.Sps	Inc/Moll/ Se	Com
110	Marsh Sandpiper	Tringa stagnatilis	WV	WL Edg.Sps	Moll/ Crus/Inc	Com



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111	Terek Sandpiper	Xenus cinereus	WV/	WL SC Edg Sps	Car/Moll/Cru/Inc	Com
112	Collared Pratincole	Glareola pratincola	WV	WL.	Inc	R
113	Small Indian Pratincole	Glareola lactea	LM/R	WL	Inc	Com
114	Black Headed Gull	Larus ridibundus	WV	WL SC/IL	Pis/ Car/ Off	UnCom
115	Brown Headed Gull	Larus unnicephalus	WV	WL SC/IL	Pis/ Car/ Off/Cru	Com
116	Lesser Black-backed Gull	Larus argentatus	WV	WL SC/IL	Pis/ Car	UnCom
117	Palla's Gull	Larus ichthvaetus	WV	WL SC/IL	Pis/ Crus	UnCom
118	Whiskered Tern	Chlidonias hvida	WV	WL SC/IL	Pis/ Crus/ Car	Un Com
119	LittleTern	Sterna albifrons	R/ LM	WL IL	Car/ Pis/	Com
		,			Aqua.Inc/Cru	
120	Gull billed Tern	Gelochelidon nilotica	LM/	WL SC/IL	Pis	Com
121	River Tern	Sterna aurantia	LM/R	WL IL	Pis/ Aqua. Inc/Cru	Com
122	Black bellied Tern	Sterna acuticauda	WV	WL SC/IL	Car/Pis/Cru/Inc	R
123	Caspian Tern	Sterna caspia	WV	WL SC/IL	Pis/Cru/	UnCom
124	Blue Rock Pigeon	Columba livia	R	Т	Gra/ Se/Veg	Com
125	Spotted Dove	Streptopelia chinensis	R	Т	Gra/ Se/Veg	Com
126	Ring Dove	Streptopelia decaocto	R	Т	Gra/ Se	Com
127	Little Brown Dove	Streptopelia senegalensis	R	Т	Gra/ Se/Veg	Com
128	Rose-ringed Parakeet	Psittacula krameri	R	Т	Fru / Se	Com
129	Brain fever Bird	Hierococcyx varius	R	Т	Inc / Fru/Car	Com
130	Indian Cuckoo	Cuculus micropterus	R	Т	Inc	Com
131	Common Cuckoo	Cuculus canorus	R	Т	Inc	Com
132	Asian Koel	Eudynamys scolopacea	R	Т	Fru/ Inc/Nec	Com
133	Greater Coucal	Centropus sinensis	R	Т	Inc/ Car/Se/Fru	UnCom
134	Lesser Coucal	Centropus bengalensis	R	Т	Inc	Com
135	Pied Crested Cuckoo	Clamator jacobinus	R	Т	Inc	Com
136	Spotted Owlet	Athene ama	R	Т	Car/Inc P	Com
137	Brown Fish-Owl	Ketupa zeylonensis	R	WD	Ro/Pis P	R
138*	Brown Hawk-Owl	Ninox scutulata	R	T F	Car/Ro P	R
139	Barn owl	Tyto alba	R	Т	Car/Ro P	Com
140	Horned owl	Bubo bubo	R	Т	Car/Ro P	UnCom
141	Comman Indian Nightjar	Caprimulgus asiaticus	R	Т	Inc	Com
142	Largetailled Nightjar	Caprimulgus macrurus	R	Т	Inc	UnCom
143	Indian Jungle Nightjar	Caprimulgus indicus	R	Т	Inc	Com
144	Asian Palm-Swift	Cypsiurus balasiensis	R	Т	Inc	Com
145	House Swift	Apus affinis	R	Т	Inc	Com
146*	Alpine Swift	Apus melba	R	Т	Inc	UnCom
147	Small Blue Kingfisher	Alcedo atthis	R	WD	Pis/ Inc/Tad	Com
148	Blackcapped Kingfisher	Halcyon pileata	R	WD	Pis/ Inc/ Car	UnCom
149	White-Breasted Kingfisher	Halcyon smyrnensis	R	WD	Car/Pis/ Inc	Com
150	Lesser Pied Kingfisher	Ceryle rudis	R	WD	Pis/Inc/ Tad	Com
151	Small Bee-eater	`	R	Т	Inc	Com
152	Blue-tailed Bee-eater	Merops philippinus	SV	Т	Inc	Com
153	Chestnut headed Bee eater	Merops leschenualti	R/SV		Inc	UnCom
154	Indian Roller	Coracias benghalensis	R	T	Inc/Car	Com
155	Common Hoopoe	Upupa epops	R	T	Inc	Com
156	Grey Hornbill	Ocyceros birostris	R	T	Fru/ Inc	UnCom
157	Coppersmith Barbet	Megalaima haemacephala	R	T	Fru /Inc/	Com
158	Lesser Golden-backed	Dinopium benghalense	R	T	Inc/Fru/ Nec	Com
150	Creater Colder hashed	Champaga lantag lasi las	р	T	Inc	UnCom
159	woodpacker	Chrysocolaptes lucidus	K	1	Inc	UnCom
160	Ashy wood Swallow	Artamus fuscus	D/IM	WD	Inc	UnCom
161	Wire tailed Swallow	Hirundo smithij	D/LIVI	WD T	Inc	UnCom
162	Red winged Bush lark	Mirafra arythroptara	R/LM R/LM		Veg/Se/Inc	UnCom
163	Ashy crowned Finchlark	Fremonterix orised	P	Т	Se/Inc	Com
164	Rufous tailed Finchlark	Ammomanes phoenicura	IM	Т	Se/Gra/Inc	UnCom
165	Short Toed lark	Galandrella cinera	I M/WV/CM	T	Se Inc	Com
166	Crested lark	Galandrella cristate	I M	Т	Se Inc	UnCom
167	Sky lark	Allanda onlugula	R	Т	Se/Inc/ Veg	Com
167	Rosy pastor	Sturnus roseus	SV	Т	Fru/ Inc/Nec/Gra	Com
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169	Starling	Sturnus vulgaris	LM	Т	Fru/ Inc	Com
170	Pied Myna	Sturnus contra	R	Т	Inc/Fru/Gra	Com
171	Common Myna	Acridotheres tristis	R	Т	Inc/Fru/Veg/Nec/Car	Com
172	Brahminy Myna	Sturnia pagodarum	R	T	Fru/Inc	Com
172	Jungle Myna	Acridotheres fuscus	R/I M	T	Fru// Gra/ Nec/Inc	Com
173	Bank Myna	Acridotheres ginginianus	R/IM R/IM	T	Fru/Inc/Gra	UnCom
174	Indian Treenie	Dendrocitta vagabunda	R	Т	Fru/Car/Inc	UnCom
175	House Crow	Comus splandans	P	Т	Omp/Eru/Car	Com
170	Jungle Crow	Convus spiendens	R D	T	Omn	Com
177	Small Minivat	Corvus macromynchos	R D	Т	Unin	Com
1/0	Common Wood Chriter	Terlerocolus cinnamomeus	K D/LM	1 T	Tri c	UnCarr
1/9	Common Wood Shrike	Tephrodornis pondicerianus	R/LM	I	Inc	UnCom
180	Spotted Babbler	Pellorneum ruficeps	K	T	Inc	Com
181	Common Babbler	Turdoides caudata	R	T	Inc	Com
182	Rufous bellied Babbler	Dumetia hyperythra	R	T	Inc	UnCom
183	Jungle Babbler	Turdoides striatus	R	T	Inc/Fru	Com
184	Tickells Blue Flycatcher	Musccicapa tickelliale	R	Т	Inc	Com
185	Paradise Flycatcher	Terpsiphone paradisi	R/LM	Т	Inc	UnCom
186	Large Bush warbler	Cettia major	R	Т	Inc	UnCom
187	Striated marsh Warbler	Megalurus palustris	WV	Т	Inc	UnCom
188	Ashy wren Warbler	Prinia socialis	WV	Т	Inc	UnCom
189	Tailor bird	Orthotomus sutorius	R	Т	Inc/ Nec	Com
190	Brown leaf Warbler	Phylloscopus sps	LM	Т	Inc	R
191	Blyth's leaf Warbler	Phylloscopus reguloides	WV	Т	Inc	UnCom
192	Indian Great Reed Warbler	Acrocephalus stentoreus	WV	Т	Inc	Com
193	Paddy field Warbler	Acrocephalus agricola	R	Т	Inc	Com
194	Magpie Robin	Copsychus saularis	R	Т	Inc	Com
195	Stone Chat	Saxicola torauata	R	Т	Inc	Com
196	Pied Bush chat	Saxicola caprata	R	T	Inc/Veg	Com
197	Indian Robin	Saxicola fulicata	R	T	Inc	Com
108	Grev Bush chat	Saxicola farraa	IM	TWD	Inc	UnCom
190	Indian Trae Dinit	Anthus hodosoni	D		Inc	UnCom
200	Paddyfield Pipit	Anthus mougsoni	R P	Т	Inc/Veg/Se	Com
200	Vallaw Wastail	Aninus Tujuius Motacilla flava	K WV	WD Edg Spc		Com
201	Create We stail	Motacilla jiava		WD Edg.Sps		Com
202	Grey wagtan	Motacilla cinerea		wD Edg.Sps		LO
203	White-Browed Wagtail	Motacilla sps.	W V/LM	I	Inc	UnCom
204	Forest Wagtail	Motacilla indica	WV/LM	1	Inc/	UnCom
205	Yellow Headed Wagtail	Motacilla citreola	WV/LM	WD	Tiny.Moll	Com
206	Large Pied Wagtail	Motacilla maderaspatensis	R/WV	WD	Inc/Moll/Se	UnCom
207	Tickelles Flower Pecker	Dicaeum erythrorhynchos	R	Т	Fru	Com
208	Purple Sunbird	Nectarinia asiatica	R	Т	Nec/Inc	Com
209	White-Backed Munia	Lonchura striata	R	Т	Se/Gra	Com
210	Spotted Munia	Lonchura punctulata	R	Т	Se/Gra	Com
211	Black-Headed Munia	Lonchura Malacca	R	Т	Se/ Gra	Com
212	House Sparrow	Passer domesticus	R	Т	Omn/Ins/ Veg	Com
213	Streaked Weaver	Ploceus manyar	R/LM	WD	Gra/ Se/ Inc	UnCom
214	Baya Weaver	Ploceus philippinus	R/LM	WD	Gra/Se/Inc	Com
215	Red Munia	Estrilda amandava	R	Т	Se/Gra	UnCom
216	White Throated Munia	Lonchura malabarica	R	Т	Se/Gra	Com
217	Red-Vented Bulbul	Pycnonotus cafer	R	Т	Fru/Nec/Inc	Com
218	Red-whiskered Bulbul	Pycnonotus jocosus	R	Т	Fru/Inc/Nec	Com
219	Common Swallow	Hirundo rustica	LM/R	WD	Inc	Com
220	Dusky Crag Martin	Hirundo concolor	R/LM	Т	Inc	UnCom
221	Brown Shrike	Lanius cristatus	R	Т	Inc/ Car	UnCom
222	Grey Shrike	Lanius excubitor	R	Ť	Car	Com
222	Bay-backed Shrike	Lanius vittatus	R	T	Inc/Car	Com
223	Common Jora	Agaithing tinhig	P	Т	Inc/Ca	Com
224	Cold fronted Chloronsis	Chloropsis aurifrons	D D	T	Inc/Noc/Em	Com
225	Eurosian Colden Oriole	Oriolus oriolus	R D	T	Eru/Veg/Ing/Nog	Com
220	Plack handed Origin	Oriolus varthemus		T	Veg/Inc/Nec	LinCom
227	Diack-neaded Offole	Oriolus xaninornus	K/LM		veg/inc	UnCom
228*	Blacknaped Oriole	Dialus chinensis	K/LM	I T	veg/Inc	Com
229	Black Drongo	Dicrurus macrocercus	K	T T	Inc/Car/Nec	Com



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230	Ashy Drongo	Dicrurus leucophaeus	R/LM	Т	Inc/ Car/ Nec	Uncom
231*	Greater Racket-tailed Drongo	Dicrurus paradiseus	R/LM	T F	Inc/ Nec	UnCom
232	White Bellied Drongo	Dicrurus caerulescrns	R/LM	Т	Inc/ Nec	Com

Kolleru lake plays an important role in the annual cycle of the migratory and non-migratory birds and serves as wintering ground for the migrant species and breeding grounds for several Resident species. Birds either resident or migratory according to their occurrence, frequency and population they have been assigned various categories. Status of birds was classified as Resident species, Local migratory (Resident of India) and Winter and Summer visitors (International) which are found in the study area only certain period. Among the species recorded over 100 species were winter visitors. Protection of winter visitors need highest priority. Breeding visitors which visit the study area only during breeding season. Breeding birds prefer waterside reeds Typha, Ipomea together with scattered bushes, trees furnish the main area of activities like nesting, roosting etc., A variety of niches provide excellent cover for the activities. Abundance of birds was classified as Common, Uncommon and Rare. Presence of some Rare and Uncommon species makes it as important area for biodiversity conservation. Birds species richness based on their food habits. High diversity and unique community composition of birds, habitat variables (Aquatic and Terrestrial) and food habits reflect the conservation importance of the lake. Considering the bird species richness the lake requires special attention for conservation (Table: 3).

Legends for the abbreviations used in the table

A. Distribution Status	B. HABITAT		
R - Resident	T - Terrestrial	F - Forests	
LM -Local Migrant	WL - Wetland	SC - Sea Coasts	IL - Inland
WV - Winter Visitor	WD - Wetland Dependent	Ed.Sps - Edge Species	
SV - Summer Visitor			
Br.V- Breeding Visitors			
-			

C. Abundance
Com - Common
UnCom - Un Common
R - Rare
SC - Scarce

D. FOOD HABITS : Basic Diet Pis - Piscivorous Ins - Insectivorous Omn - Omnivorous Fru - Frugivorous Car - Carnivorous Nec - Nectarivorous Gra - Grainivorous Veg - Vegetarian P - Predators Aqu.inc - Aquatic Insects Aqu.Veg - Aquatic Vegetation

Cru - Crustaceans Moll - Molluscs Sn - Snakes Sca - Scavenger Al - Algae D - Diatoms Co - Copepods Ro - Rodents Off - Offal Tad - Tadpole

Kolleru used to be the largest Pelicanry in India and the important bird of the lake is Grey Pelican.. The pelican's migratory route has been diverted from this area due to destruction of habitat [21]. The presence of large flocks of uncommon ducks like Whistling Teals, Siberian Cranes and a Variety of Ducks, Waders emphasize, the global importance, but they stopped visiting Kolleru due to degradation of the habitat and have changed the flyways and wintering areas.

Now the lake is regaining its splendour by the state government which demolished all illegal fish ponds backed by a standing order from the Supreme Court of India. In recent times an increase in the number of migratory birds has been observed after demolition of fish tanks. For the first time, over 75,000 birds of about 100 species have



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flocked to the lake during the migratory season that last till March. After the demolition of bunds, aquatic plants with proportionate flora have come up all over the lake area. This invited lot of bird species visiting the area for foraging, breeding and nesting. To augment the fish population the native fish verities have been released in the lake. The lake Kolleru is regaining its past glory due to actions taken by the state government.

The lake supports species of waterbirds exceeding 1% Biogeographical population, over 20 species. In ten major waterbird congregation sites, over 75,000 birds were recorded utilizing the lake annually for feeding and breeding. It fulfills the Ramsar criteria No. 5& 6 which are the norms for declaring a wetland as internationally important. The lake is an important area for the waders. Over 50% of the waterbirds recorded are waders. The world recently is in the process of losing, over 50% population of the 112 extant species of migratory waders. Of the 84 species of waders reported from India, over 40% are found in Kolleru Lake. The majority of populations of known waders are in decline all around the world. The lake supports international migratory species of waders and waterbirds [16] [51] [52] (Table: 4).

S. No.	Common Name	Scientific Name	1% Threshold Population	Number recorded in vicinity of lake
1.	Little Egret	Egretta garzetta	1400	2000 - 4000
2.	Large Egret	Casmerodius albus	1000	1200 - 2000
3.	Painted Stork	Mycterial eucocephala	2200	2500 - 3000
4.	Asian Openbill - Stork	Anastomus oscitans	3000	4000 - 5500
5.	Golden - Plover	Pluvialis fulva	710	1000 - 1500
6.	Kentish Plover	Charadrius alexandrinus	710	1000 - 1200
7.	Lesser Sand Plover	Charadrius mongolus	1300	2000 - 2500
8.	Black - tailed Godwit	Limosa limosa	1500	1600 - 2000
9.	Common Redshank	Tringa totanus	1000	2000 - 2500
10.	Little Stint	Calidris minuta	2400	3000 - 3500
11.	Black-winged Stilt	Himantopus himantopus	1700	2500 - 4000
12.	Small Pratincole	Glareola lactea	710	1000 - 1500
13.	Brown-headed Gull	Larus brunnicephalus	1400	1500 - 1600
14.	Whimbrel	Nemenius phaeopus	1000	1200 - 1250
15.	Whiskered Tern	Chlidonias hybridus	1000	1200 - 1400
16.	Common GreenShank	Tringa nebularia	1000	1200
17.	Pied Avocet	Recurvirostra avosetta	1000	2200 - 2400
18.	Curlew	Numenius arquata	1000	1200
19.	Marsh Sandpiper	Tringa stagnatilis	1900	2000 - 2200
20.	Spotted Red Shank	Tringa erythropus	250	300 - 325

Table: 4. Species of waterbirds in Kolleru Lake whose numbers exceeded 1% of Biogeographical threshold

 Table: 4. The lake supports species of waterbirds exceeding 1% Biogeographical population, over 20 species at Kolleru indicating as a key wintering site for the waterbird population in the Indian Subcontinent.

Waterbirds like Storks, Egrets, Ibis are facultative scavengers. The pelicans, Egrets, Painted Storks, Open billed Storks, Black winged Stilts, Ibises, Teals, Pin tails, Pochards, Coots, Garganey are the largest group of birds which form 40% of total population (Table: 4, Fig: 3). The Kolleru wetland is a wildlife sanctuary and an Important



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Bird Area. In 1999 an extent of 308 sq. km of the lake falling below + 5 feet contour line was declared as Kolleru Wildlife Sanctuary (KWS). The Board of Wildlife, Govt. of India and the Central Empowered Committee recommended for reducing the boundary of Kolleru Wildlife Sanctuary from + 5 feet contour to + 3 feet contour to mitigate the problems of the farmers [10] [12] [13].

Table: 5. Waterbird Groups In Kolleru				
S.No	Family Name	Species Group		
1	Podicipediadae	Grebes (1)		
2	Pelecanidae	Pelicans (1)		
3	Phalacrocoracidae	Cormorants and Darters (2)		
4	Ardeidae	Herons, Egrets and Bitterns (3)		
5	Ciconidae	Storks (1)		
6	Thereskionithidae	Ibises and Spoonbills (2)		
7	Phoenicopteridae	Flamingos (1)		
8	Anatidae	Ducks, Geese (2)		
9	Gruidae	Cranes (1)		
10	Rallidae	Rails ,Crakes, Moorhens and Coots (4)		
11	Jacanidae	Jacanas (1)		
12	Rostratulidae	Painted snipes (1)		
13	Charadrridae	Plovers, Lapwings (2)		
14	Secolopacidae	Sandpipers ,Snipes, Stints, Godwits and Curlews (5)		
15	Recurvirostridae	Stilts and Avocets (2)		
16	Glareolidae	Pratincoles (1)		
17	Laridae	Gulls, Terns (2)		



According to the Asian Waterfowl Census that is conducted every year, the avian population of Kolleru was 26,062 in 1996. With the advent of illegal aquaculture, the water fowl population has plummeted, from 23,979 in 2002 to 9,977 in 2003, slipping further down to 2,410 and to the all-time low of 1,056 in 2005. A good number of migratory birds visiting the freshwater lake from Siberia and the other far-off places were falling prey to Poachers. In the 2008 census (two years after 'Operation Kolleru') the population of water fowl in the lake in recent years increased to 75,000. The number of water fowl visiting the lake ever since has been hovering between 70,000 and 2,40,000.



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After a hue and cry by environmentalists about the unique freshwater lake the Andhra Pradesh Government declared the lake and all areas within a radius of 20 miles as protected area in 1963. But for different reasons the Pelicans stopped coming to the lake from 1974. The advent of aquaculture, continuous human disturbance and destruction of nesting canopies were cited as reasons for the disappearance of the large birds.

A survey of avian fauna made by Ramana Rao and his team of Osmania University [43] in the late '80s did not mention Pelicans in the list of 188 local and migratory birds sighted in Kolleru. After the spread of aquaculture, birds such as Teals, Pochards, Coots, and a variety of Ducks which visited the lake in thousands stopped coming in large numbers. The recent spotting of the critically-endangered Spoonbill Sandpiper, a group of 24 with a current world population of 2,500 has made the lake one of the three areas in the country, along with Point Calimare (Tamil Nadu) and Chilka Lake (Orissa).

To get back the past glory of Kolleru lake, government had taken up 'Operation Kolleru' on the Krishna and West Godavari district borders. In 2006 there was a change in the government policy and Operation Kolleru was launched and all aquaculture tanks within +5 feet contour of the lake were demolished. The pelicans "miraculously" returned in November 2006 a few months after the demolition of the fish tanks that spread all over the lake. The painted storks were also seen in hundreds.

The birds which disappeared from the Lake began reappearing. The Grey Pelicans of Kolleru Lake disappeared due to large-scale encroachment of the Ramsar site for aquaculture, returned to the lake to nest after a considerable gap at Atapaka as the first step towards reviving Kolleru's past glory. The Atapaka part of Kolleru Lake becomes as 'Pelican Paradise'. Two acres has been developed as a roosting area for the Grey Pelicans in Atapaka. The pelicans are visiting Kolleru Bird Sanctuary for roosting, breeding and nesting purposes. Hundreds of birds of different species visit seasonally for breeding and feeding. Some birds deserted Atapaka due to disturbance created by the people. The frightened birds along with their young ones took wings to Kolleti Kota, Uppalapadu, and other nearby habitations. The wetland is still under severe pressure and facing multidimensional threats.

The birds visiting for nesting and breeding purposes mainly Spot billed Pelicans, Painted storks, Openbill Storks, White Ibis, Darters, Whistling teals, Black winged Stilts and Other resident birds. The migratory birds of different species are the main delight for tourists and bird watchers. Thousands of pelicans are seen with their young ones at the Atapaka and Sanctuary areas in Kolleru. Many Pelicans built nests on the mounds. "Each pelican lays 2-3 eggs. In November-December Pelicans laid eggs and the fledglings are flying in the month of April [48].

The Large Whistling Teals and Lesser Whistling Teals were seen in large numbers, over 14000 of Whistling Teals, 14000 Glossy Ibis and 14,000 Openbilled Storks. Over 7,000 cormorants were also enumerated in the Lake area during the study period. The Whistling Teals, the Open billed Storks and White Ibis were breeding and nesting in the vicinity of the lake and sanctuary. The number of waterbirds visiting the sanctuary in winter season has been increasing exponentially since the crackdown on illegal aquaculture in it. Several species have started nesting in the sanctuary area. The chicks of the Whistling Teals and the Painted Storks were spotted throughout the winter season (October-February).

Nine Species are recorded for the first time, White Pelican (*Pelecanus onocrotalus*), Spoonbilled Sandpiper (*Eurynorhynchus pygmeus*), Rosy Pastor (*Sturnus roseus*), Bar headed Geese (*Anser indicus*) and Grey headed Lapwing (*Vanellus cinereus*), Black Ibis (*Pseudibis papillosa*), Mallard (*Anas platyrhynchos*), White eyed Pochards (*Aythya nyroca*) and Falcated Ducks (*Anas falcata*).

Wetland productivity and fish production will be enhanced by the input of nutrients in the form of Guano which is the basis for high production of fish. The adjacent lands will become fertile. The lake is ecologically sensitive and biological hotspot of the world and hence there is need to protect the bio reserve and save this famous Ramsar site of Andhra Pradesh. The number of species recorded from Kolleru Lake shows high species richness mostly the winter visitors. Presence of some uncommon species makes it as important area for biodiversity conservation. It is environmentally conscious segment of ecotourism and provides economic growth for local community [11] [50] [51].



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VI. CONCLUSION

The observations indicate that this lake support international migratory species of water birds like Ducks and Waders for feeding and foraging in open water zone. Pelicans, Storks, Ibises, Teals, Darters, Stilts visit for breeding and nesting purposes. The members of the family Anatidae are herbivore in nature depend on aquatic flora. Hence a habitat with open water having submerged vegetation, reed bed is the most suitable habitats and makes them free from human interference. Waders play an important role in the lacustrine ecosystem. Waders inhabit the edges to thrive on aquatic insects, worms and crustaceans. Therefore water quality should be ensured for proper development of food organisms. Out of 84 species of waders reported from India, over 40% of the waders species are found in this lake area. Thus it plays an important role for the fragile wader groups. The majority of known populations of waders are in decline all around the world - 'a matter of international conservation concern'. The waders are ecologically stressed edge species and indicators of healthy status of the wetland. The lake is also subjected to siltation which turns the shallow waters into sand flats. It is a serious threat to the ecosystem and the birds as well. The lake area and the adjacent agricultural fields act as potential foraging ground offering a wide variety of roosting and nesting places for several migratory and resident bird species. Wetland productivity and fish production are enhanced by the input of nutrients in the form of Guano which is the basis for high production of fish and other crustaceans, and the adjacent agricultural lands will become fertile. Water birds like Storks, Egrets, Gulls, Ibises, Herons and other Wading birds are facultative scavengers and are farmer friendly species. The reappearance of Pelicans, Painted Storks, Flamingos and variety of ducks and waders after two decades is also a significant finding during the study. Globally threatened critically endangered spoonbill sandpipers started visiting the lake and near threatened species breed in the vicinity of lake. Hence Policy makers should keep all these things in view to develop Kolleru as an important bird habitat and environmentally conscious segment of ecotourism and to provide economic benefit for local community.

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