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POPULATION COUNTING OF WETLAND BIRDS AT DIFFERENT LOCATIONS IN SAKHYA SAGAR AND MADHAV LAKES IN THE MADHAV NATIONAL PARK, SHIVPURI, M.P., INDIA

Mohit Arya*

Department of Zoology, Govt. K.R.G. P.G. (Auto.) College, Gwalior-474004, M.P., India.

ABSTRACT

The Madhav National Park, Shivpuri provides an excellent habitat for avifauna in the form of two water bodies with marshy plant growth, terrestrial platforms, earth mounds having scattered trees and bushy vegetation. Several migratory birds visit these lakes every year during winter. Keeping in view the conservation value of wetland birds, systematic efforts were made during April 2006 to March 2008 with the objective to have an overview of the species diversity, population count and location preference of wetland birds in this landscape. In Sakhya Sagar Lake during the year 2006-07 a total of 1580 individuals of 73 different species and during the year 2007-08 a total of 1396 individuals of the same 73 species of wetland birds were identified and counted. In Madhav Lake during the year 2006-07 a total of 233 individuals and during the year 2007-08 a total of 172 populations of individuals of all 73 species of wetland birds were counted and the preferable locations of each species were also recorded. Some statistical analysis of data was also done with the help of Shannon Index, Simpson Index and Evenness.

KEY WORDS: Wetland Birds, Population, Sakhya Sagar & Madhav Lakes, Species, Counting

INTRODUCTION

Birds are very important ecological indicators to understand the quality of habitats. The population of birds in any kind of ecosystem shows the environmental quality of area, pollution level, security and availability of food and habitat (Arya *et al.*, 2014a & b). Bird diversity is decreasing due to the destruction of their habitat and anthropogenic pressure (Joshi, 2015). Thus wetlands help in maintaining biodiversity

of flora and fauna (Veeramani *et al.,* 2018). Water birds are an important component of most of wetland environment, as these occupy several tropic levels in the food web of wetland nutrient cycles. In wetland, birds play a significant cultural and social role in local communities as well as being an important component of wetland ecosystem (Furness, 1993; Newman *et al.*, 2007). There are about 242 wetland bird species and 67 wetland dependent and associated bird species among the 1300 species of birds recorded in the Indian subcontinent of which of these 125 are migrants, among which 102 species are winter migrants, 10 are summer migrants and 3 are passage migrants (Grimmett *et al.*, 2006; Kumar *et al.*, 2005).

STUDY AREA

Madhav National Park, Shivpuri one of the most important and protected area of north Madhya Pradesh was selected for the study. The total area of the park is 354.61 sq km. geographically; it lies between 25º 20'- 25º 38' N latitude and 77º 38'-77 º 57' E longitudes at a height of 464 m above the msl. Sakhya Sagar Lake and Madhav Lake located inside the Madhav National Park, Shivpuri. Sakhya Sagar Lake also known as Chandpatha Lake is a large perennial man-made water body it spreads about 309.01 hectares and the Madhav Lake is spread about 49 hectares.

MATERIAL AND METHODS

Bird survey was done using direct count methods which include Point Count method (Bibby *et al.*, 2000). During the survey wetland birds were observed often times with the help of binoculars (Nikon 8×40mm) and sometimes with naked eyes in morning hours at 6:00 to 10:00 am and evening at 4:00 to 7:00 pm. Population counting of wetland birds at different locations in Sakhya Sagar and Madhav Lakes were mark on the basis of using permanent landmark of physical features in both the water bodies. Recorded species of bird were identified by field guide books Ali (1996), Manakadan and Pittie (2001) and Grimmett *et al.,* (2013). During the survey 12 locations in Sakhya Sagar Lake and 3 locations in Madhav Lake were selected for counting of bird species are as follow: Near Bhadaiya Kund- (BK), Landing No.-1 (L-1), Landing No.-2 (L-2), Landing No.-3 (L-3), Landing No.-4 (L-4), Landing No.-5 (L-5), Landing No.-6 (L-6), Landing No.-7 (L-7), Landing No.-8 (L-8), Landing No.-9 (L-9), Landing No.-10 (L-10), Near Saling Club- (SC) were marked in Sakhya Sagar Lake and Near Pump House- (PH), Mound Area in Water- (MAW), Northern bank of Lake- (NB) were marked in Madhav Lake (Fig. 1).

Fig. 1: Map of Sakhya Sagar Lake and Madhav Lake showing different location sites.

RESULTS AND DISCUSSION

Madhav National Park is surrounded by agriculture land of outside villages of nearby areas that provides extra foraging space and food for certain wetland birds and about 25 sq km. of forest spared around the water bodies. Sakhya Sagar Lake is rich in different types of vegetation. On the shore of the Sakhya Sagar Lake which edges the forests with fringing read-weeds and varieties of aquatic vegetation. Seed of Water Lilly, grasses growing in the swamps near various landing areas and other aquatic vegetation in the lake attract the avifauna for food. In Madhav Lake some mound area inside water created island with various trees and bushes meant for resting and different aquatic plants and weeds are provides food for wetland birds.

Birds have their own activity pattern for its daily life. Water birds normally active during early hours and late hours of the day since the sunlight is warmer heavily in the mid day (Veeramani and Usha, 2018). Nearly 250 species of birds are known to be highly dependent on freshwater habitats out of which a large proportion (60%) belongs to a single family Anatidae, which comprises of ducks, geese and swans. Wading birds such as sandpipers (Scolopacidae), plovers (Charadridae), herons and bitterns (Aedeidae) and other diverse assemblage of families are also associated with inland freshwater habitats (Ananthakrishnan and Sivaramakrishnan, 2006). In Sakhya Sagar Lake a total of 1580 individuals among them the maximum number 548 of individual bird recorded at location site L-3, 441 at L-5 and 168 at L-2 respectively, while the minimum number 2 individual recorded at location site L-7 and 8 individuals were observed at L-6 and L- 8 during the year 2006-07 included all 73 species of wetland birds. A total of 1396 individuals among them the highest number 479 of individual bird were recorded at location site L-3, 380 at L-5 and 165 at L-2 respectively, while lowest number of 2 individual bird recorded at location site L-7,

6 at L-6 and 8 individual at L-8, included all 73 species of wetland birds were recorded during the year 2007-08 (Table 1 & 2). Fluctuation of bird population showed at different location during both the years of study period (Fig. 2).

In Madhav Lake during the year 2006-07 a total of 233 individuals and during the year 2007-08 a total of 172 populations of individuals of the same 73 species were recorded from various locations. The maximum number 146 of individual of bird recorded at location site MAW while minimum number 31 of individual of bird recorded at location site NB during 2006-07 while highest number 110 of bird recorded at location site MAW while lowest number 21 of bird recorded at location site NB during 2007-08. Populations of bird recorded vary at different location during both the years of study period (Table 3 and Fig. 3 & 4).

Table- 1: Wetland birds counted at different locations in Sakhya Sagar Lake during 2006-07

S. No.	NAME OF SPECIES	Location sites at Sakhya Sagar Lake												
		BK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	SC	Total
1.	Little Grebe		8			10	12	2						**32**
2.	Great White Pelican				8	4								**12**
3.	Little Cormorant	3	4	1		6	1					2	1	**18**
4.	Great Cormorant			85	118		20							**223**
5.	Indian Shag			32	98		19							**149**
6.	Darter or Snake Bird		1		2	3	1						1	**8**
7.	Indian Pond-Heron	8	6	4			4						3	**25**
8.	Grey Heron	1				1						1	1	**4**
9.	Purple Heron		2				2				1		2	**7**
10.	Little Green Heron	2	1										2	**5**
11.	Night Heron	3			2		2							**7**
12.	Cattle Egret	5	3	2			5	2		2			1	**20**
13.	Large Egret	4		5		3	3						2	**17**
14.	Median Egret	2		3			3						1	**9**
15.	Little Egret	8	5	3			8						4	**28**
16.	Painted Stork				5	4	9						2	**20**
17.	Asian Open bill Stork				3	1	3							**7**

18.	European White Stork				2	1	2							**5**
	White- necked Stork	4				6	3							**13**
20.	Lesser Adjutant Stork				2		2					1		**5**
21.	Black-necked Stork				2	8	6							**16**
22.	Oriental White Ibis				2		3				1			**6**
23.	Black Ibis				2		3				1			**6**
24.	Eurasian Spoonbill				12		18					7		**37**
25.	Grey- leg Goose			10	35		15							**60**
26.	Bar-headed Goose			15	175		95							**285**
27.	Ruddy shell duck		4	4	10		6					2		**26**
28.	Comb-duck				2	8	4							**14**
29.	Lesser Whistling Duck				6		15	4				10		**35**
30.	Large Whistling Duck				8		22					12	6	**48**
31.	Northern-Pintail				4		8							**12**
32.	Gadwall				2	4	2							**8**
33.	Shoveller				4	6	2							**12**
34.	Common Teal				12	4	16							**32**
35.	Red-Crested Pochard				1	3	2							**6**
36.	Ferruginous Pochard				2	2	2							**6**
37.	Common Pochard				2	4	4							**10**

38.	Tufted Pochard				2	4	2							**8**
39.	Mallard				2	6	8							**16**
40.	Eurasian Wigeon				1	2	2							**5**
41.	Garganey				2	2	2							**6**
42.	Cotton teal			4	4	8	12							**28**
43.	Marsh Harrier	1							1					**2**
44.	Osprey	1							1					**2**
45.	Common Crane						2					2		**4**
46.	Sarus Crane						4					2		**6**
47.	White-Breasted Waterhen	6				8					3			**17**
48.	Common Moorhen	3				5								**8**
49.	Purple Moorhen					5	4				2			**11**
50.	Common Coot	9					28				5			**42**
51.	Pheasant-tailed Jacana					4	3			2				**9**
52.	Bronze-Winged Jacana					12	8			4				**24**
53.	Red-wattled Lapwing	6	5				7					2	1	**21**
54.	Golden Plover						2					2	1	**5**
55.	Little ringed plover				1		2							**3**
56.	Spotted Redshank				1		1					1		**3**

57.	Common Redshank	1			1		2				1			**5**
58.	Marsh Sandpiper	2			3		3							**8**
59.	Common Sandpiper	1			2		3				2			**8**
60.	Jack Snipe				1		1							**2**
61.	Little Stint				1		1					1		**3**
62.	Ruff				1		2							**3**
63.	Painted Snipe	3			4		5						2	**14**
64.	Black winged Stilt	11	6				5					6	4	**32**
65.	Stone-Curlew	1					1					1	1	**4**
66.	Indian Courser		1		1							1		**3**
67.	River Turn	1					2					1	1	**5**
68.	Little Turn	1					2					2	1	**6**
69.	Brown headed Gull	1										1	1	**3**
70.	Indian Skimmer						2					2		**4**
71.	Lesser Pied Kingfisher	2					2					4	4	**12**
72.	Small Blue Kingfisher	3										3	2	**8**
73.	White-breasted Kingfisher	2	1				1					2	1	**7**
	Total	**95**	**47**	**168**	**548**	**134**	**441**	**8**	**2**	**8**	**16**	**68**	**45**	**1580**

Table- 2: Wetland birds counted at different locations in Sakhya Sagar Lake during 2007-08

S. No.	NAME OF SPECIES	Location sites at Sakhya Sagar Lake												
		BK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	SC	Total
1.	Little Grebe		10			8	10	2						**30**
2.	Great White Pelican				4	4								**8**
3.	Little Cormorant	3	3	1		5	2					2	1	**17**
4.	Great Cormorant			80	115		26							**221**
5.	Indian Shag			40	100		22							**162**
6.	Darter or Snake Bird		1		2	4	1						1	**9**
7.	Indian Pond-Heron	6	6	4			4						3	**23**
8.	Grey Heron	1				1						1	1	**4**
9.	Purple Heron	2	2				3				1			**8**
10.	Little Green Heron	2	1										1	**4**
11.	Night Heron	2			1		2							**5**
12.	Cattle Egret	4	3	2			3	2		2			2	**18**
13.	Large Egret	4		4		3	4						1	**16**
14.	Median Egret	2		2			3							**7**
15.	Little Egret	9	4	4			8						4	**29**
16.	Painted Stork				4	2	8						2	**16**
17.	Asian Open bill Stork				3	2	2							**7**

18.	European White Stork					1	2							**3**
19.	White- necked Stork	4				5	4							**13**
20.	Lesser Adjutant Stork				2		2					1		**5**
21.	Black-necked Stork				2	4	3							**9**
22.	Oriental White Ibis				3		3				2			**8**
23.	Black Ibis				2		2							**4**
24.	Eurasian Spoonbill				8		20					4		**32**
25.	Grey- leg Goose			4	20		9							**33**
26.	Bar-headed Goose			20	150		81							**251**
27.	Brahminy Shelduck		4	2	8		6					2		**22**
28.	Comb-duck				2	6	2							**10**
29.	Lesser Whistling Duck				4		14	2				8		**28**
30.	Large Whistling Duck				6		18					6	2	**32**
31.	Northern-Pintail				4		4							**8**
32.	Gadwall				1	3	1							**5**
33.	Shoveller				2	4	2							**8**
34.	Common Teal				8	4	6							**18**
35.	Red-Crested Pochard					2	2							**4**
36.	Ferruginous Pochard				2	2								**4**
37.	Common Pochard					2	4							**6**
38.	Tufted Pochard				2	2	2							**6**
39.	Mallard				4	10	6							**20**

40.	Eurasian Wigeon						2							**2**
41.	Garganey				2	2	2							**6**
42.	Cotton teal			2	4	5	10							**21**
43.	Marsh Harrier								1					**1**
44.	Osprey	1							1					**2**
45.	Common Crane						2					2		**4**
46.	Sarus Crane						2					2		**4**
47.	White-Breasted Waterhen	7				10					2			**19**
48.	Common Moorhen	2				4								**6**
49.	Purple Moorhen					6	4				3			**13**
50.	Common Coot	12					20				9			**41**
51.	Pheasant-tailed Jacana					3	2			2				**7**
52.	Bronze-Winged Jacana					10	8			4				**22**
53.	Red-wattled Lapwing	4	4				6					2	2	**18**
54.	Golden Plover						2					1		**3**
55.	Little ringed plover				1		2					1		**4**
56.	Spotted Redshank				1		1					1		**3**
57.	Common Redshank	1			1		1							**3**
58.	Marsh Sandpiper	3			4		3							**10**
59.	Common Sandpiper	1			2		2				2			**7**
60.	Jack Snipe						1							**1**

61.	Little Stint				1		1					1		**3**
62.	Ruff				1		1							**2**
63.	Painted Snipe	2			2		3						1	**8**
64.	Black winged Stilt	8	5				6					5	3	**27**
65.	Stone-Curlew	1					1					2	1	**5**
66.	Indian Courser		2		1							1		**4**
67.	River Turn	1					2							**3**
68.	Little Turn	1					1					1	1	**4**
69.	Brown headed Gull	1										1	1	**3**
70.	Indian Skimmer						1					1		**2**
71.	Lesser Pied Kingfisher	2					2					4	4	**12**
72.	Small Blue Kingfisher	2										2	2	**6**
73.	White-breasted Kingfisher	2	1				1					2	1	**7**
	Total	**90**	**46**	**165**	**479**	**114**	**380**	**6**	**2**	**8**	**19**	**53**	**34**	**1396**

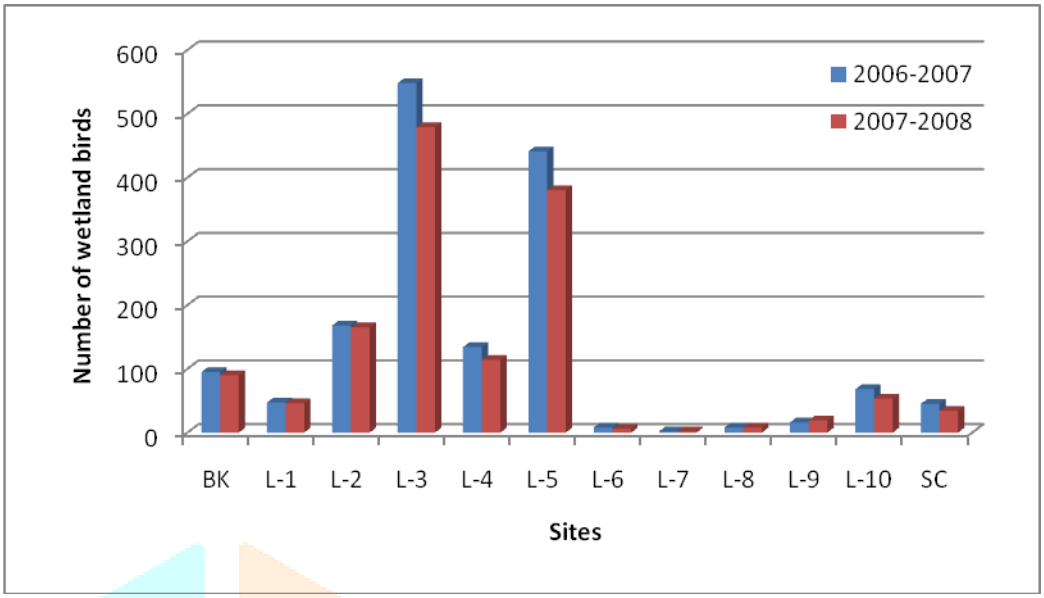

Fig. 2: Fluctuation of bird's population during 2006-07 and 2007-08 in Sakhya Sagar Lake

Table- 3: Population of bird species at different locations in Madhav Lake during 2006-07 and 2007-08

S. No.	NAME OF SPECIES	2006-2007			Total	2007-2008			Total
		PH	MAW	NB		PH	MAW	NB	
1.	Little Grebe		13		13		8		8
2.	Great White Pelican				0				0
3.	Little Cormorant			8	8			5	5
4.	Great Cormorant				0				0
5.	Indian Shag		12		12		8		8
6.	Darter or Snake Bird		2		2		2		2
7.	Indian Pond-Heron	2	2		4	2	1		3
8.	Grey Heron		1		1		1		1
9.	Purple Heron	1	1		2	1	1		2
10.	Little Green Heron		2		2		2		2
11.	Night Heron		3		3		2		2
12.	Cattle Egret	2	3		5	1	2		3
13.	Large Egret		3	2	5		2	2	4
14.	Median Egret		2		2		1		1
15.	Little Egret	4	8		12	2	8		10
16.	Painted Stork		5		5		3		3

17.	Asian Open bill Stork		3		3		4		4
18.	European White Stork				0				0
19.	White- necked Stork		4		4		2		2
20.	Lesser Adjutant Stork				0				0
21.	Black-necked Stork		5		5		3		3
22.	Oriental White Ibis				0				0
23.	Black Ibis				0				0
24.	Eurasian Spoonbill		6		6		4		4
25.	Grey- leg Goose				0				0
26.	Bar-headed Goose				0				0
27.	Ruddy shel duck		4		4		2		2
28.	Comb-duck				0				0
29.	Lesser Whistling Duck		10	2	12		8	1	9
30.	Large Whistling Duck				0				0
31.	Northern-Pintail				0				0
32.	Gadwall				0				0
33.	Shoveller				0				0
34.	Common Teal			6	6			2	2
35.	Red-Crested Pochard				0				0
36.	Ferruginous Pochard				0				0
37.	Common Pochard				0				0
38.	Tufted Pochard				0				0
39.	Mallard				0				0
40.	Eurasian Wigeon				0				0
41.	Garganey				0				0
42.	Cotton teal		10	5	15		7	4	11
43.	Marsh Harrier		1		1		1		1
44.	Osprey		1		1		1		1
45.	Common Crane				0				0
46.	Sarus Crane				0				0
47.	White-Breasted Waterhen		9		9		8		8
48.	Common Moorhen		4		4		4		4
49.	Purple Moorhen		6		6		6		6
50.	Common Coot	4	12		16	4	8		12

51.	Pheasant-tailed Jacana		5		5		5		5
52.	Bronze-Winged Jacana		9		9		6		6
53.	Red-wattled Lapwing	10		3	13	6		3	9
54.	Golden Plover	2			2	2			2
55.	Little ringed plover				0				0
56.	Spotted Redshank	1			1	1			1
57.	Common Redshank	1		1	2	1			1
58.	Marsh Sandpiper	2			2	2			2
59.	Common Sandpiper	1			1	1			1
60.	Jack Snipe				0				0
61.	Little Stint				0				0
62.	Ruff				0				0
63.	Painted Snipe	4			4	2			2
64.	Black winged Stilt	11			11	7			7
65.	Stone-Curlew	1			1	1			1
66.	Indian Courser	2			2	2			2
67.	River Turn				0				0
68.	Little Turn	1		1	2	1		1	2
69.	Brown headed Gull				0				0
70.	Indian Skimmer				0				0
71.	Lesser Pied Kingfisher	4		1	5	3		1	4
72.	Small Blue Kingfisher	2		1	3	1		1	2
73.	White-breasted Kingfisher	1		1	2	1		1	2
	Total	**56**	**146**	**31**	**233**	**41**	**110**	**21**	**172**

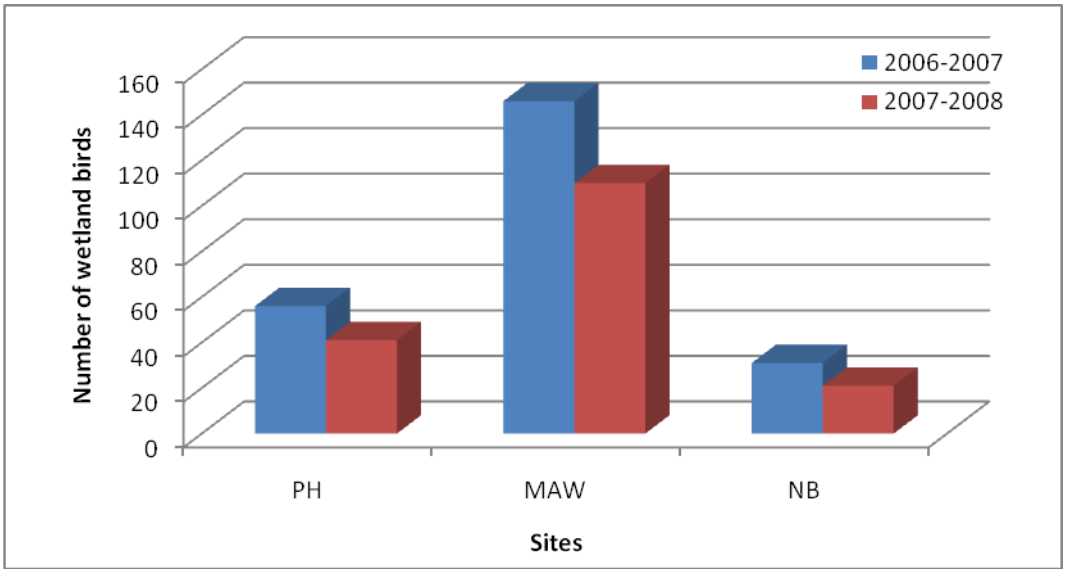

Fig. 3: Fluctuation of bird's population during 2006-07 and 2007-08 in Madhav Lake.

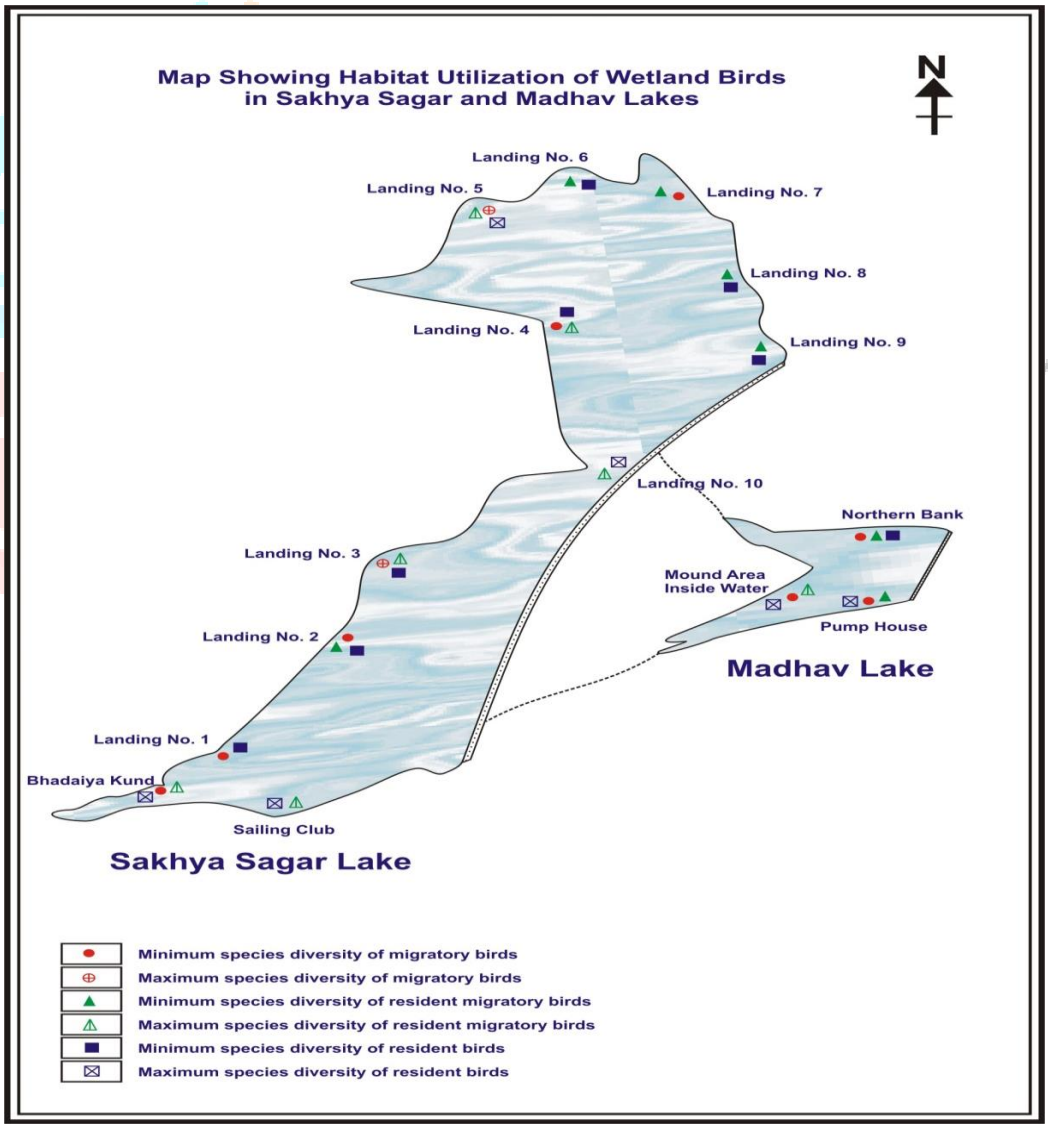

Fig. 4: Map showing locations and habitat utilization by wetland birds at Sakhya Sagar Lake and Madhav Lake.

BIRD SPECIES DIVERSITY

Habitat heterogeneity clearly distinguished in terms of availability of food and habitat resources and landscape features (natural or human-modified) play a crucial role in the avian species composition and population structure (Panda *et al.,* 2021). The variations in the bird species diversity and the species richness were observed according to the location preferred by the individual species. Rathod *et al.,* (2017) studied on variations in the bird density and the species richness according to the seasonal changes of an inland wetland.

During 2006-07 maximum individuals 285 of Bar-Headed Goose, 223 Great Cormorant and 149 Indian Shag were recorded, while only 2 individuals of Marsh Harrier, Osprey and Jack Snipe were recorded at all 12 location sites. Similar observation were also recorded during 2007-08 maximum individuals 251 of Bar-Headed Goose, 221 Great Cormorant and 162 Indian Shag were recorded, while only one individual of Marsh Harrier and Jack Snipe, 2 individuals Eurasian Wigeon, Ospery, Ruff and Indian Skimmer were recorded at all the 12 selected location sites in Sakhya Sagar Lake.

In Madhav Lake 16 individuals of Common Coot and 15 individuals of Cotton teal were noted in all three location sites during 2006-07 and 12 individuals of Common Coot and 11 individuals of Cotton teal were recorded in all three location sites during 2007-08, which were maximum individual count of particular bird species.

Species diversity index fluctuates from 0.064 to 0.113 with higher species diversity was shown at Landing No. 4 and 5 while lower diversity shown at Landing No. 6, 7 and 8 during 2006-07. The species diversity index fluctuates from 0.063 to 0.159 with the highest diversity was shown at Landing No. 4 and 5 while the Landing No. 6 had shown lowest diversity during 2007-08. Apart from the diversity, species evenness fluctuates from 0.019 to 0.047 during 2006-07 and 0.015 to 0.217 during 2007-08. Evenness maximum recorded at Landing No. 7 and minimum at Landing No. 5 during both the study years in Sakhya Sagar Lake.

In Madhav Lake the species diversity fluctuates from 0.065 at mound area to 0.113 at northern bank during 2006-07 and during 2007-08 species diversity fluctuates from 0.064 at mound area to 0.112 at northern bank. The evenness was higher at northern bank of lake and lower at mound area of lake during 2006-07 and 2007-08.

RECOMMENDATIONS

In the Madhav National Park, Sakhya Sagar and Madhav Lakes are winter resort for variety of wetland birds for food, shelter and breeding and provides a suitable habitat for large number of wetland birds. The ecological conditions of area and water quality of lakes also provides safe, protected and undisturbed habitat for wetland birds. However the data of the present paper is old but this study provides a baseline data of wetland birds to know the population status and species richness of wetland bird species in north Madhya Pradesh. This study helps to understand the locations and habitat conditions preferred by

wetland birds in comparison to other protected or unprotected areas in M.P. and other stats of India, which maybe suitable for wetland birds and also help in exploring the possibilities for better management, development and conservation of biodiversity of any specific area.

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