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Dhavalkumar Vargiya & Anita Chakraborty

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The status of waterbird populations of Chhaya Rann Wetland Complex in Porbandar, Gujarat, India

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Abstract: The present investigation was undertaken to study the diversity of wetland birds in Chhaya Rann (Gujarati: Deserted land) wetland complex, situated in the urban setting of Porbandar City, in the western state of Gujarat, India. Almost 70 species belonging to 21 families of wetland birds have been reported from here with an estimated count of 35,747 and 20,981 in the year 2016 and 2015 respectively. Anatidae and Scolopacidae represent the higher number of species (11 each) followed by Ardeidae (eight species) and Laridae (seven species). The wetland complex supports one IUCN Red Listed Vulnerable species (Common Pochard *Aythya ferina),* six Near Threatened species (Lesser Flamingo *Phoeniconaias minor,* Oriental Darter *Anhinga melanogaster,* Dalmatian Pelican *Pelecanus crispus,* Black-headed Ibis *Threskiornis melanocephalus,* Black-tailed Godwit *Limosa limosa* and River Tern *Sterna aurantia*), and 63 Least Concern species. The wetland meets the Criteria 5 and 6 for listing as a wetland of international importance under the Ramsar Convention.

Keywords: Asian Waterbird Census, Gosabara-Mokarsagar Wetland Complex, Gujarat, IUCN Red List, Porbandar, wetland birds.

Gujarati: હાલની તપાસ ભારત દેશના પશ્ચિમ રાજ્ય ગુજરાતના પોરબંદર શહેરમાં આવેલા છાયા રણ વેટલેન્ડ કોમ્પ્લેક્સમાં પક્ષીઓની વિવિધતાનો અભ્યાસ કરવા માટે હાથ ધરવામાં આવી હતી. વર્ષ ૨૦૧૬અને ૨૦૧૫માં અનુક્રમે ૩૫૭૪૭ અને ૨૦૯૮૧ની અનુમાનિત ગણતરી સાથે આર્દ્રથી જલપ્લાવિત ક્ષેત્રના પક્ષીઓના ૨૧ કુટુંબોની ૭૦ પ્રજાતિઓ લગભગ નોંધાયેલી છે. એનાટીડે અને સ્કોલોપેસિડે એ જાતિઓ વધુ સંખ્યા (પ્રત્યેકની ૧૧ પ્રજાતિઓ) રજૂ કરે છે, ત્યારબાદ આર્ડેઈડે (આઠ પ્રજાતિઓ) અને લારિડે (સાત પ્રજાતિઓ) આવે છે. વેટલેન્ડ કોમ્પ્લેક્સ એક આઈયુસીએન રેડ લિસ્ટેડ વલનરેબલ પ્રજાતિ રાખોડી કરચીયા, છ નિયર થ્રેટંડ પ્રજાતિઓ (નાનો હંજ, સર્પ ગ્રીવા, ચોટીલી પેણ, કાળી કાકણસર, અને કેંચી પૂંછ વા-બગલી), અને ૬૩ લિસ્ટ કન્સર્ન પ્રજાતિઓને આશરો આપે છે. રામસર કન્વેશન હેઠળ આંતરરાષ્ટ્રીય મહત્વના જલપ્લાવિત ક્ષેત્ર તરીકેની સૂચિ માટે છાયા વેટલેન્ડ, ૫ અને ૬ ક્રમાંકના માપદંડને પૂર્ણ કરે છે.

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INTRODUCTION

Wetlands are the most precious life sustaining water resource of this planet. Some of the vital functions are surface water storage, groundwater recharge, storm water retention, flood control, shoreline stabilization, erosion control, and retention of carbon, nutrients, sediments, and pollutants. Apart from these wetlands are the repository of rich flora and fauna, however, these complex ecosystems only constitute 4% of the earth's ice-free land surface (Panigrahy et al. 2012).

Birds which are fully dependent on wetlands for their physiological and behavioral characters are termed as waterbirds. Natural wetlands are the mainstay of the waterbirds; they are also regarded as the custodian of huge avifauna populations (Weller 1999; Stewart 2001). At present, wetlands in India face tremendous anthropogenic pressure. Almost 38% of inland wetlands in India have been lost during 1971–2001 (Prasad et al. 2004). This has resulted in loss of biodiversity affecting the overall functioning of the wetland ecosystem.

Gujarat occupies 6.2% of the total geographic area in India and has the longest coastline (almost 1,600km) of any state. It is bestowed with 17% of wetlands including intertidal mudflats, mangroves, coral reefs , rivers/ streams, reservoirs/barrages, creeks and salt marsh (National Wetland Atlas: Gujarat 2010).

The Chhaya Rann wetland complex, situated in an urban setting of the coastal Porbandar town, comprises an important part of the Porbandar Bird Sanctuary (officially designated in 1988), however, very few scientific investigations have been published on its birds (Anonymous 2016).

As part of the results of the Asian Waterbird Census conducted in January 2016 in the area, Vargiya et al. (2016) refer to loss of connectivity of the Chhaya Rann wetland complex with the parent wetland and ingress of factory effluents, rapid urbanization, and encroachment inside the wetlands, lack of conservation initiatives and a wetland management authority. They also include images of birds being struck by power lines, affected by fire crackers and DDT spraying.

This paper presents results of baseline information of the waterbirds of the Chhaya Rann wetland complex between January 2015 and January 2016.

STUDY AREA

Porbandar is a coastal district of Gujarat and covers an area of 2,294km^2. It lies in a semi-arid climatic zone with average daily temperatures ranging 21.6–40.4°C, with maximum temperatures being recorded from May to June and minimum from December to January. The average rainfall in Porbandar is 629mm, mainly during July–September. A total of 226 wetlands are mapped in the district by the Indian Space and Research Organization, including 95 small wetlands (< 2.25ha) with a total area of 22,199ha. Inland wetlands contribute 27.3% of the total wetland area while coastal wetlands contribute 72.7%. The major wetland categories of the district are lagoons, rivers/ streams, reservoirs and sand/beach (National Wetland Atlas: Gujarat 2010). Physiogeographically, Porbandar District has two regions, i.e., the Barda Hills forested region and the river plains. The major rivers of the district are Bhadar, Ojat, Minsar and Madhuvanti. Porbandar District is enclosed by Arabian Ocean on the west, by Jamnagar and Devbhumi Dwarika districts on the north, and Junagadh from the east and the south.

The Mokarsagar–Gosabara Wetland Complex in and around Porbandar is a complex of several coastal intertidal and brackish to freshwater wetlands, namely, Medha Creek, Kuchhadi, Chhaya Rann, Subhashnagar, Zavar, Kurly I, Karly II, Vanana, Dharampur, Gosabara, Mokarsagar, and Amipur.

Of these, the Chhaya Rann Wetland Complex (here after Chhaya Wetlands) is a narrow strip of brackish wetland habitat, about 4.5km long and 0.5km wide (2.25km^2) and comprises of Porbandar Rann, Chhaya 1, Chhaya 2 and Chhaya 3 wetlands. Historically, the Chhaya Wetlands were known as the Birla Rann where sea salt was produced several decades ago. Locally the Chhaya and Mokarsagar wetlands are known as 'Rann', i.e., 'Chhaya nu rann' and 'Mokar nu rann', as rann means deserted and non-productive land (a reference to when the wetland dries in summer and looks like barren land).

Over time, much of the wetland area was filled in for construction of housing societies, roads, shops, petrol pumps and educational buildings as part of the urban expansion of Porbandar. With the development of roads, this wetland was fragmented into several small wetlands now named Porbandar Bird Sanctuary (declared in 1988), Porbandar Rann, Chhaya 1, Chhaya 2 and Chhaya 3 near Balwy colony (Map 1 and Table 1). These wetlands are now separated from each other and surrounded by housing colonies and industrial areas. The Porbandar Bird Sanctuary is also separated

Figure 1. Chhaya Rann Wetland Complex, Porbandar City, Gujarat State.

from the rest of the Chhaya Wetlands. Water can flow between Chhaya 1, Chhaya 2 and Chhaya 3 and none are connected to the sea. Chhaya 3 dries out in summer while the other wetlands always retain some water during this period. As Chhaya 3 was previously managed as a salt pan it retains features like bunds, barriers and quadrates which provide roost sites for waterbirds.

The water depth was not measured in any wetland, however, by observing the foraging habits of Lesser Flamingo *Phoeniconaias minor*, which have the longest leg length and by considering the average leg length (as per Mascitti & Castañera 2006), it was possible to roughly calculate the maximum water depth to be about 50cm. Lesser Flamingo can forage at a water depth of 02 to 50cm. Complete legs of the Lesser Flamingo was seen when feeding at the periphery of the wetlands, while in the middle, the flamingos appeared to be floating with their entire legs out of view; here we assume the water depth to be about or at least 50cm in the Chhaya 2 wetland.

Porbandar Bird Sanctuary is a relatively deep water habitat compared to the Chhaya 2 wetland. The state forest department has created around 40 islets within the waterbody to encourage roosting of waterbirds and has planted the Indian Tulip Tree (*Thespesia populnea*) along the periphery of the sanctuary. There are no plantation or habitat creation activities in the Chhaya 1, 2 and 3 wetlands.

Due to increase in salinity in nearby farm areas, salt production was stopped and as a consequence, the wetland currently is maintained by inflows of urban domestic drainage water from the Chhaya municipality area and a limited quantity of rain water during the annual monsoon. In an attempt to combat the breeding of mosquitoes in the area, the Chhaya wetlands was filled with waste material locally called 'datt' from a nearby factory by local municipality (Kishore Joshi, pers. comm. 2016). This dumping created a shallow water wetland and salinity of the datt when mixed with rain water created an algal bloom which appears to have attracted flamingos. The first flock of Lesser Flamingo was seen in the winter of the 1960s (Kishore Joshi, pers. comm. 2016).

METHODS

The Chhaya Wetlands were visited once a month between January 2015 and January 2016 during which a total of 13 counts of birds were made. Surveys were conducted in the mornings at 07.00–10.00 h and in the evenings at 16.00–18.00 h. The species were identified using Grimmett et al. (2015) and birds were counted using block count and individual count methods. The January 2015 and January 2016 counts were linked to the Asian Waterbird Census coordinated nationally by Wetlands International and the Bombay Natural History Society.

RESULTS

A total of 70 species of 21 families of waterbird and wetland bird species were reported in this wetland complex during 2015–2016 (Table 2 and Image 1). Anatidae and Scolopacidae represent the higher number of species (11 each), followed by Ardeidae (eight) and Laridae (seven) (Fig. 2). The Chayya Wetlands support one (1.4% of all species) Vulnerable species (Common Pochard *Aythya ferina)* as per the IUCN Red List of Threatened Species (IUCN 2018), six (8.5%) Near Threatened species (Lesser Flamingo, Oriental Darter *Anhinga melanogaster,* Dalmatian Pelican *Pelecanus crispus,* Black-headed Ibis *Threskiornis melanocephalus,* Black-tailed Godwit *Limosa limosa*, and River Tern *Sterna aurantia*), and 63 (82.9%) species listed as of Least Concern (Fig. 3).

Out of 70 species recorded, seven breed in Chhaya Wetlands, while 27 are resident in the district and have not been recorded to breed here, and 36 are migratory. The estimated counts of waterbird and wetland bird species of the entire wetland complex are 20,981 and 35,747 in January 2015 and January 2016, respectively (Table 2). The Lesser Flamingo was the most abundant species, with 14,649 and 21,611 individuals recorded in 2015 and 2016, respectively. And the species diversity remains the same for the Porbandar Rann for both the survey years (2015 and 2016), i.e., 21 species. While in other sites, the number of species observed dropped from 2015 to 2016; Chhaya 1 & 2 from 39 species in 2015 to 31 in 2016 and at Chhaya 3 from 27 in 2015 to 18 in 2016.

Flocks of 80 to 100 Lesser Flamingos were observed to fly from the Porbandar Rann, Chhaya 2, and 3 to Chhaya 1 wetland only to bathe and after several minutes, to

Table 1. Description of Chhaya Rann Wetland Complex and observed threats to wetlands.

Site No.	Name of wetland	Location (lat. & long.)	Observed threats	Conservation action	Governance
1	Porbandar Bird Sanctuary and associated area	21.636^{0}N & 69.618^{0}E	· Pollution by domestic sewage and garbage · Wetland as inflow of sewage water and no outflow has resulted in an increase in water depth which is not suitable for many wader species. A new municipal sewage system is expected to address this pollution issue.	In April 2019, inflow of municipal sewage water has been reduced. As a result, the water level of the wetland dropped and after 30 years more than 800 Lesser flamingos were seen feeding here.	Porbandar Forest Division & Municipality of Porbandar
2	Porbandar Rann	21.632^{0}N & 69.623^{0}E	· Pollution by domestic sewage and garbage · Dumping zone of waste materials · Industrial effluents · Feral dogs killing birds		Municipality of Chhaya
3	Chhaya 1 & 2	21.630^{0}N & 69.626^{0}E	· Fragmentation and filling of wetland for illegal commercial development and houses · Dumping zone of waste materials · Pollution by domestic sewage and garbage · Invasion of *Prosopis juliflora* on fringes · Annual spraying with DDT along the wetland periphery aimed at controlling mosquitoes	In November 2018, City Survey Porbandar issued 85 notices for illegal construction.	Municipality of Chhaya
4	Chhaya 3	21.622^{0}N & 69.636^{0}E			

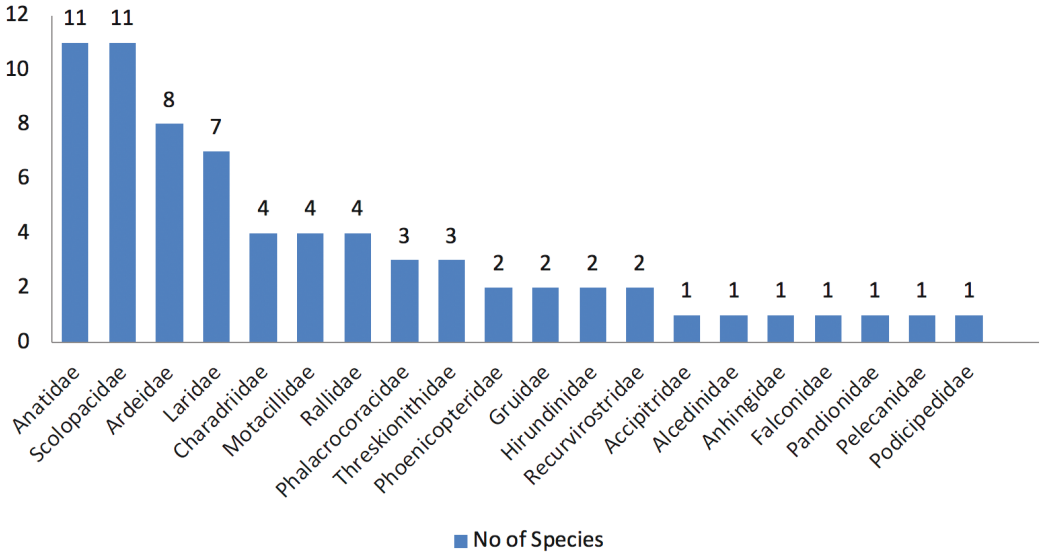


Figure 2. Wetland bird species composition recorded in Chhaya Rann Wetland Complex during the study.

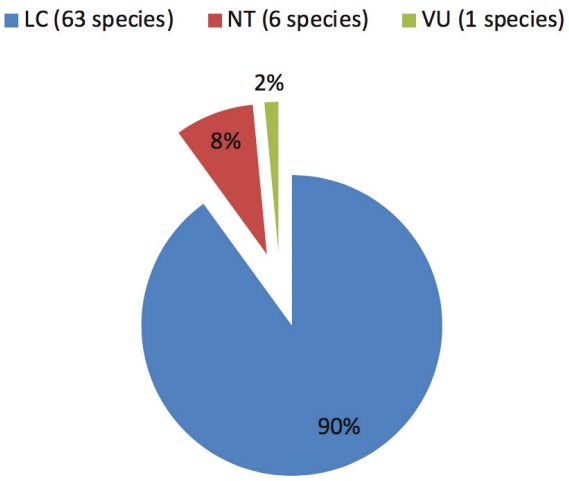


Figure 3. Conservation status (percentage composition) of wetland bird species as per their IUCN Red List category (VU—Vulnerable | NT—Near Threatened | LC—Least Concern).

fly back to the other wetlands. This phenomenon was only observed during afternoons. Greater Flamingo preferred Chhaya 1 for courtship while Lesser Flamingo preferred Chhaya 2 for their courtship activities.

Porbandar Bird Sanctuary: A total of 41 waterbird and wetland bird species were reported in January 2015 and 2016. During the summer, the islets supported nesting of about five pairs of Red-wattled Lapwings *Vanellus indicus* and seven pairs of Black-winged Stilts *Himantopus himantopus*. Tall reeds towards the western side of the sanctuary provided roosting sites for marsh birds like moorhens and waterhens. These reeds were also favored by Demoiselle Cranes *Anthropoides virgo* and Common Cranes *Grus grus* that were injured by kite flying threads and remained throughout the year at the sanctuary as their ability to fly was hampered. The sanctuary appeared to support a number of freshwater fishes, judging from the number of fish-eating birds that were regularly seen feeding. The sanctuary was also the roosting ground of Black-headed Ibis and in summer, a maximum of around 150 were recorded. A pair of Great Cormorants *Phalacrocorax carbo* was observed building a nest although nesting was not successful. In April 2019, inflow of municipal sewage water into the sanctuary was stopped and this reduced the water level of the wetland. These conditions appeared to have been suitable for more than 800 Lesser flamingos that were observed to feed here after a gap of 30 years.

The water at the shallow periphery dried out in Chhaya 1 and 2 which supported roosting birds. Though only 37 Greater Flamingo *Phoenicopterus roseus* were recorded during the January waterbird count, their number was observed to increase up to 500 individuals in Chhaya 1 and Porbandar Rann wetlands after March. One pair of Kentish Plover and two pairs of Little Ringed Plover were recorded nesting in Chhaya 3 wetland in 2016.

The Chhaya wetlands were observed to face various threats, including dumping of solid waste, domestic sewage and garbage. The wetland annually receives a spray of DDT along the periphery to control mosquitoes (Table 1).

Table 2. Wetland bird diversity recorded in Chhaya Rann Wetland Complex during assessment period (with numbers during January 2015 and January 2016).

	English name	Scientific name	Gujarati name	Family	IUCN Conservation status (1)	Status in Study area (2)	AWC January 2015 count	AWC January 2016 count
1	Lesser Whistling-duck	*Dendrocygna javanica* (Horsfield, 1821)	Nani sisoti batak	Anatidae	LC	R	11	10
2	Comb Duck	*Sarkidiornis melanotos* (Pennant, 1769)	Nakto	Anatidae	LC	R	2	4
3	Ruddy Shelduck	*Tadorna ferruginea* (Pallas, 1764)	Bhagvi surkhab	Anatidae	LC	M	4	7
4	Gadwall	*Mareca strepera* (Linnaeus, 1758)	Luhar	Anatidae	LC	M	0	8
5	Eurasian Wigeon	Mareca penelope (Linnaeus, 1758)	Piyasana	Anatidae	LC	M	0	20
6	Indian Spot-billed Duck	*Anas poecilorhyncha* Forster, 1781	Teelavali batak	Anatidae	LC	R	57	40
7	Northern Shoveler	*Spatula clypeata* (Linnaeus, 1758)	Gayno	Anatidae	LC	M	3292	1190
8	Northern Pintail	*Anas acuta* Linnaeus, 1758	Singpar	Anatidae	LC	M	184	12
9	Garganey	*Spatula querquedula* (Linnaeus, 1758)	Chetva	Anatidae	LC	M	0	5
10	Common Teal	*Anas crecca* Linnaeus, 1758	Murghabi	Anatidae	LC	M	157	45
11	Common Pochard	*Aythya ferina* (Linnaeus, 1758)	Rakhodi Karchiya	Anatidae	VU	M	7	14
12	Greater Flamingo	*Phoenicopterus roseus* (Pallas, 1811)	Moto hanj	Phoenicopteridae	LC	R	37	0
13	Lesser Flamingo	*Phoeniconaias minor* (Geoffroy Saint-Hilaire, 1798)	Nano hanj	Phoenicopteridae	NT	R	14649	21621
14	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	Nani dubki	Podicipedidae	LC	R	25	80
15	Osprey	*Pandion haliaetus* (Linnaeus, 1758)	Matsya bhoj	Pandionidae	LC	M	1	0
16	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	Nano Kajoyo	Phalacrocoracidae	LC	R	10	50
17	Indian Cormorant	*Phalacrocorax fuscicollis Stephens, 1826*	Kajiyo	Phalacrocoracidae	LC	R	0	24
18	Great Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	Moto Kajiyo	Phalacrocoracidae	LC	R	0	4
19	Oriental Darter	*Anhinga melanogaster* Pennant, 1769	Sarpa griva	Anhingidae	NT	R	0	2
20	Dalmatian Pelican	*Pelecanus crispus* Bruch, 1832	Chotili Pen	Pelecanidae	NT	M	2	2
21	Grey Heron	*Ardea cinerea* Linnaeus, 1758	Kabut Baglo	Ardeidae	LC	R	2	2
22	Purple Heron	Ardea purpurea Linnaeus, 1766	Nadi baglo	Ardeidae	LC	R	0	1
23	Great Egret	*Ardea alba* (Linnaeus, 1758)	Moto baglo	Ardeidae	LC	R	25	40
24	Intermediate Egret	*Egretta intermedia* (Wagler, 1829)	Dhola bagalo	Ardeidae	LC	R	24	0
25	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	Nano Baglo	Ardeidae	LC	R	18	10
26	Western Reef Heron	*Egretta gularis* (Bosc, 1792)	Dariyai baglo	Ardeidae	LC	R	4	2
27	Eastern/ western Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	Dhor baglo	Ardeidae	LC	R	53	73
28	Indian Pond-heron	*Ardeola grayii* (Sykes, 1832)	Kani bagli	Ardeidae	LC	R	33	24
29	Glossy Ibis	*Plegadis falcinellus* (Linnaeus, 1766)	Pan/nani kakansar	Threskiornithidae	LC	M	21	0
30	Black-headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	Dholi kakansar	Threskiornithidae	NT	RB	65	54

	English name	Scientific name	Gujarati name	Family	IUCN Conservation status (1)	Status in Study area (2)	AWC January 2015 count	AWC January 2016 count
31	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	Kali kakansar	Threskiornithidae	LC	RB	1	23
32	Eurasian Marsh-Harrier	*Circus aeruginosus* (Linnaeus, 1758)	Pan pattai	Accipitridae	LC	M	2	1
33	White-breasted Waterhen	*Amaurornis phoenicurus(Pennant, 1769)*	Davak	Rallidae	LC	RB	8	0
34	Grey-headed Swamphen	*Porphyrio poliocephalus* (Latham, 1801)	Nil jalamurgho	Rallidae	LC	R	4	14
35	Eurasian Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	Jal kukadi	Rallidae	LC	R	5	8
36	Eurasian Coot	*Fulica atra* (Linnaeus, 1758)	Bhagatdu	Rallidae	LC	R	100	200
37	Demoiselle Crane	*Anthropoides virgo* Linnaeus, 1758	Karkaro	Gruidae	LC	M	7	10
38	Common Crane	*Grus grus* (Linnaeus, 1758)	Kunj	Gruidae	LC	M	11	7
39	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	Gajpau	Recurvirostridae	LC	RB	240	312
40	Pied Avocet	*Recurvirostra avosetta* Linnaeus, 1758	Ulti chanch	Recurvirostridae	LC	M	78	0
41	Pacific Golden-plover	*Pluvialis fulva* (Gmelin, 1789)	Soneri batan	Charadriidae	LC	M	2	15
42	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	Titodi	Charadriidae	LC	RB	159	108
43	Kentish Plover	*Charadrius alexandrinus* Linnaeus, 1758	Bhulamani dhongili	Charadriidae	LC	RB	11	0
44	Little Ringed Plover	*Charadrius dubius* Scopoli, 1786	Vilayati jini titodi	Charadriidae	LC	RB	1	21
45	Terek Sandpiper	*Xenus cinereus* (Güldenstädt, 1775)	Chanchal tutvari	Scolopacidae	LC	M	6	0
46	Common Sandpiper	*Actitis hypoleucos* Linnaeus, 1758	Samanya tutvari	Scolopacidae	LC	M	23	9
47	Common Greenshank	*Tringa nebularia* (Gunnerus, 1767)	Lilapag	Scolopacidae	LC	M	6	1
48	Marsh Sandpiper	*Tringa stagnatilis* (Bechstein, 1803)	Gandapag tutvari	Scolopacidae	LC	M	241	11
49	Wood Sandpiper	*Tringa glareola* Linnaeus, 1758	Van tutvari	Scolopacidae	LC	M	1	4
50	Common Redshank	*Tringa totanus* (Linnaeus, 1758)	Ratapag	Scolopacidae	LC	M	11	33
51	Black-tailed Godwit	*Limosa limosa* (Linnaeus, 1758)	Kali punchh gadero	Scolopacidae	NT	M	45	21
52	Ruff	*Calidris pugnax* (Linnaeus, 1758)	Tiliyo	Scolopacidae	LC	M	177	361
53	Little Stint	*Calidris minuta* (Leisler, 1812)	Kalapag kichadiyo	Scolopacidae	LC	M	119	21
54	Red-necked Phalarope	*Phalaropus lobatus* (Linnaeus, 1758)	Laldok chanchal	Scolopacidae	LC	M	1	0
55	Common Snipe	*Gallinago gallinago* (Linnaeus, 1758)	Pankhapunch garkhod	Scolopacidae	LC	M	1	4
56	Black-headed Gull	*Larus ridibundus* Linnaeus, 1766	Kali pith dhomado	Laridae	LC	M	848	1100
57	Brown-headed Gull	*Chroicocephalus brunnicephalus* (Jerdon, 1840)	Ladakhi dhomado	Laridae	LC	M	140	1100
58	Gull sp.	*Larinae sp.*	Dhomado	Laridae	LC	M	13	8000
59	Little Tern	*Sternula albifrons* (Pallas, 1764)	Nani dhomdi	Laridae	LC	M	8	0
60	River Tern	*Sterna aurantia* Gray, 1831	Kenchipunch vabagali	Laridae	NT	R	11	40
61	Whiskered Tern	*Chlidonias hybrida* (Pallas, 1811)	Kashmiri vabagali	Laridae	LC	R	0	21
62	Gull-billed Tern	*Gelochelidon nilotica* (Gmelin, 1789)	Dhomada dhomadi	Laridae	LC	M	2	0

	English name	Scientific name	Gujarati name	Family	IUCN Conservation status (1)	Status in Study area (2)	AWC January 2015 count	AWC January 2016 count
63	Peregrine Falcon	*Falco peregrinus* Tunstall, 1771	Kalo shaheen	Falconidae	LC	M	1	0
64	White-throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Safed chhati kalkaliyo	Alcedinidae	LC	R	0	4
65	Wire-tailed Swallow	*Hirundo smithii* Leach, 1818	Tarpunch tarodiyu	Hirundinidae	LC	R	20	550
66	Red-rumped Swallow	*Cecropis daurica* (Laxmann, 1769)	Kanchipunch tharodiyu	Hirundinidae	LC	R	0	400
67	Western Yellow Wagtail	*Motacilla flava* Linnaeus, 1758	Rakhodi mathano pilakiyo	Motacillidae	LC	M	2	1
68	White-browed Wagtail	*Motacilla maderaspatensis* Gmelin, 1789	Khanjan	Motacillidae	LC	R	0	3
69	Citrine Wagtail	*Motacilla citreola* Pallas, 1776	Pila mathano pilakiyo	Motacillidae	LC	M	5	0
70	White Wagtail	*Motacilla alba* Linnaeus, 1758	Diwali ghodo	Motacillidae	LC	M	1	0

IUCN Red List status: VU—Vulnerable | NT—Near Threatened | LC—Least Concern. Status in study area: R—Resident | M—Migrant | RB—Resident and Breeding.

The main threats to waterbirds were injury from kites being flown around the wetlands, predation by feral dogs, fire crackers, and injury & electrocution when flying into power lines. During the study period, a total of 15 flamingos (Lesser and Greater Flamingo) were injured due to kite-flying in the Uttarayan festival celebrated annually on 14 January. The festival was celebrated with rockets and other fire crackers in the evening causing the birds to take flight and risk injury and electrocution from nearby powerlines or injury by flying directly into blast area of rockets. Feral dogs were regularly observed to feed on injured flamingos. A Dalmatian Pelican was also observed to have died after electrocution on a power line at the Chhaya Wetlands in February 2016.

DISCUSSION

The Chhaya Rann Wetland Complex is a natural-cum-man-made wetland located within Porbandar City. This study provides baseline information on the high diversity of waterbirds and wetland birds recorded during two years. This high diversity can be corroborated with the varied microhabitats that appear to provide ideal foraging and roosting sites for migratory and resident species. Studies elsewhere have demonstrated that shallow depth and heterogeneity of habitats often results in higher diversity and abundance (Velasquez 1992; Elphick & Oring 1998, 2003; Svingen & Anderson 1998; Edwards & Otis 1999; Colwell & Taft 2000; Fairbairn & Dinsmore 2001; Riffel et al. 2001; Isola et al. 2002; Taft et. al. 2002; Darnell & Smith, 2004; Zárate–Ovando et al. 2008; Datta 2011).

The main threats observed at these wetlands are similar to those reported from other wetlands in the Indian subcontinent. For example, siltation, eutrophication, risk of DDT and pesticide intoxication, excessive weed infestation and degradation of water quality, encroachment by agriculture and urbanisation were some the main threats to wetlands and waterbirds of Shallabug Wetland in Kashmir (Dar & Dar 2009). While at Rupa Lake in Pokhara, Nepal, threats of habitat destruction by soil erosion, sedimentation and agricultural conversion, human disturbance, water pollution and eutrophication, as well as trapping/hunting and fish farming using nets are reported (Kafle et. al. 2008).

Similarly, the major threats to some of the main waterbird species at the Chhaya Wetlands are reflective of those at other sites. For example, the main threats to the Lesser Flamingo across its global range are the loss and/or the degradation of its specialised habitat at key sites through altered hydrology and water quality, wetland pollution, collision with man-made structures, human disturbance at non-breeding sites and predation (Childress 2008**)**. The recently produced single species action plan for the Dalmatian Pelican lists habitat degradation and collision with powerlines as high threats to the species (Catsadorakis & Portolou 2018) and both threats are recognised at the Chhaya Wetlands.

These wetlands are formed of a single stretch of a wetland that is now separated by roads. Holistically for


Black-tailed Godwit


Black-winged Stilt


Common Redshank


Common Sandpiper


Common Coot


Dalmatian Pelican


Darter


Demoiselle Crane


Glossy Ibis


Golden Plover


Great Cormorant

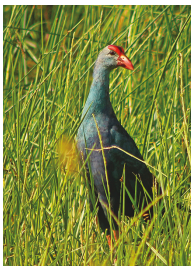

Great Egret


Greater Flamingo


Grey Heron


Lesser Flamingo


Purple Heron


Purple Moorhen


Red-wattled Lapwing


River Tern


Whiskered Tern


White Ibis


Wood Sandpiper

Image 1. Some waterbirds of Chhaya Wetland Complex. © Dhavalkumar Varagiya.

better management, they should be treated as a single wetland complex and not as separate wetlands. The importance of this is borne out by the observations of the flamingos moving between all four wetlands for feeding, bathing and other behavioural aspects.

Rehabilitation and release of Near Threatened Lesser Flamingos and other species injured due to powerlines and kite-flying threads, habitat restoration and removal of encroachment from the wetlands, control of poaching of birds, removal of solid waste, treatment of sewage water before entry into the wetlands, controlling population of feral dogs, removal of invasive species, especially *Prosopis* and Water Hyacinth *Eichhornia crassipes*, and avoiding spraying of DDT are some of the conservation actions that can be taken to preserve and improve management of the Chhaya Wetlands and its biodiversity.

Additionally, from a management point of view, the lack of formal conservation status (such as a protected area) and absence of comprehensive baseline information on waterbirds may deter science-based decision-making of these internationally important wetlands. Additional studies are required to improve understanding of the ecology of these wetlands and factors to maintain and enhance waterbird diversity and abundance.

The Chhaya Rann wetland complex has been influenced by salt and soda ash from the past salt production. In recent years, the main source of water has been domestic sewage and rain water. As it appears that these conditions are still conducive to attract the flamingos and other waterbirds and in internationally important numbers (>20,000 individuals) as per Criterion 5 of the Ramsar Convention on Wetlands, it is important for the state and national authorities to propose formal designation of the area as a Ramsar site. Development and implementation of a comprehensive management plan is needed to conserve this unique suite of wetlands with such high diversity in the face of rapid urbanization of the city.

Additionally, the Chhaya Wetlands qualify as an Important Bird and Biodiversity Area (IBA). According to global IBA criteria (BirdLife International 2018), criterion A1 states "a site is known or thought regularly to hold significant numbers of a globally threatened species" and criterion A4, "the site is known or thought to hold congregations of ≥1% of the global population of one or more species on a regular or predictable basis".

Finally it should be noted that Lesser Flamingos attempted nesting in Chhaya Wetlands in the 1980s, with around 180 nests; unfortunately heavy rain were reported to have destroyed the colony. It was later identified that they may have been "play-nesting". More recently, in 2015, Lesser Flamingos were seen mating here although they did not nest (Vargiya 2015). It is quite possible that if management of the area is strengthened with conditions created that are conducive for nesting, such as the construction of a flat island for the Lesser Flamingo and disturbance from feral dogs and people is stopped, the Chhaya Wetlands could even provide a unique and safe urban breeding site for the species; as has been demonstrated at the Kampers Dam in Kimberley, South Africa (BirdLife International 2019). Breeding of the flamingo here could provide a unique opportunity for the municipal and state authorities to demonstrate management of urban wetlands and environmental protection can go hand in hand.

The beauty and importance of the Chhaya Wetlands and its flamingos has been highlighted to the local community through various activities, notably 'Pink Celebration' that is organised every year since 2015 by the Mokarsagar Wetland Conservation Committee (Vargiya 2018). Organisation of such activities into the future can help to enhance the local awareness, interest and support for the management of the Chhaya Wetlands.

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