

An assessment of threats to the bird populations in Ousteri wetland, Puducherry, India

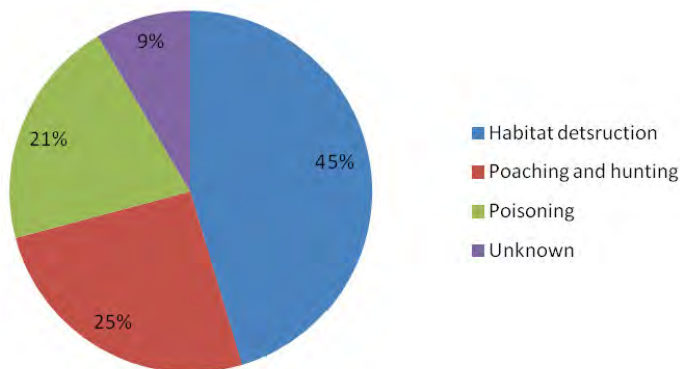
Freshwater wetlands are good breeding and foraging grounds for numerous resident and migratory water birds. Several lesser-known species such as Greater flamingos *Phoenicopterus ruber*, Spot-billed pelicans *Pelecanus philippensis*, and Painted storks *Mycteria leucocephala* were recorded in these wetlands. India is one of the global hotspots for birds, with over 1263 bird species (12% of world species) (Jayapal and Pittie 2016). Aquatic ecosystems are critical components of our environment. In fact, long term monitoring of wetlands is essential to conserve flora and fauna of these wetlands. In addition to being essential contributors to biodiversity and ecological productivity, wetlands also provide a variety of ecosystem services to human populations (Poff et al. 2002). In view of their environmental, ecological and conservation values, some of the wetlands in the world are protected as national parks and world heritage Sites. Few wetlands are known to cater to tourists for recreational purposes, fishing, hunting, boating and aesthetic retreats. The revenue generated from such tourism activity would benefit both the wetlands as well as the local communities depending on it.

The importance of local freshwater ecosystem for conservation can only be understood by knowing the structure of the bird community of that region (Kattan and Franco 2004). Regular monitoring and assessment of threats for the wetland bird population provides valuable information about the ecological health of that wetland. Periodic bird monitoring programmes can be a vital tool in developing awareness on the conservation value the wetland among local communities who depend on this wetland for their livelihood. The Diverse prey base attracts a large number of water birds from Europe, Siberia, Asian countries and other parts of the nation. These birds spend use Ousteri wetland as a wintering ground roosting on the natural vegetation (Davidar, 2011). Even though, there are considerable number of studies on the bird diversity of Ousteri (Abbasi, 2008; Padmavathy et.al 2010; Davidar, 2011; Murugesan et.al 2013), there were none carried out so far on the assessment of threats to the avian population of Ousteri. So keeping in view the need for such study, we carried out systematic field surveys during April 2012 to March 2014 for assessing threats to the avian fauna.

Study area description

The Ousteri wetland is situated between 11°56'35.68"N & 79°44'48.35"E 10 km from north of Puducherry. It is a interstate fresh water wetland spread over 1.48 sq km in Puducherry region and 3.72 sq km in both Puducherry and Tamil Nadu (Abbasi 1997; CMAPC, 2011). Ousteri wetland has been identified as an important wetland of Asia by the International Union for Conservation of Nature and Natural Resources IUCN and identified as a wetland of national importance under the national wetland conservation programme of the Ministry of Environment, Forest and Climate Change (MoEFCC) and has also been declared one of the 93 significant wetlands in Asia by the Asian Wetland Bureau (The Hindu, July 19, 2017). The lake has also been declared as a bird sanctuary by the Government of Puducherry in 2008. Maximum and minimum temperatures in the study region vary between 31.6°C and 18.7°C. Mean annual rainfall in the study area is 1354 mm with 55 mean no of rainy days (Murugesan et.al 2013).

The Ousteri wetland provides varied habitats for a various range of resident and migratory birds with 480 plant species (Comprehensive Management Action Plan for



Various threats to bird population in Ousteri wetland

Conservation of Oussudu Sanctuary, Puducherry, 2011) marshy plant growth, riparian vegetations, various channels with scattered trees, bushy vegetation and surrounding fertile agricultural areas. The predominating vegetation of the sanctuary is typically the dry deciduous type. Common tree species are *Neem Azardirachta indica*, *Jujub Zizyphus jujuba*, *Borasus flabellifer*, Indian banyan *Ficus benghalensis*, Peepal tree *Ficus religiosa*, Khejiri *Prosopis cineraria* and Mesquite *Prosopis juliflora* and planted North Indian rosewood *Dalbergia sissoo*. The dominant deciduous shrub species are *Capparis brevispina*, *Calotropis procera*, *Alhagi maurorum* and *Xanthium strumarium*, *Parthenium*, *Amaranthus spinosus*, *Chenopodium ambrosiodes*. The herb species are *Achyranthes aspera*, *Malvastrum sp.* and *Boerhavia diffusa* are the prominent weeds in the study area. The predominant vegetation of the sanctuary is typically the dry deciduous type. Aquatic plants in the lake are *Hydrilla sp.*, *Typha sp.*, *Cyperus sp.*, *Azolla sp.* etc. Besides the macrophytic plants such as water hyacinth *Eichhornia crassipes* lily *Nymphaea alba*, lotus *Nelumbo nucifera*, reeds *Phragmites australis* and cattails *Typha angustifolia* provide major habitat for Common coots (Eurasian

Table 1. Bird species recorded from the Ousteri wetland, Puducherry

No	Family	Common Name	Species Name	IUCN Category	Feeding habit	Abundance
1	Ardeidae	Cattle egret	<i>Bubulcus ibis</i>	LC	Carnivore	C
2		Purple heron	<i>Ardea purpurea</i>	LC	Carnivore	C
3		Grey heron	<i>Ardea cinerea</i>	LC	Carnivore	C
4		Large egret	<i>Casmerodius albus</i>	LC	Carnivore	C
5		Medium egret	<i>Mesophoyx intermedia</i>	LC	Carnivore	C
6		Little egret	<i>Egretta garzetta</i>	LC	Carnivore	C
7		Indian pond heron	<i>Ardeola grayii</i>	LC	Carnivore	C
8	Accipitridae	Shikra	<i>Accipiter badius</i>	LC	Carnivore	IR
9		Black-shouldered kite	<i>Elanus caeruleus</i>	LC	Carnivore	C
10		Black kite	<i>Milvus migrans</i>	LC	Carnivore	C
11		Eurasian sparrow hawk	<i>Accipiter nisus</i>	LC	Carnivore	FC
12		Brahminy kite	<i>Haliastur indus</i>	LC	Carnivore	UC
13	Alcedinidae	Lesser Pied kingfisher	<i>Ceryle rudis</i>	LC	Carnivore	FC
14		Small blue kingfisher	<i>Alcedo atthis</i>	LC	Carnivore	C
15		Stork-billed kingfisher	<i>Halcyon capensis</i>	LC	Carnivore	C
16		White breasted kingfisher	<i>Halcyon smyrnensis</i>	LC	Carnivore	C
17	Alaudidae	Singing bush-lark	<i>Mirafra cantillans</i>	LC	Omnivore	C
18	Apodidae	Palm swift	<i>Cypsiurus parvuns</i>	LC	Carnivore	FC
19	Anhingidae	Oriental darter	<i>Anhinga melanogaster</i>	NT	Carnivore	FC
20	Anatidae	Eurasian wigeon	<i>Anas penelope</i>	LC	Carnivore	FC
21		Northern pintail	<i>Anas acuta</i>	LC	Carnivore	C
22		Garganey duck	<i>Anas querquedula</i>	LC	Herbivore	UC
23		Spot-billed duck	<i>Anas poecilorhyncha</i>	LC	Herbivore	UC
24		Common teal	<i>Anas crecca</i>	LC	Herbivore	UC
25	Ciconiidae	Painted stork	<i>Mycteria leucocephala</i>	NT	Carnivore	UC
26		Asian open-billed stork	<i>Anastomus oscitans</i>	LC	Carnivore	UC
27	Charadriidae	Little ringed plover	<i>Charadrius dubius</i>	LC	Carnivore	C
28		Little stint	<i>Calidris minuta</i>	LC	Carnivore	C
29		Redwattled lapwing	<i>Vanellus indicus</i>	LC	Carnivore	C
30		Yellow wattled-lapwing	<i>Vanellus malarbaricus</i>	LC	Carnivore	C
31	Columbidae	Blue rock pigeon	<i>Columba livia</i>	LC	Herbivore	C
32		Spotted dove	<i>Streptopelia chinensis</i>	LC	Herbivore	C
33		Eurasian collared-dove	<i>Streptopelia decaocto</i>	LC	Herbivore	C
34		Black-bellied sandgrouse	<i>Pterocles orientalis</i>	LC	Herbivore	C

No	Family	Common Name	Species Name	IUCN Category	Feeding habit	Abundance
35	Cuculidae	Common cuckoo	<i>Cuculus canorus</i>	LC	Carnivore	C
36		Pied cuckoo (Pied crested cuckoo, Jaccobian cuckoo)	<i>Clamator jacobinus</i>	LC	Carnivore	C
37		Greater coucal	<i>Surniculus cuckoo</i>	LC	Carnivore	C
38	Corvidae	House crow	<i>Corvus splendens</i>	LC	Omnivore	C
39		Indian treepie	<i>Dendrocitta vagabunda</i>	LC	Omnivore	C
40	Coraciidae	Indian roller	<i>Coracias benghalensis</i>	LC	Carnivore	C
41	Dicruridae	Black drongo	<i>Dicrurus macrocercus</i>	LC	Omnivore	C
42	Estrildidae	Black-headed munia (Tricoloured munia)	<i>Lonchura malaca</i>	LC	Herbivore	FC
43	Hirundinidae	Wire-tailed swallow	<i>Hirunda smithii</i>	LC	Carnivore	FC
44	Jaccanidae	Pheasant-tailed jacana	<i>Hydrophasianus chirurgus Wagler</i>	LC	Omnivore	C
45	Motacillidae	Paddyfield pipit	<i>Anthus rufulus</i>	LC	Omnivore	C
46		Yellow wagtail	<i>Motacilla flava</i>	LC	Carnivore	UC
47	Muscicapidae	Asian brown flycatcher	<i>Muscicapa dauurica</i>	LC	Carnivore	C
48		Asian paradise-flycatcher	<i>Terpsiphone paradisi</i>	LC	Carnivore	C
49	Meropidae	Green bee-eater	<i>Merops orientalis</i>	LC	Carnivore	C
50		Blue-tailed bee-eater	<i>Merops philippinus</i>	LC	Carnivore	UC
51	Nectariniidae	Purple sunbird	<i>Nectarinia asiatica</i>	LC	Omnivore	C
52		Little spider-hunter	<i>Arachnothera longirostris</i>	LC	Omnivore	C
53	Oriolidae	Eurasian golden-oriole	<i>Oriolus oriolus</i>	LC	Omnivore	R
54	Phylloscopidae	Common babbler	<i>Turdoides caudatus</i>	LC	Omnivore	R
55		Magpie robin	<i>Copsychus saularis</i>	LC	Omnivore	C
56		Common tailor bird	<i>Orthotomus sutorius</i>	LC	Omnivore	UC
57		White-headed babbler	<i>Turdoides affinis</i>	LC	Omnivore	C
58	Passerinae	Common lesser white-throat	<i>Sylvia curucca</i>	LC	Carnivore	C
59	Phalacrocoracidae	Little cormorant	<i>Phalacrocorax niger</i>	LC	Carnivore	C
60	Passeridae	House sparrow	<i>Passer domesticus</i>	LC	Omnivore	C
61	Pycnonotidae	Red-vented bulbul	<i>Pycnonotus cafer</i>	LC	Omnivore	C
62		White-throated bulbul	<i>Alophoixus flaveolus</i>	LC	Omnivore	C
63	Podicipitidae	Little grebe	<i>Tachybaptus ruficollis</i>	LC	Carnivore	C
64	Pelecanidae	Spot-billed pelican	<i>Pelecanus philippensis</i>	NT	Carnivore	R
65	Psittacidae	Rose-ringed parakeet	<i>Psittacula krameri</i>	LC	Herbivore	C
66	Picidae	Common golden-backed woodpecker	<i>Dinopium javanense</i>	LC	Carnivore	UC

No	Family	Common Name	Species Name	IUCN Category	Feeding habit	Abundance
67	Rallidae	Common coot	<i>Fulica atra</i>	LC	Omnivore	C
68		White-breasted waterhen	<i>Amauornis phoenicurus</i>	LC	Omnivore	C
69	Recurvirostridae	Black-winged stilt	<i>Himantopus himantopus</i>	LC	Carnivore	C
70	Scolopaciade	Common sandpiper	<i>Actitis hypoleucos</i>	LC	Carnivore	C
71		Common greenshank	<i>Tringa nebularia</i>	LC	Carnivore	UC
72		Marsh sandpiper	<i>Tringa stagnatilis</i>	LC	Carnivore	C
73	Sturnidae	Common myna	<i>Acridotheres tristis</i>	LC	Carnivore	C
74		Brahminiy starling	<i>Sturnus pagodarum</i>	LC	Omnivore	UC
75	Strigidae	Spotted owlet	<i>Athene brama</i>	LC	Carnivore	R
76	Acrocephalidae	Blyth's reed warbler	<i>Acrocephalus dumetorum</i>	LC	Carnivore	C
77	Leiotrichidae	Laughingthrush	<i>Garrulax delesserti</i>	LC	Omnivore	UC
78		Oriental magpie-robin	<i>Copsychus saularis</i>	LC	Omnivore	C
79	Upupidae	Hoopoe	<i>Upupa epops</i>	LC	Carnivore	C
80	Phoenicopteridae	Greater flamingo	<i>Phoenicopterus ruber</i>	LC	Omnivore	R
81	Glariolidae	Glareola pratincola	<i>Glareola pratincola</i>	LC	Carnivore	UC
82	Threskiornithidae	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	Carnivore	R
83		Eurasian spoonbill	<i>Platalea leucorodia</i>	LC	Omnivore	UC
84		Glossy ibis	<i>Plegadis falcinellus</i>	LC	Carnivore	R
85	Phasianidae	Grey francolin	<i>Francolinus pondicerianus</i>	LC	Omnivore	C
86	Cisticolidae	Plain prinia	<i>Prinia sylvatica</i>	LC	Carnivore	C
87	Ploceidae	Baya weaver	<i>Ploceus philippinus</i>	LC	Omnivore	C

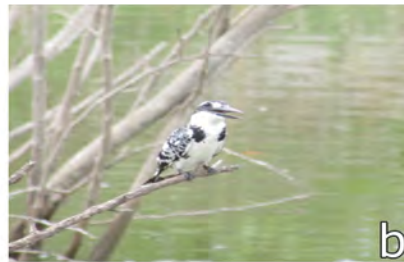
LC: Least Concern, NT: Near Threatened, NT: Not Evaluated, C: Common, R: Rare, UC: Uncommon, FC: Fairley Common

coot) *Fulica atra*, Indian spot-billed duck *Anas poecilorhyncha*, common migrant such as Common teal (Eurasian Teal) *Anas crecca*, Little stint *Calidris minuta*, Common greenshank *Tringa nebularia* and Marsh sandpiper *Tringa stagnatilis* and Common moorhen (Eurasian Moorhen) *Gallinula chloropus* .

Methods

The survey was conducted in all the seasons from 2012 to 2014. Regular transect walking was made on fixed paths through the study area. We recorded birds while walking on a predetermined path in the study area. The birds were observed during the morning and evening hours of their activity with binoculars. However, opportunistic records were also made during other time, 10 am to 4pm periods of the daytime. Birds picked up were put down along with habitat type, season, and frequency of sightings of a peculiar

Plate 1.



a) Black-winged stilt b) Lesser pied kingfisher
c) Greater flamingo d) Painted stork e) Spotted dove f) Eurasian spoonbill g) Spotted owl

species. Pictures were taken whenever possible with digital camera Canon (model SX500IS). Identification of birds was done using field guides (Thirumalai and Krishnan 2005; Daniel 2012; Prasad 2014; Shah

et.al, 2016), and only those species with confirmed identity are reported in this paper. The checklist was prepared using standard common and scientific names of the birds following Davidar, (2011), Salim Ali

revised by Daniel, 2012, Inskipp Carol, 2011, and Ali et.al 2013). The status of the recorded bird species was established on the basis of frequency of sightings following Kumar and Gupta (2009) as common recorded 9–10 times out of 10 visits, fairly common recorded 6–8 times out of 10 visits, uncommon recorded 3–5 times out of 10 visits, and rare recorded 0–2 times out of 10 visits. Feeding guilds were classified on the basis of direct observations and available literature (Ali and Ripley 1987). The conservation status of the bird species was categorised according to IUCN Red List data. Data on threat factors were assessed by direct observation and personal interviews with local people and local informal fish market visits. We used direct observation method to identify the various threats to bird's population both the native and migratory birds and their habitats, while observations and informal discussions

were made with local fisher folks, cattle herders, farmers and poachers to collect the data on various bird habitat destructions in the lake. We have made frequent surveys during the breeding season from October to February from 2012 to 2014. In our analysis we classified the various threats to bird populations as: (1) habitat degradation (2) hunting and poaching (3) poisoning and (5) unknown

Results

Ninety three wetland birds belonging to 51 families were recorded (Plate 1 and 2) from the Ousteri wetland during 2012 to 2014, of which 4 species are under Near Threatened category (NT) such as Black-headed Ibis *Threskiornis melanocephalus*, Spot billed pelican *Pelecanus philippensis*, Oriental darter *Anhinga melanogaster* and Painted stork *Mycteria leucocephala* and 87 species categorised as Least Concern (LC) category, The checklist

of recorded bird species along with their abundance, residential, feeding habit and conservation status are presented in Table 1. The family Ardeidae

represented by 6 species, dominated the wetland bird community of the study region. The composition of birds in major feeding habit in the study area

Plate 2.



i) Oriental magpie-robin j) Indian roller k) Little cormorant l) Common greenshank m) Open-billed stork n) Cattle egret o) Paddyfield pipit p) Blue-tailed Bee-eater

Plate 3.



Threats-Poisoning: a) Spot-billed duck b) Green bee-eater c) Pheasant-tailed jacana d) Fish e) Common coot, **Other Threats:** f. Excessive grazing g. Agricultural activities h. Excessive harvesting of reed

showed that the carnivore was the most common with 54 (58 %) species, followed by Omnivore 31 (33%), and Herbivore 8 (9%). The wetland birds

are heterogeneous in their feeding habits (Ali and Ripley 1987). Wetland birds are using different habitats for feeding and breeding purposes within

the ecosystem. The summer visitors, namely Black-headed Munia *Lonchura malacca* and Ashy-crowned Sparrow-lark *Eremopterix griseus* were spotted during summer seasons from April to July. The winter migratory birds such as Darter *Anhinga melanogaster*, Northern pintail *Anas acuta* Western yellow wagtail *Motacilla flava* and Blue-tailed bee-eater *Merops philippinus* appeared at the wetland from mid October and stayed up to April. The peak of winter population of migratory birds was observed during the months of October to February. In the present study, irrigated agricultural fields surrounding the sanctuary, with scattered trees, extensive reed growth, water lily, cattails species, riparian vegetation and open grasslands probably provided shelter and suitable foraging grounds for the wetland birds. This habitat by supporting different food sources like fish, crustaceans,

invertebrates, water plants and plankton further adds to the diversity of wetland birds (Basavarajappa 2006). The earlier studies conducted by Bassouvalingam et.al (2012) have reported 41 bird species, Davidar (2011) 121 species, CMAP, (2011) 166 and Murugesan et.al (2013) have reported 166 bird species in Ousteri wetland.

Larger bird species such as Greater flamingos *Phoenicopterus ruber*, Eurasian spoonbill *Platalea leucorodia*, Asian painted stork *Mycteria leucocephala* and Spot-billed pelican *Pelecanus philippensis* are arrived during the month of August and departure by only in the month of November in 2014, these populations of larger birds was found to be high in the month of October. During the 2 years period a total number of 714 birds' species were found dead (Table 2). The greatest number of threats 324 (45%) was due to habitat destruction, which was counted with destroyed nests on the degraded, ploughed and irrigated lands. The second most threats was hunting and poaching 182 (25%) (Plate 3). In an informal discussions with the poachers during birds threats survey Carbofuran (furadon) poisoning is the third most threats to the bird population 147 (21%) the poachers insert insecticides (Furadan) in the abdominal cavity of freshwater snails targeting for egrets, and herons, mixing poison (Furadon) with lily flower seeds targeting for coots and ducks. The poisoned molluscs and lily seeds spread the vicinity of the lake and on the floating leaves of aquatic plants such as white waterlily *Nymphaeae alba*, Blue waterlily *Nymphaea capensis* and lotus *Nelumbo nucifera*. Birds consume these poisoned molluscs, freshwater crabs and seeds, become lethargic, saliva frost in beaks and ultimately unconscious and becoming easy prey to the poachers. The poachers revive them putting water drops in the bird's mouth (Srivastava and Srivastava, 2012). The unknown reason was found 61 (9%). Most of the threats were taken place during winter season as the season attracts more migratory birds in the lake.

Habitat loss causes the destruction of natural flora in which many resident and migratory birds are dependant for example reeds are extensively utilized for thatching purposes, Kans grass *Saccharum spontaneum* are mainly used for thatching and fencing purposes by the local villagers. The weaver birds (*Ploceus philippinus*) are being gravely affected and threatened by human activities with habitat loss. According to recent survey conducted by revenue department of Tamil Nadu in its Ousteri wetland jurisdiction was estimated that 150 acres of land belongs to Kadaperikuppam Village, 700 acres of land is belongs to Poothurai Village and 70 acres of land area are belongs to Perambai Village of these total 920 acres of land, around 70 acres of land are encroached for agricultural purpose by Kadaperikuppam and Poothurai Villagers which is calculated 7.6% of land being reduced the bird area in the Ousteri wetland. Carbofuran also known as furadan

which is widely applied as an agricultural pesticide is being used to kill birds by mixing with snails, fish and crabs targeting larger migratory birds, during the threats survey there were around 216 combined many kind of bird species found dead due to poisoning. The pesticide is mixed with lily and lotus flower pollen grains targeting Common coots *Fulica atra*, Cormorants *Phalacrocorax niger* and Spot-billed ducks *Anas poecilorhyncha* these kind of poisoning killed around 125 common coots. Illegal hunting and poaching further reduced bird populations in Ousteri wetland, because the hunting targets are often on migratory birds mainly by the local tribal due to its high demand for trade the present study found that 162 bird species were killed by poachers of these, Painted stork 12 and Asian open-billed stork around 7 were found killed. Egg collection by cattle herders and local people are some extent disturbance to ground nesting bird population within the sanctuary particularly during the breeding seasons of ground nesting birds. Intensive farming such as tillering, irrigation has had particularly damaging effects on ground-nesting birds.

Discussion

Grassland birds are most vulnerable due to flooding, fires, overgrazing, and invasion by exotic vegetation. Before the announcement of the Ousteri wetland as a bird sanctuary, it had its natural water stream during the rainy season; and was drained partially or in full during summer season. As a consequence, there was open grassland and the reefs flourished well. The native ground nesting birds such as skylarks, paddy field pipits, sand groves, doves and lapwings largely used these lands as feeding and breeding grounds. After the announcement of the Ousteri wetland as a bird sanctuary in the year of 2008, the Government of Puducherry has completely stopped the water for recreation, tourism and conservation purposes. This has caused the grasslands to be entirely submerged under water, as a result of which the ground nesting birds migrated to the surrounding abandoned agricultural areas when these agricultural areas are ready for second term cultivation in April–May, this results in the demolition of ground nesting birds' nests due to the summer ploughing and irrigation. A study conducted by Alexandar (2012) has estimated that due to the agricultural practices within the lake there were around 79 nests: nest with eggs, 34; hatchlings 8 were destroyed due to the second-term of paddy cultivation.

The bird population of Ousteri wetland ecosystem is under serious threats due to anthropogenic activities resulting in habitat loss, agricultural encroachments, hunting and poaching, poisoning and weed infestation (Davidar, 2011; Jhunjhunwala 1998; Islam and

Rahmani 2006; CMAP, 2011 and Alexandar, 2012). The modus operandi of the poachers is to trap the birds by mixing poisonous substance in fish and grains on the sprawling lake (The Hindu, July 19, 2017). The lake attracts its bird population are mainly due Kaliveli lake in Villupuram district and Odiyur lake in Kanchipuram districts had gone bone dry owing to severe drought and only a few lakes such as the Ousteri wetland contained (The Hindu, July 19, 2017). Ousteri wetland depends for its water sources from its catchment for 75%; the remaining 25% comes from diversion channels fed by the waters of Penaiyar river Suthukeny canal (Davidar, 2011). Some of the natural canals in the catchment area are blocked by Industries and agricultural lands; rejuvenation of all the tributary canals to the Ousteri wetland will increase water sources. Migratory birds are particularly vulnerable to hunting and poaching (CMAP, 2011) during winter season and this must be checked regularly until the breeding season is over. Ousteri wetland is rich in water birds, more species can be expected from the lake catchment including nearby lakes, ponds and paddy fields. So a detailed bird survey needs to be conducted in winter, summer and monsoon seasons in the entire lake catchment to prepare a comprehensive checklist.

Our results suggest that habitat loss is dominant threat to birds in Ousteri wetland, followed by poaching and poisoning. Fishing activity is a major threat to the bird population in Ousteri wetland. Unsustainable fishing activities are prevalent around the lake. The diversity of fish species in the lake attracts people for fishing. Around 15 fish species were recorded in Ousteri wetland (Alexandar and Siva Sankar, 2013). Fishing activity using nylon fishing nets not only killing of water birds such as pelicans, coots, and darters also has led to the killing of water snakes (Alexander, 2010 and CMAP, 2011). Akin to these, fishing cause direct disturbance to birds due to reduced availability of fish species, for which several avian species visit the lake. 36 piscivorous species (especially 21 heronry species) were observed visiting the lake for foraging due to the availability of diversified fish species (CMAP, 2011). These birds especially the heronry species visit the lake for foraging and breeding, and several of them would be threatened if fishing activities were not controlled or regulated. macrophytic plants such as *Hydrilla verticillata*, Lotus (*Nelumbo nucifera*), Pink lily and White lily (*Nymphaea sp*), *Eichornia crassipis* and *Najas minor* are mainly reducing bird's habitat and food sources.

Increasing real estate business and sprawling of human settlements around the lake generates large quantum of solid wastes thereby, creating problems related to their disposal. In India, it is a common practice to deem wetlands or marshes as wastelands and use them as dump yards for untreated raw sewage and solid wastes. This practice of solid waste dumping in wetlands leads to fall in ecological and conservation value, species

Table 2 List of threats to the bird population in Ousteri wetland

S. No.	Species Name	Number of Species found dead	Month	Causes to Death
1	Cattle egret	63	September, October	Hunting and poaching
2	Common teal	11	November	Poisoning
3	Spot-billed duck	32	October, November and December	Poisoning
4	Painted stork	12	August, September	Hunting and poaching
5	Red-wattled lapwing	54	April, May	Habitat destruction
6	Pheasant-tailed jacana	30	November	Hunting and poaching
7	Small bee-eater	11	November	Unknown
8	Little cormorant	74	November	Poisoning
9	Little grebe	24	November	Hunting and poaching
10	Spot billed pelican	2	November	Poisoning
11	Little cormorant	31	November	Unknown
12	Common coot	125	October, November and December	Poisoning
13	Asian open-billed stork	7	October	Hunting and poaching
14	Oriental white-ibis	14	October	Poisoning
15	White-breasted waterhen	22	November	Hunting and poaching
16	Common moorhen	32	November	Poisoning
17	Paddyfield pipit	81	April, May	Habitat destruction
18	Sand plover	37	April, May	Habitat destruction
19	Weaver bird	52	October, November and December	Habitat destruction

richness or species distribution of the system / area. Apart from swallowing / shrinking of the wetland, dumping municipal wastes can seriously effects the water bodies by releasing noxious chemicals during decomposition. The heavy organic contents in municipal wastes degrade slowly and release acidic and toxic leachates for many years. The Ousteri wetland is not much an exception to this, as we could see large quantities of solid wastes in and around the lake embankment during the present survey. Solid waste dumped in different parts of the wetland is a major environmental, public health threat, and a management issue. Waste water discharges from industries, commercial establishments, institutions and domestic sectors into the lake are deteriorating the water quality and ecosystem health (CMAP, 2011)

The presence of agricultural fields around the lake contributes significant amounts of N, P, K and pesticides through run-off. The wetland is presumed to receive loads of agricultural pesticides from paddy crops cultivated in its border villages. Heavy metals and several pesticides, as an outcome of application of agrochemicals in nearby agriculture

fields, can get accumulated through the trophic levels (macrophytes, fish etc.) in the wetland ecosystem and may ultimately affect the apex of the food chain, i.e. birds. Wetlands located in agricultural landscapes are particularly affected by agrochemicals (Azeez et al 2007 and Prusty et al 2007). Presently, Ousteri wetland is one of the locations in the Puducherry region that draws considerable number of tourists both nature lovers and commercial tourists. One of the major impacts of tourism is generation of solid waste near the lake banks and littering of the area. The survey team has noticed dumping and/or throwing of food packets, polythene bags and other solid waste into the lake.

In considering these threats to bird population, the wetland needs to be jointly patrolled by both Tamil Nadu and Puducherry Forest officials to minimize disturbance, in particular during the breeding season. Conservation education and awareness programmes are essential for local farmers in order to practice organic farming, students, fishing community and visitors to the lake. The present study suggest that the micro catchments and more suitable plantations in the marginal areas and removal of excessive aquatic weeds would be a relief to bird populations during the summer season and this ecosystem will be suitable place for breeding ground for migratory birds.

The Tamil Nadu Government on August 11, 2014 declared Ousteri wetland as the 15th bird sanctuary (The Times of India Aug 11, 2014). The efforts taken by the Puducherry government to promote the lake since 2008, did not yield the desired results as major part of the lake was located in Villupuram District of Tamil Nadu, which did not declare Ousteri wetland as a sanctuary which leads poaching and poisoning of birds was rampant and the number of migratory birds came down drastically. Despite the decision taken by the Government of Tamil Nadu, the Ousteri wetland has come into completely protected, hence the encroachments, poaching and poisoning of bird population must be stopped.

The sanctuary has no watchtowers and large expanse of unfenced areas has enabled poachers to make their way into the sanctuary for poaching. There has been a rise incidence of any patrolling inside the sanctuary. The boat operations should be stopped during breeding seasons or at least restrict near to the birds nesting sensitive islands.

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