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Temporal pattern of flock size among Aquatic bird species in Thol Lake, Mehsana, Gujarat

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Abstract
Birds are the diverse group of fauna and a vital component of wetland ecosystem. The community structure and temporality of flock size are important life strategy of birds to survive in a particular habitat. Thol Lake is an important wetland system of varied species of birds, thus it was established as Thol Bird Sanctuary in the year 1988, which is located in the central part of Gujarat. The study was conducted to assess the annual pattern of flock size of aquatic bird species found in this sanctuary. The study was carried out on monthly basis to assess the flock size of aquatic birds and their temporal pattern in the sanctuary. A total of 9612 individuals of birds from 55 species and 730 flocks of 40 aquatic bird species were recorded during the study period. The highest frequency was recorded of Oriental Darter (9.74%), followed by Eurasian Spoonbill (8.99%) among the aquatic bird species of the lake. The mean flock size (39.25±11.56) of Common Coot was recorded as largest, followed by Common Crane (38.39±16.95) among all aquatic bird species recorded in this lake. The estimated population and flock size was recorded maximum during winter season and minimum during monsoon season.

Keywords: aquatic bird, flock composition, temporal pattern, Thol lake, Gujarat

Introduction
Birds are one of the integral components of wetland plays vital role in maintaining ecological services and maintaining ecological functions. They are also crucial component of wetlands as well as for recreation and ecotourism (Desgranges *et al*. 2006) [3]. Birds are one of the best ecological indicators and for the environmental health of an area. Assessment of avian community structure is very much important for conservation planning (Khan and Pant 2017) [9]. Wetlands are crucial ecosystem of arid and semi-arid landscape due to the richness of avi-faunal species. Wetlands are also important conservation sites due to the extensive food chain and rich biodiversity they support (Getzner 2002). The habitat type and structural complexity are known to influence avian diversity and composition (MacArthur and MacArthur 1961). The loss of natural habitat and its fragmentation is a major cause of species loss and changes in community structure. Diamond (1976) highlighted the urgent need of ecological studies to develop conservation programme for a habitat which are degrading in faster rate.
The Thol Lake is an important wetland ecosystem of the semi-arid landscape of Gujarat state which supports diverse flora and dependent fauna. The lake is also an ecologically rich site for resident and migratory birds visiting across the globe which attracts large number tourist from various parts of the country (Modi *et al.*, 2013) [11]. The avi-faunal diversity of the Sanctuary was explored by notable authors viz. GEER (2002) [4], Patel and Dharaiya (2008) [15], Jathar and Hathi (2010) [7] and Karia (2012) [8]. The ecology and habitat utilization pattern of piscivorous birds were studies by Pathak (2011) and Shah (2016) [18]. The structure and composition of aquatic bird in various wetlands of arid and semi-arid areas of India has been poorly documented. Understanding the flock composition and its temporal pattern is one of the central questions in bird community ecology. Thus, the present study was carried out to assess the community structure and temporal pattern of avi-fauna of this lake.

Materials and Method
The Thol Lake which was later established as Thol Bird Sanctuary is geographically spread in 6.99 km^2 area which is located in the Mehsana district of Gujarat (Figure 1). The extent of wetland within Gujarat state is about 34,350 sq. km (17.6% of the state's geographical area and 22.9 % of the national wetlands area). The major part of the Thol Bird Sanctuary was covered by Thol lake which was constructed in the year 1918 (Karia 2012) [8]. The lake is fed by the runoff water from nearby agricultural landscape through seasonal water channels. The sanctuary is an important destination of large number of tourist from the state as well as of the country.
The aquatic birds of this lake were surveyed during June 2014 to July 2015 using flock count method (Bibby *et al*. 1992, Steinkamp *et al*. 2003) [2, 19] in monthly basis. To determine the temporal variation in aquatic bird, surveys were conducted in three days in each month covering all diurnal hours (morning, noon and afternoon hours). Each individuals of the flock were counted using 8X40 binocular. The aquatic bird species were identified using various field guides (Ali and Ripley 1983, Grimmett *et al.* 2006) [1, 5]. Counts were done near the pond where all or most of the surface area and edge was visible and least disturbance created. Birds were counted at their point of first detection and particular care was taken to ensure that birds were only counted once. The duration of the survey encompassed the time required to thoroughly scan a pond, identify and count all the bird species present on the

pond. After completion of the point count, the accessible edges of the pond were walked around to detect any unseen birds. For the sake of consistency, it was decided that if an individuals of bird was recorded less than 20 m from its nearest neighbouring individuals of same species, the two individuals were in the same flock. The data on flock size and its temporal variation were analysed using Microsoft Excel.

Results

During the study period, a total of 56 species of aquatic bird of 46 genera belonging to 16 families were recorded from the lake. A total of 9512 individuals of birds were enumerated during the observation period of which 8166 individuals of bird were found in flocks. Out of the total aquatic bird population estimated during the study period, maximum recorded during winter season (52.79%), followed by summer season (24.63%) and minimum during monsoon season (22.58%). A significant difference ($F=8.21$, $p<0.0005$) found in the aquatic bird population between the three season.

Flock Composition

During the whole survey period, a total of 730 flocks of 40 species of aquatic bird were recorded which are mostly of resident bird species naturally found in different size of flocks. Among the recorded birds, highest number of flocks (341) was recorded during winter while lowest number of flocks (86 flocks) was recorded during monsoon season. On analysis of the population composition of birds in the lake, it was found that highest population of aquatic birds were recorded of Oriental darter (795), followed by Eurasian spoonbill, common crane while lowest population recorded of Pheasent-tailed Jacana (6) during the study period (Table 1). Similarly, highest number of flocks was recorded of Oriental Darter (57), followed by Little Egret (51), Knob-billed Duck (38), Black-winged Stilt (38) while lowest number of flocks recorded of Bar-tailed Godwit (3) during the whole study period.

On analysis of the mean flock size of 40 aquatic bird species recorded from the Thol lake it was found that the mean size of flock of Common coot (39.25±11.56) was largest, followed by Common crane (38.39±16.95), Little cormorant (31.29±8.39), Eurasian spoonbill (28.23±7.59) while smallest mean size of flock were recorded of Pheasant-tailed jacana (1.5±0.58) and White-breasted kingfisher (1.31±0.43) among the aquatic bird species (Table 1).

Table 1: Flock Composition of Aquatic birds in Thol Bird Sanctuary

Sl. No	Scientific name	Common name	No. of Flocks Recorded	Individuals recorded	Flock size (Mean ± SD)
1	*Alcedo atthis*	Asian openbill	19	450	23.68±10.04
2	*Halcyon smyrnensis*	Bar-tailed Godwit	3	33	11±2.65
3	*Sarkidiornis melanotos*	Black-headed Ibis	25	369	14.76±7.70
4	*Anser anser*	Black-winged Stilt	38	343	9.02±5.65
5	*Anas poecilorhyncha*	Cattle Egret	31	223	7.19±5.00
6	*Dendrocygna javanica*	Common Coot	8	314	39.25±11.56
7	*Spatula clypeata*	Common Crane	18	709	38.39±16.95
8	*Anhinga melanogaster*	Common Kingfisher	9	18	2±1.50
9	*Bubulcus ibis*	Common Moorhan	10	24	2.4±0.97
10	*Ardea alba*	Dalmatian Pelican	5	88	17.6±3.05
11	*Ardea cinerea*	Eurasian Spoonbill	26	734	28.23±7.59
12	*Ardeola grayii*	Glossy Ibis	11	55	5±3.19
13	*Egretta garzetta*	Graylag Goose	9	108	12±5.43
14	*Ardea purpurea*	Great Egret	12	52	4.33±2.10
15	*Vanellus indicus*	Great White Pelican	14	394	28.14±15.95
16	*Anastomus oscitans*	Greater Flamingo	26	322	12.38±11.74
17	*Mycteria leucocephala*	Green Sandpiper	17	85	5±3.48
18	*Grus grus*	Grey heron	5	20	4±2.12
19	*Antigone antigone*	Indian Cormorant	7	75	10.71±3.20
20	*Hydrophasianus chirurgus*	Indian Pond Heron	21	40	1.9±1.26
21	*Sternula albifrons*	Indian Spot-billed Duck	27	184	16±4.24
22	*Sterna aurantia*	Knob-billed Duck	38	295	7.76±3.31
23	*Chlidonias hybrida*	Lesser Flamingo	7	133	19±9.63
24	*Pelecanus crispus*	Lesser whistling Duck	18	200	11.11±4.56
25	*Pelecanus onocrotalus*	Little Cormorant	17	532	31.29±8.39
26	*Phalacrocorax fuscicollis*	Little Egret	51	323	6.33±5.54
27	*Microcarbo niger*	Little Tern	13	71	5.46±1.20
28	*Phoenicopterus roseus*	Northern Shoveler	8	49	6.12±3.04
29	*Phoeniconaias minor*	Oiented Darter	57	795	13.94±10.64
30	*Fulica atra*	Painted Stork	27	313	11.59±5.37
31	*Gallinula chloropus*	Pheasent-tailed Jacana	4	6	1.5±0.58
32	*Amaurornis phoenicurus*	Purple Heron	29	74	2.55±1.18
33	*Porphyrio porphyrio*	Purple Swamphen	5	12	2.4±1.14
34	*Himantopus himantopus*	Red-naped Ibis	7	19	2.71±0.76
35	*Limosa lapponica*	Red-wattled Lapwing	20	139	6.95±4.10
36	*Tringa ochropus*	River Tern	5	86	17.2±5.26
37	*Threskiornis melanocephalus*	Sarus Crane	36	325	9.03±6.77
38	*Platalea leucorodia*	Whiskered Tern	8	70	8.75±4.03
39	*Plegadis falcinellus*	White-breasted Kingfisher	16	21	1.31±0.43
40	*Pseudibis papillosa*	White-breasted Waterhen	23	63	2.73±2.51

Temporal pattern of aquatic bird community

The analysis of the monthly variation in species richness, population and flock size of aquatic bird species recorded in the lake, it was found that the richness and population of aquatic bird species was highest (41 species) during the late winter months viz February and March while lowest recorded during early summer (19 species) and monsoon months (Table 2). On assessing the annual pattern of the estimated population and flock size of aquatic birds of the lake it was found that the highest population of aquatic birds were recorded during late winter and lowest during summer months (Figure 2). Similarly, the flock size aquatic birds were recorded highest in late winter, followed by monsoon and smallest flock size were recorded during the summer season (Figure 3).

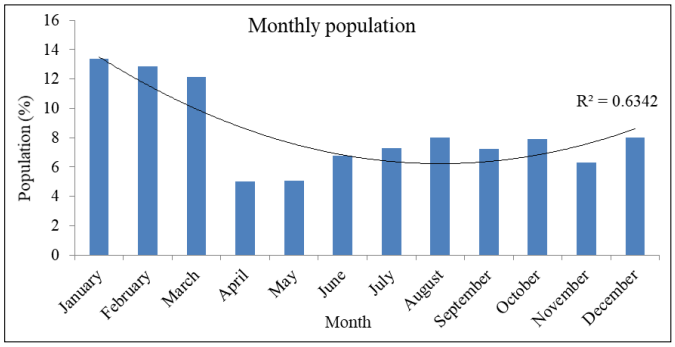

Fig 2: Monthly pattern of aquatic bird population in Thol lake (N=8166)

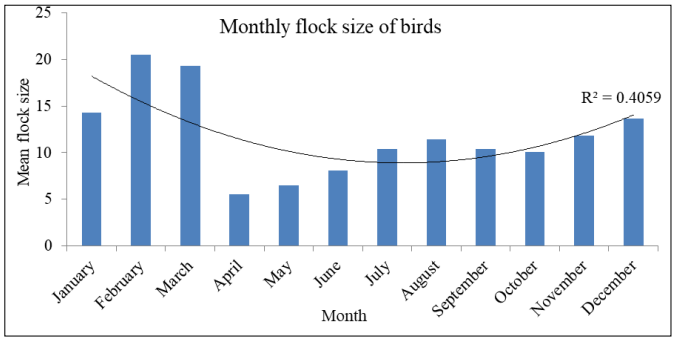

Fig 3: Monthly pattern of flock size of aquatic birds in Thol lake (N=730)

Discussion

Bird population and its community structure are fundamental to assess the habitat and ecological condition. Wetland or aquatic habitats are comparably facing more threats due to anthropogenic development as well as of changing climatic condition over the globe. The study recorded more than 9000 individuals of various aquatic birds during the survey period in the Thol lake. The highest population of aquatic birds were recorded during the winter season was mainly due to the influx of large number of migratory birds in this season. Jathar and Hathi (2010) [7] estimated a population of more than 40000 birds of 14 aquatic birds in the year 2008-2009 in Thol Bird Sanctuary in which the population of Glossy Ibis was alone 20000.

The flock size of various aquatic birds of this study area is not estimated by the earlier workers. Flocking is an important social behaviour and life strategy for birds which increase the foraging competition among individuals but help in scanning of food and escaping from predators by increasing the vigilance of the group due to 'many eyes effect' (Pulliam 1973) [17]. The present study has found significant difference among population and flock size of aquatic birds in between different seasons and months in the Thol lake during the survey. Morse (1970) [13] observed the change in flock size between seasons among mixed deciduous forest habitat. The flock size of birds depends upon the availability of food, size of habitat and seasonality (Morse 1970) [13]. The mean flock size of 20 little egret recorded during summer season in rice field of Camargue, France by Hafner *et al.* (1980) while the mean flock size of 6.33 individuals/flock of Little egret recorded in the present study.

In the present study, the highest population size and flock size of aquatic birds were recorded during the late winter season compared to summer and monsoon. The variation in population and flock size of bird is a vital ecological process to sustain in particular habitat and ecosystem. Pulliam and Caraco (1984) [16] highlighted that variation in flock size increases the habitat profitability of bird. Thol lake is now a famous destination for the large number tourists from various parts of state as well as of the country. A correlation between flock composition and human disturbance was found by Mori *et al.* (2001) [12]. The increasing number of tourist and their activity has also played role in variation of the bird population and its flock size of this lake.

Conclusion

The study observed 55 species of aquatic birds from the Thol Lake during the study period in which 40 species were recorded in various sizes of flocks which are varied in between different months and seasons. Their flock size was found to be varied from the maximum of 39.25 individuals per flock to a minimum of 1.5 individuals per flock among the recorded bird species. The study concluded that the flock size of aquatic bird varied between various months and season. This might be due to change in water level, size of lake, period of migration, availability of food, etc. The increasing number of tourist is also one of the factors for variation in bird population and its flock size between month and season.

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Reference

1. Ali S, Ripley SD. A Pictorial Guide to the birds of the Indian subcontinent. Bombay Natural History Society. Oxford University Press, Bombay, 1983, 165.
2. Bibby CJ, Burgress ND, Hill DA *et al*. Bird Census Techniques, Academic Press, London, 1992.
3. Desgranges J, Ingram J, Drolet B *et al*. Modelling wetland bird response to water level changes in the Lake Ontarioe St. Lawrence River hydrosystem. Environmental Monitoring and Assessment, 2006; 113:329-365.
4. GEER. Ecological study of Thol Lake Wildlife Bird

Sanctuary, GEER Foundation, Indroda Park, Gandhinagar, 2002.
5. Grimmett R, Inskipp C, Inskipp T. Pocket Guide to the birds of the Indian sub-continent. Oxford University Press, New Delhi, 2006, 384.
6. Hafner H, Boy V, Gory G. Feeding methods, flock size and feeding success in the Little Egret *Egretta garzetta* and the Squacco Heron *Ardeola Ralloides* in Camargue, Southern France. Ardea, 1982; 70:45-54.
7. Jathar G, Hathi D. Thol - a bird paradise of Gujarat. BUCEROS. 2010; 14(3):7-10.
8. Karia JP. Floral and Avifaunal Diversity of Thol Lake Wildlife (Bird) Sanctuary of Gujarat State, India. *In Biodiversity Enrichment in a Diverse World*, Edited by Gbolagade Akeem Lameed, 2012, 3-34:508.
9. Khan MS, Pant A. Conservation status, species composition, and distribution of Avian Community in Bhimbandh Wildlife Sanctuary, India. Journal of Asia-Pacific Biodiversity, 2017; 10:20-26.
10. MacArthur RH, MacArthur JW. On bird species diversity. Ecology, 1961; 42:594-598.
11. Modi NR, Mulia NR, Dudani SN. Ecological investigations of Shahwadi Wetland. International Journal of Pharmacy & Life Sciences. 2013; 4(12):3193-3199.
12. Mori Y, Sodhi NS, Kawanishi S, Yamagishi S. The effect of human disturbance and flock composition on the flight distances of waterfowl species. J Ethol 2001; 19:115-119.
13. Morse DH. Ecological Aspects of Some Mixed-Species Foraging Flocks of Birds. Ecological Monographs. 1970; 40(1):119-168.
14. Nirmal Kumar JI, Verma Y, Rita NK. Spatial Analysis of Composition and Species Interactions with Temporal Variation of Zooplankton Community of Shallow Tropical Lake: Thol Bird Sanctuary, India. Universal Journal of Environmental Research and Technology. 2011; 1(2):151-159.
15. Patel S, Dharaiya N. Marsh Bird Community Index of biotic integrity: a key to study an ecological condition of wetland. 558-561 *In* Ed. Sengupta N. and Dalwani, R Proceedings of Taal 2007: The 12th World Lake Conference, 2008.
16. Pulliam HR, Caraco T. Living in groups: Is there an optimal group size? In Behavioural ecology: An evolutionary approach. Edited by J.R. Krebs and N.B. Davies. Blackwell Scientific. Oxford. UK, 1984, 122-147.
17. Pulliam HR. On the advantages of flocking. Journal of Theoretical Biology. 1973; 38(2):419-422.
18. Shah CV. Habitat Utilization by the Piscivorous Birds in Thol Bird Sanctuary. RESEARCH HUB - International Multidisciplinary Research Journal. 2016; 3(9):1-7.
19. Steinkamp MH, Peterjhon V, Bryd Carter H, Lowe R *et al*. Breeding season survey techniques for seabirds and colonial water birds throughout North America. www.i m.nbs.gov/cwb/manual. 2003.