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Habitat utilization pattern by winter migrants at Kolleru lake in Andhra Pradesh.

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Abstract

The present studies deals with habitat use by different winter migrants at Kolleru lake. The percent composition of waterfowl was predominant at open lake area (22%) followed by submerged vegetation (17.8%), fish ponds (17%), Agricultural area (16%) and floating vegetation (15%). The habitat utilization pattern by different winter migrants at the kolleru lake are highly influenced by the availability food and other biotic factors. The study also highlighted the various problems related to conservation of this wetland and its bird diversity.

Keywords: Habitat utilization, winter migrants, Kolleru, Andhra Pradesh.

1. Introduction

Kolleru lake is the largest natural freshwater shallow lake in India having a water spread of 901 Sq. Km. at its maximum lake level at + 10. 7' M.S.L., with an average normal water spread area of 300 Sq. Km at +5 M.S.L (Fig.1). This lake also is the largest freshwater fish producing center in the country harbouring about 63 species of fish (Dutt, 1982) [1]. In addition, that the lake provides provenance to at least 188 identified species of birds is a measure of its productivity (Anjaneyulu, 1992; Aziz *et al*, 2011) [2, 3] Yet, no comprehensive ecological studies have been taken up and consequently no concise report on field characteristics, status, distribution of avi-fauna and notes on the general ecology of lake is available, other than sporadic scanty literature (Neelakantan 1949; Ramana Rao, 1982; Seshavatharam; Venu, 1980, Balakrishna, 1984) [4, 5, 6, 7] The present paper deals with habitat use by different winter migrants at Kolleru lake and various problems related to conservation of the wetland and its bird diversity.

2. Study Area

2.1 The Kolleru wetland

Kolleru lake falls between 80°-5' E to 81°-20' E and 16°-32' N to 16°-57' N with total catchment area of 4,763 Sq. Km. This lake is fed by 2 rivers, 15 irrigation channels and 15 drains from Krishna and Godavari barrage irrigation system. Thus, the lake swells up during S- W monsoon period from August to December when the level of the lake is around + 7 M.S.L., and shrinks to less than 25 Sq. Km. during May and June. (Fig.1)

There are 50 islands and 98 bordering habitations in the lake region having a total population of 2.16 lakhs. The foreshore area is under cultivation up to +5 M.S.L. The area below +5 M.S.L. is generally free from any cultivation, but this area is used for capture fishery. The foreshore area is presently under accelerated conversion into fish ponds for culture fisheries.

The lake is presently facing a ecological crisis being situated in the deltaic region between Krishna and Godavari rivers central' to highly agriculturally and industrially developed area. The industrial pollutants are mainly of organic nature and the agricultural runoff containing nutrients and pesticide residues enter the lake. In addition, the improvements to drainage to remove flood waters by deepening, widening and straightening the out-let creek, has resulted in faster drying up of the lake since 1986 after monsoon. Until 70's the lake level was maintained at more than +5 M.S.L. from July to February and with lesser water level at +3 M.S.L. during March to June. The present situation of longer period of low-level and drying and influx of nutrients, has resulted in coverage of almost the entire area with water hyacinth and other floating weeds, apart from submerged and emergent weeds. This has resulted in reduction of capture fishery of about 4,000 MT. within 10 years period.



Fig 1: Geographical location of Kolleru Lake (Source. Anjaneyulu Ph.D. Thesis Kolleru)

2.2 Methodology

The study area was confined to a limited part of the lake of about 4 sq km. Observations were conducted in this area at weekly intervals between arch 2007 to July, 2012. The field notes on major bird fauna were mainly taken during forenoon between 7 A.M. to 11 A.M. by using 10 x 50 binoculars. At each sampling station, observations were made on population estimations, predators, vegetation changes, land-use patterns and man-made effects like poaching and water level changes.

3. Results and Discussion

3.1 Wetland resources

3.1.1 Ornithological importance

Government of India being the signatory to the Ramsar Convention (Scott, 1982) [8] Convention of wetland of International importance especially as waterfowl habitat, it is mandatory that the lake and its waterfowl should be preserved. Though, Kolleru is a habitat for a variety of birds it has not received wide attention and no checklist of birds was available

till 1985 other than sporadic listing of birds by Department of Forests (Balakrishna, 1984). [9]

Kolleru was declared as a 'Protected area' for pelicans in 1962, the lake hosted the largest pelicanry in this subcontinent. More than 8,000 Grey pelicans (*Pelecanus Philippensis*) used to nest in three pelicanries around Kolleru region (Neelakanton, 1949) [10]. But by 1970 onwards, the breeding colony has been abandoned due to ecological disturbance imposed by man, such as killing and habitat destruction (Nagulu and Ramana Rao, 1983). [11] Due to several conservation measures, the Pelicans were returned back to Kolleru during 2008 and successfully breeding in the region. Information emerging from field investigations, show that the lake is teeming with bird-life with 188 species recorded belong to 45 families and 155 genera (Anjaneyulu and Ramana Rao, 1990; Raghavendra Rao and Ramana Rao, 1985; Azeezet al 2011). [12, 13, 14] Out of which, certain species are found exclusively in this wetland. Some of the important dominant species of water birds and their status have been presented (Table.1).

Table 1: Important dominant species of water birds and their status at Kolleru

Sl. No	Common name	Scientific name	Abundance	Status
Order	Podicipediformes			
Family	Podicipedidae			
1	Great Crested Grebe	<i>Podiceps cristatus</i>	VR	WM
2	Little Grebe	<i>Podiceps ruficollis</i>	A	RES
Order	Pelecaniformes			
Family	Pelicanidae			
3	Little Cormorant	<i>Phalacrocorax niger</i>	A	RES
Family	Ardeidae			
4	Grey Heron	<i>Ardeacinerea</i>	C	LM

5	Purple Heron	<i>Ardeapurpurea</i>	A	RES
6	Large Egret	<i>Ardea alba</i>	C	LM
7	Pond Heron	<i>Ardeola grayii</i>	A	RES
8	Cattle Egret	<i>Bubulcus ibis</i>	A	RES
9	Median Egret	<i>mesophox intermedia</i>	A	RES
10	Little Egret	<i>Egretta garzetta</i>	A	RES
11	Indian Reef Heron	<i>Egretta garzetta</i>	R	LM
12	Night Heron	<i>Nycticorax nycticorax</i>	R	LM
13	Chestnut Bittern	<i>Ixobrychus cinnamomeus</i>	C	RES
14	Yellow Bittern	<i>Ixobrychus sinensis</i>	C	M
Order	Ciconiiformes			
Family	Ciconiidae			
15	Open Bill Stork	<i>Anastomus oscitans</i>	A	LM
16	Painted Stork -	<i>Mycteria leucocephala</i>	R	LM
	Threskiornithidae			
17	Black Ibis	<i>Pseudibis papillosa</i>	R	LM
18	Glossy Ibis	<i>Plegadis falcinellus</i>	R	M
Order	Anseriformes			
Family	Anatidae			
19	Lesser Whistling Teal	<i>Dendrocygna javanica</i>	A	RES
20	Large Whistling Teal	<i>Dendrocygna bicolor</i>	C	RES
21	Brahminy Duck	<i>Tadorna ferruginea</i>	C	M
22	Pintail	<i>Anas acuta</i>	A	WM
23	Common Teal	<i>Anas crecca</i>	C	WM
24	Spot Bill duck	<i>Anas poecilorhyncha</i>	C	RES
25	Garganey	<i>Anas querquedula</i>	A	WM
26	Gadwall	<i>Anas strepera</i>		
27	Northern Shoveller	<i>Anas clypeata</i>	A	WM
28	Red Crested Pochard	<i>Nettion rufina</i>	A	WM
29	White Eyed Pochard	<i>Aythya nyroca</i>	R	WM
30	Scaup Duck	<i>Aythya marila</i>	R	WM
31	Cotton Teal	<i>Nettion coromandelianus</i>	C	RES
32	Comb Duck	<i>Sarkidiornis melanotos</i>	C	WM
Order	Gruiformes			
Family	Rallidae			
33	Water Rail	<i>Rallus aquatica</i>	C	RES
34	Ruddy Crake	<i>Porzana fusca</i>	C	RES
35	Little crake	<i>Porzana parva</i>	C	RES
36	White-Breasted waterhen	<i>Amaurornis phoenicurus</i>	C	RES
37	Watercock	<i>Gallicrex cinerea</i>	C	RES
38	Common Moorhen	<i>Gallinula chloropus</i>	A	RES
39	Purple Moorhen	<i>Porphyrio porphyrio</i>	A	RES
40	Common Coot	<i>Fulica atra</i>	A	RES
	Jacaniidae			
41	Pheasant Tailed Jacana	<i>Hydrophasianus chirurgus</i>	A	RES
42	Bronze winged Jacana	<i>Metopidius indicus</i>	A	RES
Order	Charadriiformes			
Family	Recurvirostridae			
43	Black Winged Stilt	<i>Himantopus himantopus</i>	A	RES
44	Common Sandpiper	<i>Actitis hypoleucos</i>	C	WM
45	Wood Sandpiper	<i>Tringa glareola</i>	C	WM
46	Marsh Sandpiper	<i>Tringa stagnatilis</i>	C	WM
47	Common redshank	<i>Tringa totanus</i>	C	WM
48	Green sandpiper	<i>Tringa ochropus</i>	C	WM
49	Little stint	<i>Calidris minuta</i>	C	WM

3.2 Categorization of species

1. 7 species are classified as local migrants; their local movements are restricted to small distances either for feeding or breeding.
2. 23 species are resident birds which are regularly observed while feeding as well as to be breeding in this wetland.
3. 27 species are listed as dominant in the lake based on the density. The most dominant species are migratory wild-ducks.
4. 8 species are very rarely observed (Table.1)

3.3 Fishery resources

Kolleru is the largest fish producing natural fresh water body in this State. A total of about 42,000 populations are depending on Kolleru fishing. So far, 63 species of fish belonging of 28 families were identified (Dutt, 1982) [15]. Out of 63 species, 44 are basically fresh water fish, and 19 species are salt water fish. Natural fisheries of the lake is on decline due to various man-made activities like over-fishing, annual drying of the lake due to increased drainage, excessive weed growth and pollution. The natural production decreased from 7,000 tons on 1974 to 2,952 tons in 2000.

Pisciculture has been started by the Government since 1977, as a source of supplementary income to the fishermen of Kolleru.

At present 30,000 Acres of land is under fish-culture practices. Fish farming in Kolleru is of extensive and semi-intensive type by using polyculture method. There are six important varieties of cultured fish is under practice viz. 1. *Catla catla*, 2. *Cirrhinus mrigala*, 3. *Lebeo rohita*, 4. *Ctenopharyngodonidella*, 5. *Cyprinus carpio*, 6. *Hypophthalmichthys molitrix*. The average production rate from this culture is 3.75 tons/ha.

3.4 Other socio-economic values

The lake has been utilized for a number of purposes for the past decade i.e., fishery, agriculture, buffalo grazing and duck rearing. The aquatic weeds like *Phragmites* culms and *Typha* weeds are presently used for thatching of roof and reinforcement, of the mud walls, mat and basket weaving. The dried weeds are also used for fuel purposes.

3.5 Habitat utilization by winter migrants

The habitat selection by the birds is determined by availability of food, shelter, cover and protection from predators and also from vagaries of climate. Most of the birds are strictly confined to particular habitat where the abundant natural food

and suitable micro climate is available. The habitat selection is also partly a psychological process. Lack, (1940, 1946);^[16] lacks Veneble (1939).^[17] Suggested that birds recognize their ancestral habitat by certain conspicuous essential features. The vertical distribution of foliage within a habitat was correlated with the number of resident species by Roth (1976),^[18] Mac Arthur (1961),^[19] Mac Arthur *et al* (1965)^[20], Rotenberry (1978)^[21]. The habitat utilization of birds was further studied by Vijayan (1987)^[22] who visualized the relationships between vegetation, food availability and bird density in Bharatpur. In the present study, seven distinct habitats were identified. The species distribution in various habitats has been illustrated in (Table No. 2) and then the percentage family wise presence of birds in different habitats was analyzed. Maximum 22% of birds were recorded in open waters followed by 17.8% on submerged vegetation, 17% in fish ponds, 16% in Agricultural area, 15% in floating vegetation and 10% in shallow waters. (Table.2). Most of the waterfowl use these habitats for feeding and foraging. Further, family wise distributions of waterfowl in various habitats are summarized below.

Table 2: Percentage composition of terfowl in various habitats of the lake

S. No.	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	%
1	Agriculture area	11.5	12.0	11.5	14.5	4.0	4.0	4.0	3.5	3.0	9.0	13.0	10.5	16.0%
		(188)	(79)	(6165)	(9290)	(206)	(50)	(62)	(67)	(35)	(4454)	(12853)	(12853)	
2	Fish ponds	19.5	24.5	25.5	12.0	7.5	5.0	5.0	7.0	5.0	10.0	18.0	18.0	16.78%
		(7615)	(10814)	(5926)	(1333)	(211)	(72)	(92)	(93)	(96)	(2976)	(2029)	(4394)	
3	Open lake area	16.0	15.0	14.5	6.0	6.0	6.5	4.0	4.0	4.5	8.5	11.0	16.0	22.0%
		(10828)	(8839)	(10230)	(328)	(321)	(192)	(83)	(76)	(71)	(5923)	(1232)	(8642)	
4	Shallow Waters	23.5	23.5	21.5	17.5	3.5	2.0	1.5	1.0	7.5	12.5	19.5	22.5	9.73%
		(3129)	(3491)	(3422)	(2461)	(250)	(102)	(101)	(58)	(336)	(698)	(1276)	(5346)	
5	Floating Vegetation	26.0	26.0	23.0	15.5	12.5	1.5	2.0	2.0	4.0	14.5	17.5	25.0	15.19%
		(8576)	(8905)	(6558)	(3158)	(102)	(101)	(58)	(336)	(31)	(698)	(1276)	(2481)	
6	Submerged Vegetation	14.5	16.5	11.0	9.0	5.0	1.5	0.5	1.5	3.5	9.5	11.5	13.5	17.8%
		(1047)	(8232)	(7606)	(3460)	(1554)	(15)	(14)	(14)	(214)	(4362)	(7362)	(8314)	
7	Reed Areas	14.5	11.5	12.5	11.5	8.5	10.0	9.0	10.0	8.0	9.5	11.5	13.5	2.41%
		(173)	(217)	(278)	(188)	(478)	(1757)	(708)	(7771)	(156)	(175)	(190)	(138)	

3.6 Agricultural area

Paddy fields occupy considerable area in this lake bed. These paddy fields provide good cover and feeding ground for number of waders and ducks. More number of species was observed in watered agricultural fields during the months of November and December. In these months the paddy fields generally filled with water and can be readily used for ploughing and tilling for transplantation. In this period, the mudflats and stagnant waters have extensive litter that provides sufficient nutrients for micro invertebrate populations (Nelson and Kadlec, 1984)^[23]. More number of species belongs to Charadriidae (10%) and Lariidae (3%) utilize Agricultural areas (Fig.2). Very low populations of birds were recorded during transplantation and sibling stage while only few Pond herons and Little Egrets were observed feeding on insects in the standing crops. The birds belonging to Anatidae (85.1%) have shown significant populations in harvesting stages i.e. April and November, large populations of migratory duck species damage standing crop. These observations lead further support to the observations of Baldassarre (1980)^[24] Whyte (1985)^[25] who visualized the significant relation of

ducks to agricultural fields.

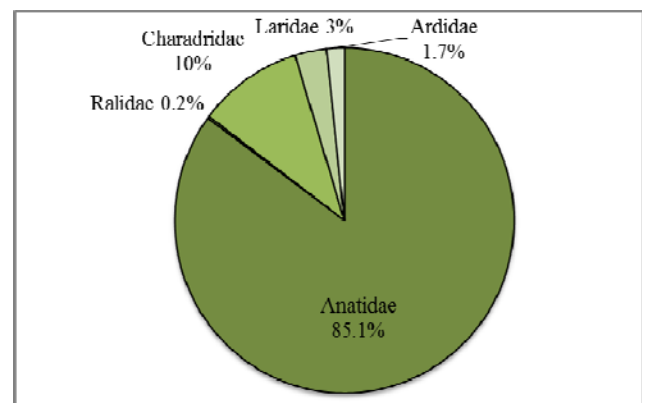


Fig 2: Pie diagram showing family wise percentage distribution of waterfowl in agricultural area around the lake.

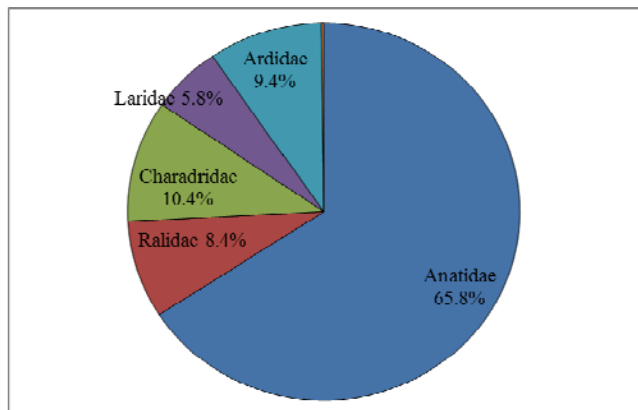


Fig 3: Pie diagram showing family wise percentage distribution of waterfowl in fish ponds around the lake

3.7 Fish Ponds

In Fish ponds the water level is generally maintained at 5 to 7 ft. They are located adjacent to the lake. Each fish pond holds about 20 to 30 temporary fixed poles in the middle which act as a good perching place for fish eating birds. The water is pumped out from the bund before harvesting the culturable fish, as a result small pools of water and mudflats appear which disappear after 10 to 15 days. Fig No. 3 shows the family wise distribution of birds in fish ponds; the species belong to the family Anatidae are seen to be maximum (65.8%), when tank is full with water, whereas birds belonging to Charadriidae (10.4%), Ardeidae (9.4%) and Laridae (5.8%) were more in number after harvesting the fish. Although food availability was not measured in this area, other studies have attempted to relate the abundance of food in drained flats which generally provide suitable habitat for shore birds (Fredrickson 1986) [26].

3.8 Open lake Area

The lake maintains full water during monsoon season from August to December, Fig No. 4 indicates family wise habitat preference in different parts of the lake. Anatidae showed high utilization (93%), Ralidae (3.36%) Laridae (3.76%) prefer open waters and Ardeidae (0.06%) prefer only marginal waters. Ducks and coots mostly are seen moving in the middle of the lake, where the disturbance is less.

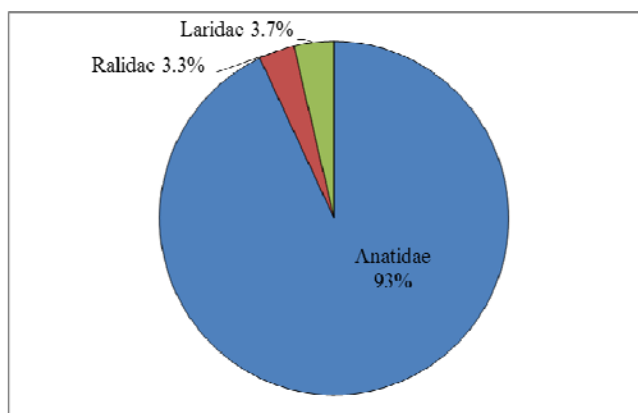


Fig 4: Pie diagram showing family wise percentage distribution of waterfowl in open lake area.

3.9 Shallow Waters

The shallow water zone provides very good habitat for the diversity of waterfowl. The low depths are ideal for many

large and small sized waders. Fig.No. 5 indicates the family wise percentage of birds distributed in shallow waters. The families like Anatidae (31.65%), Ardeidae (21.86%), Charadriidae (19.06%), Laridae (17.8%) and Ralidae (9.4%) showed high preference to these areas. This shallow zone provide variety of food items to the stints, plovers, stilts, curlews, godwits, shanks, sandpipers, egrets, herons and storks. Similar observations were made by Fedrickson and Taylor (1982) [27] on the waterfowl in relation to water depths. Evidences show gradual decrease of water level provide maximum potential for maintaining the waders and suggest that between 1 to 5 cm is the suitable depth to attract waders.

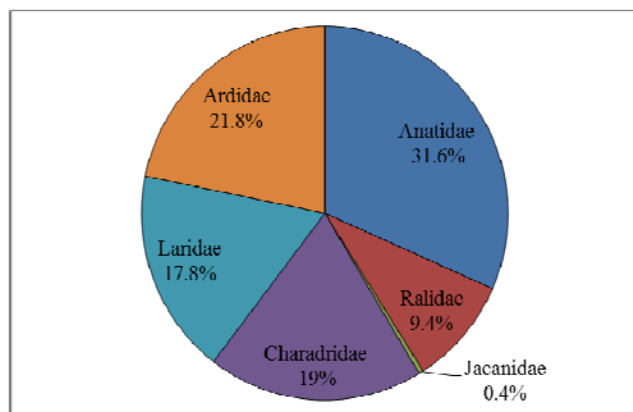


Fig 5: Pie diagram showing family wise percentage distribution of waterfowl in shallow waters of the lake.

3.10 Floating Vegetation

Ipomea and Echnornia are the dominant vegetation in this wetland which provide good feeding and breeding cover for moorhens and coots (Ralidae 17.06%), Jacanas (Jacanidae 3.36%) and ducks (Anatidae 72.15%); Fig. 6). The abundant growth of Ipomea vegetation develops a congenial habitat for duck species. This habitat provides thick insights good shelter and protection against the predator. Marsh Harrier is the common predator in this wetland which frequently attacks the ducks and coots. To protect against this predator, these species seek Ipomea vegetation as their cover. Similar observations were made on Pacific Black Ducks, Chestnut Teal and Graf Teal at Serendip Victoria (Norman et al 1971) [28]. The study reviews the necessity of thick floating vegetation for those ducks. This vegetation also provides good breeding grounds for moorhens, coots and jacanas.

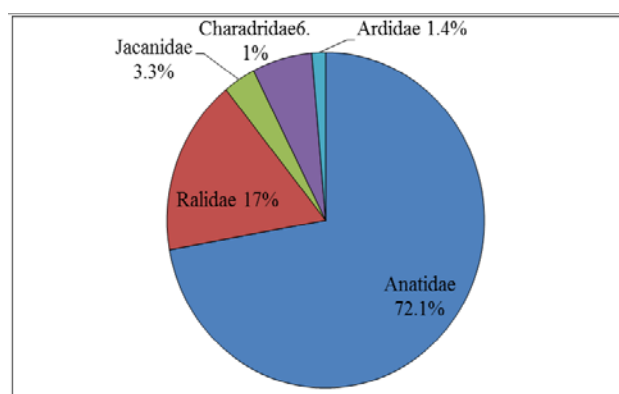


Fig 6: Pie diagram showing family wise percentage distribution of waterfowl in floating vegetation areas of the lake.

3.11 Read Area

The large expanse of aquatic reeds mainly dominated by *Phragmites* and *Typha* provide good breeding cover for many water birds as well as Terrestrial birds. (Fig. 7) depicted the percentage variations in Rallidae (25.1%), Jacanidae (25%), Laridae (20.7%) Ardeidae (13.7%), Charadriidae (8.06%) and Anatidae (6.8%) recorded in this habitat. Mostly the resident duck, Whistling Teal, Indian Moorhen, Purple Heron, Whiskered Tern breed in the thick zones of this vegetation. The other species prefer this habitat mainly as protecting against predators.

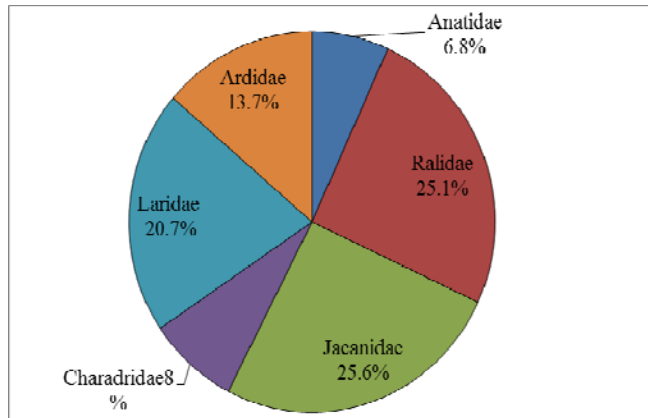


Fig 7: Pie diagram showing familywise percentage distribution of waterfowl in reed areas of the lake.

3.12 Factors influencing the lake

i) Hydrology

The lake receives water from catchment area comprising of 3,405 sq.km. of upland and 1,360 sq.km. of delta. The maximum estimated inflow from canals and drains is 1, 10, 920 cu/sec (Pandurangam, 1976) [29]. The discharge of water is through only one outlet to the sea. In early 1972, the estimated discharge was 6,650 cu/sec, but, since 1986, the discharge capacity was raised to 14,600 cu/sec. Due to this activity the present water-spread area is gradually sinking, as a result, the exposed land is converted into fish-ponds and lake-bed agriculture (Lakshmi pati Rao, 1978) [30].

ii) Pollution

The lake is threatened with excessive pollution, increased human interference and habitat destruction. The lake is facing ecological crisis being situated within deltaic region between Godavari and Krishna rivers. The major effluents are from 10 major industries such as milk products, sugar factories and paper mills with a release of 72,01,000 liters per day land agricultural run-off from delta (13,000 sq.km.) and upland (2,552 sq. km). A Report of Andhra Pradesh Pollution Control Board (1982) [31] mentioned that 17,527 M.T. fertilizers per year enter the lake. The straightening of the creek is expected to improve tidal effect further up leading ultimately to salination of water and soil. In the context of green-house effect and global sea level changes, tidal influx can assume alarming proportions.

iii) Extensive weed growth

The lake is very rich in aquatic plant life, 18 species of microphytes belonging to 14 families were recorded (Seshavatharam and Venu, 1982) [32]. The main dominant plants are *Ipomea* and *Eichhornia*, spreading all over the lake causing menace to navigation, decrease water quality and

create stagnant conditions of water.

iv) Roads and bridges

The current use of land for human habitations and for communications, the roads and bridges were laid without understanding the flow parameters. The consequences are huge disparities in water level and number of artificially created discontinuous zones.

v) Poaching

Poaching of wild birds is a regular practice in Kolleru. During migratory seasons, major wild-ducks like Shovellers, Gargeney, Whistling teals and also other water birds like pond Heron, Moorhens and Jacanas are trapped by mist nets. A very large number of mist nets are used netting an average of 10-50 per net birds during peak season from October to March (Nagulu *et al.*, 1992) [33].

3.13 Conservation measures

1. The long term economic and environmental development of Kolleru lake region can be achieved only by maintenance of hydrology in a systematic manner. The annual flooding and drying up of the lake can be avoided by developing internal canalisation and construction of regulator across Upputeru. Government has proposed a regulator to maintain +5 M.S.L., but this is strongly objected by the public. The optimum +5 M.S.L. is very essential as a level below which will be un-economic and disastrous to the ecosystem.
2. The current use of land for human habitations and communicated roads and bridges construction is breaking organic continuity of the lake. Such practices of using exposed lake-bed for agriculture should be discouraged to avoid agricultural drain off posing pollution threat.
3. Setting up industries close to the lake is to be discouraged to avoid effluent entry. Quite a few have come up in Kolleru belt and there is a need to monitor and control their effluents. Apart from rigorous control of emission and effluent levels, it may be worthwhile to undertake alternate measures. Since the maximum influx is from the Chandrayya drain and Eluru Town side, with sizeable tanneries, it is worthwhile to consider setting up along the most vulnerable point of the western shore a dyke permitting suspect waters first to flow through settling and treatment ponds before entering main lake on analogy with major river cleaning projects.
4. Control of aquatic microphytes is very essential in order to maintain optimal habitats. The weeds especially the emergent and floating types block the waterways which should be thinned or removed by mechanical or manual measures. Presently, chemical control is being used by spraying fungicides and other chemicals which ultimately add to pollution and will promote excessive growth to the plant life in the next season. The biological control is also effective to some extent and may be preferred.
5. The wetland habitat being a famed and populous bird sanctuary more effective steps from control of poaching should be mounted. And for habitat preservation, the bird sanctuary should be fenced to provide a disturbance-free environment for birds and afford complete protection from illegal activities.
6. Some of the fishing methods are locally known as (a) Dadikattu-made up of bamboo curtain for setting up basket traps across the inlet channels. The main disadvantage from this method is it obstructs the

waterways by trapping water hyacinth, otherwise the weed floats off into the sea through the outlet. (b) Doddi Fishing-by small temporary bunds when the water-level is low, as a result lake becomes compartmentalized during summer. Such methods of fishing should be banned.

4. Acknowledgement

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