Rapid degradation of wetlands and its impact on avifauna: A case study from Ambuja Wetland, West Bengal, India

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Abstract

Urbanisation perturbs the natural structure and function of an ecosystem, exerting negative effects on biodiversity. Birds are excellent biological indicators due to their rapid response to changing habitat. The present study was undertaken to evaluate the change in avifaunal congregation pattern, and diversity, and the threats, and possible remedies, in a rapidly degrading wetland of an industrial city, Durgapur. Ambuja Wetland, located amidst the most populated area of Durgapur, in West Bengal, was recorded to harbour 73 bird species of 34 families. Lesser Whistling Duck *Dendrocygna javanica* was recorded as the dominant species, however, its numbers were found to decrease gradually during the study period (June 2013–May 2017). In addition, the number of other waterbirds also decreased. A positive correlation was found between vegetation cover and waterbirds to non-waterbirds conversion ratio. Illegal hunting of the ducks was recorded as a direct threat. Excess nutrient load, as a consequence of incessant solid waste dumping, has been assessed as the main cause degrading this wetland. Long-term management of wetlands requires a scientific management plan to ensure their restoration.

Introduction

Wetland habitats of the world are reservoirs of incredible biodiversity and provide many important social, environmental, and economic services (Mitsch & Gosselink 2007. But nowadays, many wetlands with large avian congregations are threatened by the problems of habitat loss and degradation of water quality. Rapid urbanisation, due to accelerating human needs, is one of the major causes of wetland degradation in developing countries like India. However, literature that quantifies the impact of rapid transformation in an urban wetland is scanty in India. Durgapur is an industrial city of West Bengal, which is located between the Chotanagpur Plateau and the Gangetic Plains. It shares the flora and fauna from both these eco-regions. To date, very little work has been done on the avifauna of this region (Gauntlett 1986; Chakraborty 2011; Nayak *et al.* 2015; Adhurya *et al.* 2015), and most of the avifaunal study has concentrated on the Damodar Valley with little information published on the impact of urbanisation on the birds of Durgapur.

The present study was undertaken to quantify the impact of rapid conversion of Ambuja Wetland, due to urbanisation, manifested in its avifaunal composition over a period of four consecutive years. The main vegetation of this wetland, as recorded during our study, comprised narrowleaf cattail *Typha angustifolia*, tall reeds *Phragmites karka*, Indian lotus *Nelumbo nucifera*, common water hyacinth *Eichhornia crassipes*, *etc*. Fifteen species of Odonata have been documented from this lake (Nayak & Roy 2017). The wetland also has plenty of fish of various sizes, freshwater crabs, five species of snakes, and the Indian black turtle *Melanochelys trijuga*. While the wetland is not being commercially fished, people do catch fish on the eastern bank.

This paper presents an account of the birds of rapidly degrading Ambuja Wetland and highlights obvious threats. Also, efforts have been made to identify possible remedies to conserve this urban waterbird abode.

Materials & methods

The study was carried out at Ambuja Wetland (23.54°N, 87.31°E), adjacent to the historical Kali Temple of Bhavani Pathak in the City Center of Durgapur. The wetland is about 2.84 ha in area and roughly rectangular in shape. It was densely vegetated from the very beginning of our study and open water space decreased continuously over the entire span of our study **[43 (a,b), 44]**. Additionally, the northern and recently also eastern part of the lake was encroached upon by reclaiming during the construction of a residential complex, which poses a risk of polluting the water and a threat to the wetland's biodiversity.

As part of the study, the sampling of birds was done monthly between June 2013 and May 2017. Point counts were conducted during the first two hours after sunrise (0600–0800 hr), during noon (1200–1400 hr), and in the evening (1600–1800 hr) (Adhurya et al. 2016). We estimated the extent of vegetation cover of the wetland from satellite images downloaded from Google Earth's historical images, covering the extent of the study period.

2-sample independent t-test was used to find if there were any significant changes in the number of waterbirds and non-waterbirds between the period 2013–2014 and 2016–2017. Pearson's correlation coefficient was calculated to find the correlation between vegetation cover and the ratio between non-waterbirds to waterbirds. All of the statistical analysis was performed using Minitab 17. To calculate the seasonal relative

43. Conversion of Ambuja Wetland. The first photo was taken on 15th February 2013, the second photo was taken on 10th July 2016.

abundances of different birds (Table 1), first, the average number of different species over the four years was calculated (e.g., the average number of individuals of a particular species for January was calculated from the data for the month of January collected during four years). Then this averaged individual value of all months was summed up and considered as 100%. Then the relative abundance of a particular month was calculated as how many fractions of this total value actually observed in that particular month.

For simplicity, if the number of individuals of a species (suppose species A) for the month one of year one, two, three, and four were N_{m1y1}, N_{m1y2}, N_{m1y3} and N_{m1y4} respectively. Then, an average number of individuals for this species of the month one was calculated as:

$$N_{m1} = (N_{m1y1}+N_{m1y2}+N_{m1y3}+N_{m1y4})/4 \quad (1)$$

Similarly, the values for other months (month 2 to 12) were calculated. Now the values of these months were summed up.

$$N_{total} = N_{m1}+N_{m2}+.....+N_{m12} \quad (2)$$

Here, N_{total} was the total value of these averaged values of all months. Then, seasonal relative abundances for month 1(RA_{m1}) was calculated as:

$$RA_{m1} = (N_{m1}/N_{total})\times 100 \quad (3)$$

A four-coloured gradient plot has been used to demonstrate the seasonality of different bird species across the year. The gradient plot representing seasonality was plotted using R.

Again, the mean annual bird abundance was calculated by averaging the number of a particular species over all the months for a particular year (Table 1).

Results & discussion

73 avian species were recorded during the present study (Table 1). Out of these, two were summer migrants, ten were winter migrants, and the rest were resident. Of these, 20 species were categorised as waterbirds and 53 as non-waterbirds. Lesser Whistling Duck *Dendrocygna javanica* was the most abundant

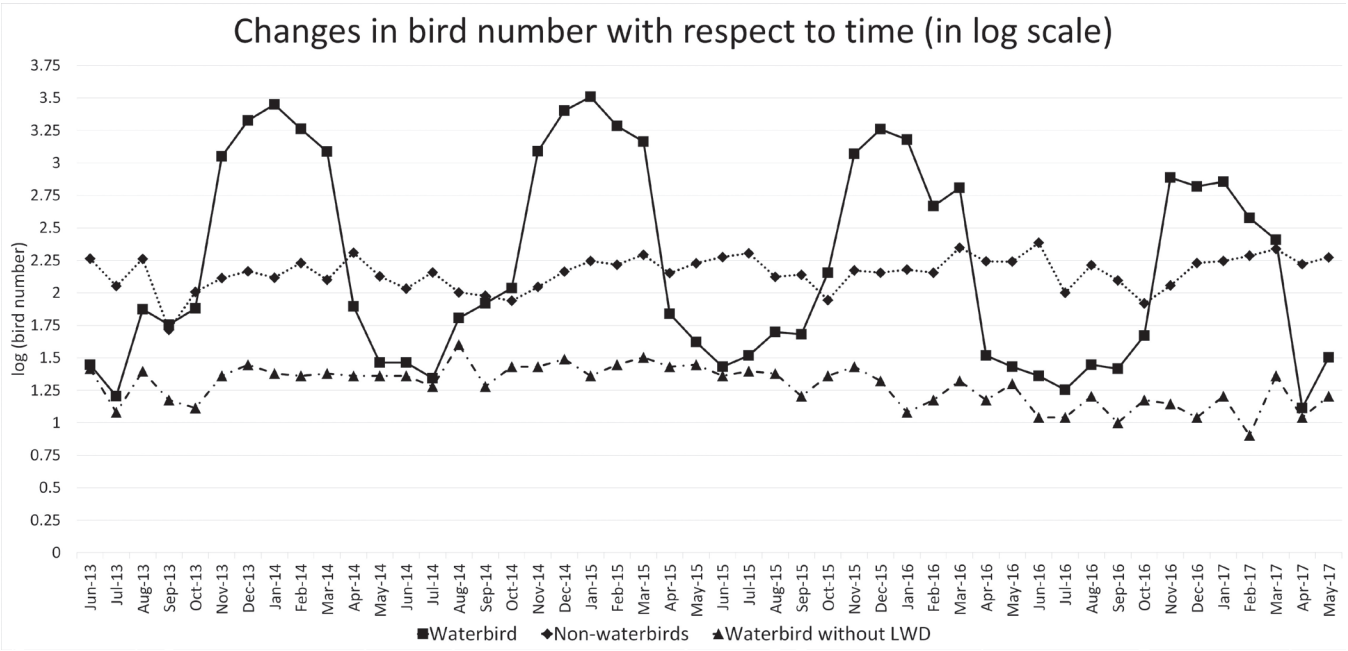


Fig. 1. Changes in number of waterbirds, non-waterbirds with respect to time. Waterbirds without the dominant species (Lesser Whistling Duck is shown separately). Waterbirds for their large number in winter taken as Waterbird/10 for comparison with the number of other birds.

Table 1. Checklist of birds of Ambuja Wetland, with their migration status, abundance and year of occurrence between 2013 and 2017. An Asterix (*) mark is placed after the scientific name of waterbird species.

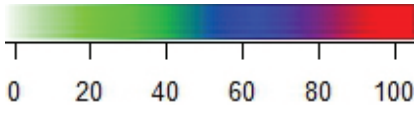
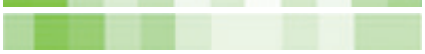
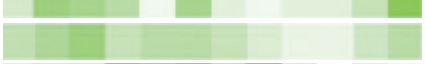
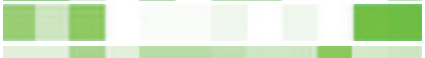
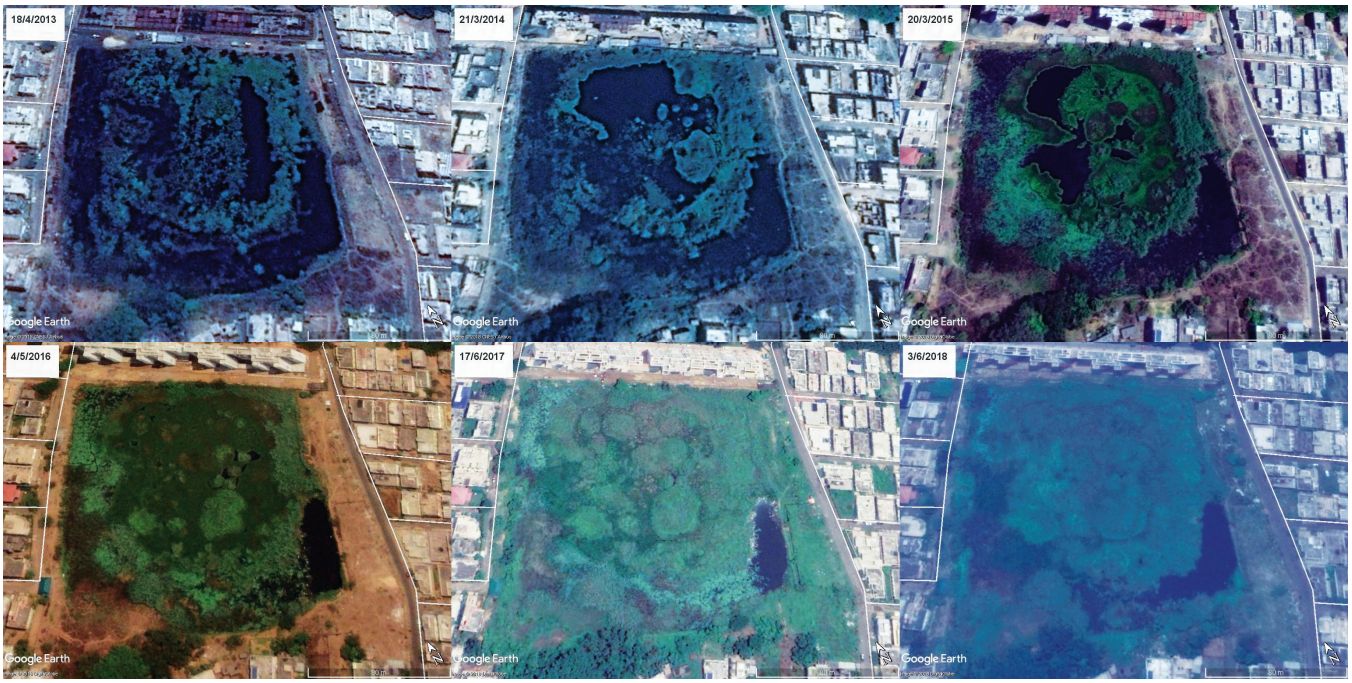
Sl. No.	Bird Name	Seasonal relative abundance (in %)	Mean annual bird abundance			
			2013-2014	2014-2015	2015-2016	2016-2017
1	Lesser Whistling Duck *Dendrocygna javanica**		768.6	871.7	478.3	234.3
2	Cotton Teal *Nettapus coromandelianus**		0.2	0.0	0.0	0.0
3	Little Grebe *Tachybaptus ruficollis**		2.4	3.1	1.3	0.2
4	Rock Pigeon *Columba livia*		6.7	6.3	6.9	7.0
5	Eurasian Collared Dove *Streptopelia decaocto*		2.4	2.7	2.7	2.6
6	Spotted Dove *Streptopelia chinensis*		1.8	2.4	1.8	1.9
7	Asian Palm Swift *Cypsiurus balasiensis*		1.8	1.8	0.9	0.8
8	Indian House Swift *Apus affinis*		3.2	0.3	1.1	3.8
9	Greater Coucal *Centropus sinensis*		0.8	0.8	0.7	0.7
10	Pied Cuckoo *Clamator jacobinus*		0.3	0.0	0.2	0.0
11	Asian Koel *Eudynamys scolopaceus*		2.0	2.0	1.8	2.3
12	Plaintive Cuckoo *Cacomantis merulinus*		0.0	0.0	0.0	0.1
13	Common Hawk Cuckoo *Hierococcyx varius*		0.5	0.3	0.5	0.5
14	White-breasted Waterhen *Amaurornis phoenicurus**		1.6	1.8	2.1	1.5
15	Purple Swamphen *Porphyrio porphyrio**		0.0	0.6	0.0	0.0
16	Common Moorhen *Gallinula chloropus**		2.4	2.7	2.1	0.9
17	Cinnamon Bittern *Ixobrychus cinnamomeus**		0.0	0.7	0.5	0.4
18	Black Bittern *Ixobrychus flavicollis**		0.0	0.2	0.1	0.1
19	Black-crowned Night Heron *Nycticorax nycticorax**		0.1	0.1	0.5	0.3
20	Indian Pond Heron *Ardeola grayii**		2.9	3.9	3.3	2.8
21	Cattle Egret *Bubulcus ibis**		2.9	3.6	2.6	2.6
22	Purple Heron *Ardea purpurea**		0.6	0.8	0.2	0.0
23	Little Egret *Egretta garzetta**		0.8	1.2	0.5	0.1
24	Little Cormorant *Microcarbo niger**		3.0	3.0	2.3	1.4
25	Pheasant-tailed Jacana *Hydrophasianus chirurgus**		0.1	0.2	0.0	0.0
26	Bronze-winged Jacana *Metopidius indicus**		2.6	2.7	2.1	1.0
27	Green Sandpiper *Tringa ochropus**		0.0	0.0	0.1	0.0
28	Black-winged Kite *Elanus caeruleus*		0.0	0.1	0.1	0.1
29	Shikra *Accipiter badius*		0.4	0.8	0.6	0.3
30	Black Kite *Milvus migrans*		0.1	0.3	0.3	0.2
31	Spotted Owlet *Athene brama*		0.1	0.3	0.3	0.3
32	Eurasian Wryneck *Jynx torquilla*		0.1	0.0	0.0	0.0
33	Lesser Golden-backed Woodpecker *Dinopium benghalense*		0.6	0.7	0.5	0.8
34	Blue-throated Barbet *Psilopogon asiaticus*		0.1	0.1	0.2	0.5
35	Coppersmith Barbet *Psilopogon haemacephalus*		0.9	0.7	0.7	1.3
36	Green Bee-eater *Merops orientalis*		3.3	4.3	4.0	4.5
37	Blue-tailed Bee-eater *Merops philippinus*		0.6	0.3	0.0	1.1
38	Common Kingfisher *Alcedo atthis**		0.7	1.1	0.9	1.1

Table 1. Checklist of birds of Ambuja Wetland, with their migration status, abundance and year of occurrence between 2013 and 2017. An Asterix (*) mark is placed after the scientific name of waterbird species.

Sl. No.	Bird Name	Seasonal relative abundance (in %)	Mean annual bird abundance			
		0 20 40 60 80 100 J F M A M J J A S O N D	2013-2014	2014-2015	2015-2016	2016-2017
39	Stork-billed Kingfisher *Pelargopsis capensis**		0.2	0.1	0.4	0.1
40	White-throated Kingfisher *Halcyon smyrnensis**		1.3	1.5	1.3	1.0
41	Rose-ringed Parakeet *Psittacula krameri*		4.7	4.9	5.8	5.9
42	Black-hooded Oriole *Oriolus xanthornus*		0.8	0.9	0.8	0.7
43	Indian Golden Oriole *Oriolus kundoo*		0.0	0.2	0.3	0.2
44	Ashy Woodswallow *Artamus fuscus*		5.6	8.8	5.5	5.3
45	Black Drongo *Dicrurus macrocercus*		1.3	1.9	1.7	1.8
46	Brown Shrike *Lanius cristatus*		0.6	0.8	0.8	0.6
47	Rufous Treepie *Dendrocitta vagabunda*		1.3	1.2	1.0	0.9
48	House Crow *Corvus splendens*		7.8	12.4	10.2	11.8
49	Purple-rumped Sunbird *Leptocoma zeylonica*		1.6	1.1	0.9	0.4
50	Purple Sunbird *Cinnyris asiaticus*		2.4	2.3	1.7	2.4
51	Baya Weaver *Ploceus philippinus*		27.4	13.4	41.8	32.8
52	Scaly-breasted Munia *Lonchura punctulata*		2.9	2.6	4.4	4.3
53	Tricoloured Munia *Lonchura malacca*		0.0	0.2	0.2	0.0
54	Olive-backed Pipit *Anthus hodgsoni*		0.8	1.0	0.9	1.1
55	White Wagtail *Motacilla alba*		1.1	1.3	0.9	1.1
56	Ashy Prinia *Prinia socialis*		3.7	4.7	4.7	4.9
57	Plain Prinia *Prinia inornata*		3.8	5.0	4.3	5.5
58	Common Tailorbird *Orthotomus sutorius*		2.2	2.0	2.5	2.3
59	Blyth's Reed Warbler *Acrocephalus dumetorum*		0.5	0.4	0.5	0.5
60	Red-rumped Swallow *Cecropis daurica*		0.0	0.0	0.1	0.1
61	Wire-tailed Swallow *Hirundo smithii*		0.2	0.2	0.4	0.5
62	Barn Swallow *Hirundo rustica*		6.2	5.4	5.5	3.2
63	Red-whiskered Bulbul *Pycnonotus jocosus*		2.7	2.8	2.9	2.9
64	Red-vented Bulbul *Pycnonotus cafer*		4.0	4.3	3.6	4.4
65	Dusky Warbler *Phylloscopus fuscatus*		0.3	0.3	0.7	1.0
66	Greenish Leaf Warbler *Seicercus trochiloides*		1.2	1.2	1.3	1.3
67	Yellow-eyed Babbler *Chrysomma sinense*		0.2	0.9	0.8	1.3
68	Jungle Babbler *Turdoides striata*		8.2	7.1	7.0	7.8
69	Asian Pied Starling *Gracupica contra*		12.9	15.6	13.5	17.6
70	Chestnut-tailed Starling *Sturnia malabarica*		1.7	1.3	2.1	1.9
71	Common Myna *Acridotheres tristis*		6.5	6.6	7.5	5.9
72	Oriental Magpie Robin *Copsychus saularis*		1.2	1.4	1.0	1.8
73	Taiga Flycatcher *Ficedula albicilla*		0.8	0.7	0.9	0.8



44. Satellite image of Ambuja Wetland from 2013 to 2017 in sequence (Source: Google Earth; Accessed on 25.08.2018).

species. Its number declined from about 3000 individuals in 2013 to less than 500 in 2017 (Fig. 1). The overall number of waterbirds from 2013–2014 to 2016–2017 decreased significantly ($p=0.049$) while the number of non-waterbirds remained relatively stable ($p=0.122$). To avoid one species (Lesser Whistling Duck) influencing our conclusion, the analysis was also performed by excluding the species and our conclusion remains the same ($p<0.001$).

Apart from Lesser Whistling Duck, three other waterbirds, Cotton Teal *Nettapus coromandelianus*, Purple Swamphen *Porphyrio porphyrio*, and Pheasant-tailed Jacana *Hydrophasianus chirurgus*, which were recorded during the earlier part of the present study, completely deserted this habitat by the end of the study. The impact of habitat change was also apparent in the steady decrease in abundance of seven other waterbird species: Little Grebe *Tachybaptus ruficollis*, White-breasted Waterhen *Amaurornis phoenicurus*, Common Moorhen *Gallinula chloropus*, Cinnamon Bittern *Ixobrychus cinnamomeus*, Purple Heron *Ardea purpurea*, Little Cormorant *Microcarbo niger*, and Bronze-winged Jacana *Metopidius indicus* (Table 1). To summarize, the abundance of 11, out of 20, waterbird species was immensely influenced by the rapid conversion of Ambuja Wetland due to anthropogenic intervention. However, this change actually favoured some of the non-waterbird species. These included Rose-ringed Parakeet *Psittacula krameri*, Ashy Prinia *Prinia socialis*, Dusky Warbler *Phylloscopus fuscatus*, and Yellow-eyed Babbler *Chrysomma sinense*. Aquatic plants like narrowleaf cattail, tall reed provide refuge to birds like prinias and some warblers. Increase in vegetation cover over the lake which also included these plant species may have encouraged the colonisation and increase in a number of these kinds of birds. The Rose-ringed Parakeet was observed favouring arboreal and shrubby layer of vegetation with a strong relationship with anthropic habitats (Hugo & Van Rensburg 2009; Fraticelli 2014). It was interesting to note that two of the commonest bird species, the House Crow *Corvus splendens* and the Asian Pied Starling *Gracupica contra*, both scavengers, had increased in abundance during the present study, though was not so for the Common Myna *Acridotheres tristis*. This may be due to the former two species' the fast evolving nature (urban adapters) with anthropic habitats. However, it was surprising to note that the number of Black Kites *Milvus migrans* did not change much during the study period and this might be due to the presence of a nearby (within a radius of approximately five kilometers) dumping ground of Sepco township.

Bird species richness was highest during 2014–2015 and reduced gradually (Table 1). This decline is attributed to the rapid degradation of the habitat. Illegal hunting of birds, over the years, has also made a significant difference. The temporal changes and degradation of the lake during the present study is visible in **[44]** Vegetation cover, measured using the satellite images, in 2013, 2014, 2015, 2016, and 2017 was 47.6%, 46.6%, 80.5%, 87.6%, and 88.4% respectively. A positive correlation was noted between vegetation cover and the ratio of non-waterbirds to waterbirds (Pearson's $r = 0.878$, $p = 0.122$). Among waterbirds, we observed chicks/juveniles of Bronze-winged Jacana *Metopidius indicus*, Common Moorhen *Gallinula chloropus*, White-breasted Waterhen *Amaurornis phoenicurus*, and Little Grebe *Tachybaptus ruficollis* thereby confirming that they bred there. Chicks were found from April to September. It is possible that other waterbirds nested in this habitat before the conversion of the wetland. Huge evening congregations of Baya Weaver *Ploceus philippinus* used the reeds on the eastern and south-western margins to roost in at night.

The Lesser Whistling Duck and possibly other birds, turtles, and fishes are caught and eaten by the ethnic people who live nearby. We have seen them killing birds with a catapult (*gulti* or *gulail* in the local language), or even by throwing stones at flocks of Lesser Whistling Duck. The birds were hunted during the day, and the dead birds were collected in the evening. On multiple

occasions we have observed people approaching birds with the intention of killing them. According to one hunter, the meat of the Lesser Whistling Duck was believed to reduce blood sugar levels. A probable solution to stop this kind of activity is to spread awareness among the people and by increasing surveillance by forest department staff.

The main reasons for the loss and degradation of the wetland are (a) loss of wetland area due to conversion for housing and, (b) solid waste dumping (mainly household garbage and wastes from religious rituals). The margins of the lake are full of plastic, thermoplastic waste, and other waste **[45]**. The chemicals released from solid garbage waste may provide nutrients that contribute to the rapid growth of wetland plants, which in turn leads to the reduction of open water.

45. Solid waste at Ambuja Wetland.

A comprehensive management plan is needed for the restoration and sustainable management of this degraded wetland. It is possible to rejuvenate the dead lake with a proper management plan, as seen at Puttenahalli (PNLIT 2019), whereas improper management may result in the loss of biodiversity (Sapthagirish *et al.* 2015). Considering the present scenario, the concerned authorities should immediately cease the dumping of waste in the lake. Other interventions that would help include through-dredging of parts of the lake to restore deeper water areas, and the control of macrophytes through the use of biocontrolling agent of aquatic weeds like grass carp *Ctenopharyngodon idella* may be considered (Mitzner 1978). However, these actions should only be done after a comprehensive assessment of options, and the development of an action plan. A systematic restoration plan would benefit from the suggestions of Sapthagirish *et al.* (2015). In addition, raising public awareness regarding the importance of wetlands and the risk of wetland degradation is urgently needed.

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