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Flock composition and social behavior in greater flamingo (*Phoenicopterus roseus*) in Haryana

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ABSTRACT

Flamingo is a long-legged colonial bird with white plumage sprinkled with pink plumage. It is a state bird of Gujarat where it is found in colonies of millions along wide tracts of etlands of Rann of Kutchch. It is resident species found throughout wetlands of India. The present study was carried out with the following objectives: To assess the social organization in Greater Flamingo and to analyze various behavioral patterns in Greater flamingo in selected sites of Haryana during the period of September 2019 to October 2021. The Unmanned aerial vehicle (UAV) system i.e., drone was used to study the flock composition of Greater Flamingos. To study the behavior of Greater Flamingo Canon SX60 camera was used to record photographs and videography. In the study it was observed that during first year of the study period (from October, 2019 to September, 2020), 287 individuals comprising 68.9% Adult sightings and 31.01% Sub-adult sightings were recorded. Whereas during second year of the study period (from October, 2020 to September, 2021), 4655 Greater flamingo were comprising of 80% Adult sightings and 20% Sub-adult sightings. Increase in flock composition was observed due to stable habitat conditions and perennial wetlands prevailing in Najafgarh Lake and Basai wetland. Resting, wing-leg stretching, drinking water, bathing, sleeping, alert posture, wing-salute, twist preen, inverted wing-salute, broken neck posture, ritual bickering, threatening and hooking were some of the behaviours observed during the present study. The feeding activity was minimal during early morning hours (30.3%) and gradually peaks as the day progresses and get maximum during evening hours. Whereas, resting activity reached at peak during morning hours. These observations contribute great in the conservation strategies of this nearly threatened species as this provides baseline data in restoring the habitat of the species.

Keywords: Flamingo; Phoenicopteridae; feeding activity; behavioral patterns

1. INTRODUCTION

Flamingo means "Flame-coloured" (Sumathi, 2008), are large wading birds that belong to the Family- Phoenicopteridae and Order- Phoenicopteriformes (Jarvis et al., 2014). Greater Flamingo has strikingly long neck and legs with pink plumage, that make them an astonishing bird. The neck and legs are long in comparison to

body size, with respect to flying birds of other groups (Johnson and Cezilly, 2007). Plumage coloration plays a key role in signaling as more darkly coloured individuals should be selected as mates during group displays. The plumage and feathers were more brightly and intensively coloured before the onset of the breeding season and gets faded soon after a short time (Johnson et al., 1993). India also possesses two species of Flamingos: The Lesser Flamingo (*Phoeniconaias minor*) and the Greater Flamingo (*Phoenicopterusroseus*) (Grimmett et al., 1998). Flamingo is gregarious bird extending from a few to thousands or lakhs miles and their group are termed as 'Pat' (Tere, 2005; Johnson and Cezilly, 2007). They continuously cluster in large feeding flocks or groups during the non-breeding season (Allen, 1956). Flamingos are socially active colonizing birds existing in flocks consistently in large numbers (Johnson and Cezilly, 2007).

The species is facing a number of threat factors that affect the survival and breeding of Greater Flamingos. Low reproductive or breeding success is commonly observed resulting from anthropogenic. (Ogilvie and Ogilvie, 1986, In Haryana, no effort has been made so far to detail ecological studies on Greater Flamingos, to the best of our knowledge. As a part of a detailed ecological study of these species, we made an extensive survey of selected sites of Gurugram, Haryana. The present population status of Flamingos in the Haryana, as well as their preferred habitat, is poorly known. To fill this gap of knowledge, the present study was carried out with the following objectives: To assess the social organization in Greater Flamingo and to analyze various behavioral patterns in Greater flamingo in selected sites of Haryana.

2. STUDY AREA AND METHODOLOGY

The study was conducted in different parts of Haryana State, particularly in the Southern Districts of Haryana, in order to achieve research objectives. Najafgarh Jheel (28.774" N & 76.622" E), also known as Najafgarh Lake or Najafgarh Drain is a part of the dying Sahibi River on the Delhi-Haryana border (Plate 3.1). It is a large inland wetland and tributary of the Yamuna River. The Jheel estimated around 7 km long, extends to villages Kherki-Majra and Dhankot covering an area of 298 acres of district Gurugram, Haryana. Basai wetland (28.478" N & 76.982" E at 216-219 m) named after the village Basai, in Gurugram district, Haryana. The wetland lies close to Basai-Dhankot railway station and about 8 km from the Sultanpur National Park (Plate 3.2). It is a perennial shallow water wetland with an area of 250 acres and is known as one of India's Important Bird and Biodiversity Areas (IBAs), with global conservation significance; as supports population of several endangered, vulnerable and threatened bird species (Islam and Rahmani, 2004). Three villages, namely Basai, Dhanwapur and Dhankot surround this IBA site. This site was identified as an IBA, but is not under any formal protection (Bird Life International, 2015). The study area comprises diverse habitats viz., scrubby forest, aquatic, residential area, agricultural and fallow land.

Methodology

To find out the potential habitat of Greater Flamingos preliminary reconnaissance surveys were carried out. The Unmanned aerial vehicle (UAV) system i.e., drone was used to study the flock composition of Greater Flamingos in large congregations as it is an easy and accurate method measuring the number of birds, occurring in large densely packed flocks. In aerial photographs, each individual was easily recognizable. Apart from counting of Flamingo from captured videos, the developed aerial photographs were projected on to a sheet of white paper. In the present study, the DJI Tello UAV drone (Figure 3.8) in combination with Apple iPhone 11 Mobile devices was used. This Drone is a Quadcopter i.e., having four rotors equipped with a 5MP HD camera with 720p recording and controlled by the Smartphone app (Tello). Also study the behavior of Greater Flamingo Canon SX60 camera was used to record photographs and videography. Various body posture of Greater Flamingo was recorded through Scan sampling and focal sampling method (Altmann, 1974). The focal animal sampling method was used to collect data of diurnally activity. Various egocentric and social behavioural patterns were observed and recorded during the entire study period.

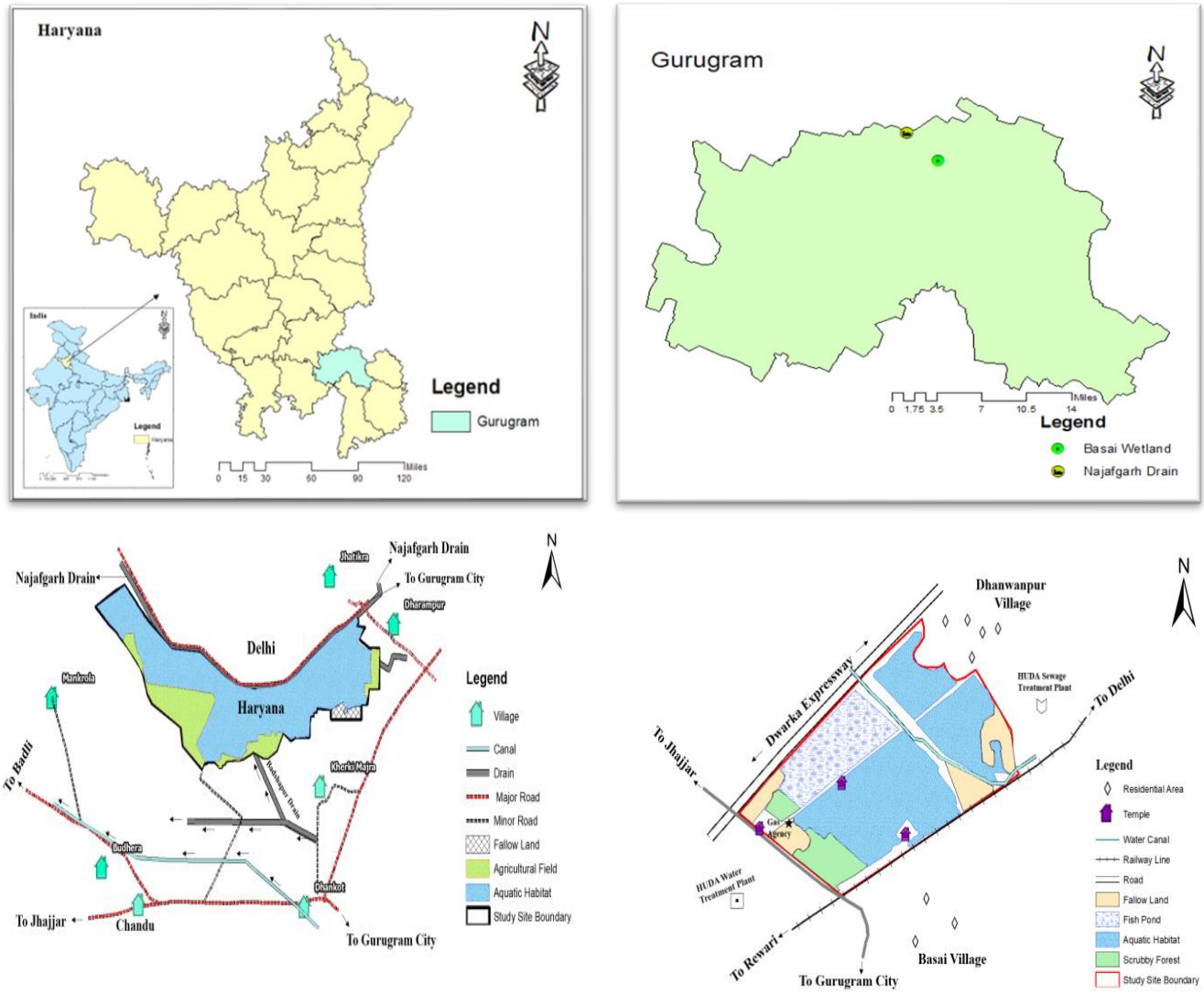

Figure 1 Map of Study Area showing Najafgarh lake and Basai wetland in Haryana.

3. RESULTS

Flock Composition

In each sighting of Greater Flamingo, information about the flock size as well as number of flocks including different age classes were recorded. Flock size composition of Greater Flamingos was recorded (Table 1). Also, two age classes i.e., adult (mature), sub-adult (immature & juvenile) as presented in Table 2. Adults and Immature (sub-adults) can be differentiated from each other according to their plumage characteristics (Plate 1 and plate 2). Field data was pooled corresponding to two seasons i.e., Summer (April-September) and Winter (October-March) to test the seasonal variation of the species in the study area. The flock composition was estimated by dividing the cumulative count for each site by total number of visits in the study area.

Table 1 Greater Flamingos in the various Study sites of Haryana censused from October, 2019 to September, 2021.

Study Site	Study Period	Number of visits	Total flock	Mean Flock Size ±SE
Najafgarh Jheel	2019-2020	9	52	89.51±8.49
	2020-2021	11	54	95.90±8.50
	Overall (2019-2021)	20	106	92.77±5.99
Basai Wetland	2019-2020	9	10	28.7±5.29
	2020-2021	11	2	7.5±5.5
	Overall (2019-2021)	20	12	25.16±5.02

During first year of the study period (from October, 2019 to September, 2020), 287 individuals comprising, 198 (68.9%) Adult sightings and 89 (31.01%) Sub-adult sightings were recorded (Table 2). During second year of the study period (from October, 2020 to September, 2021), out of 15 individuals, 12 (80%) Adult sightings, 3 (20%) Sub-adult sightings were observed. Of recorded 4655 individuals sighting of Greater Flamingo from October, 2019 to September, 2020, 2876 (61.7%) Adult and 1779 (38.2%) Juvenile (sub-adult) individual sightings were observed. Similarly, during the second year (from October, 2020 to September, 2021), a total of 5179 individuals depicting 2900 (55.9%) Adult and 2279 (44.0%) Juvenile (sub-adult) sightings were recorded (Table 2). Number of adult males in all sightings was maximum in winter (2019-20) and number of sub-adults in all sighting was maximum in summer (2021).

Table 2 Age structure of Greater Flamingo in Najafgarh Jheelb d Basai wetland from October, 2019 to September, 2021.

Seasons	Juvenile				Adult				Total	
	Number		%		Number		%			
Winter, 2019-2020 (October to March)	1626	69	38.7	30.8	2570	155	61.2	69.19	4196	224
Summer, 2020 (April to September)	153	20	33.3	31.74	306	43	66.6	68.25	459	63
Annual (2019-2020)	1779	89	38.2	31.01	2876	198	61.7	68.98	4655	287
Winter, 2020-2021 (October to March)	976	3	31.7	23.07	2094	10	68.1	76.92	3074	13
Summer, 2021 (April to September)	1303	0	61.7	00	806	2	38.2	100	2109	2
Annual (2020-2021)	2279	3	44.0	20	2900	12	55.9	80	5179	15
Total (October, 2019-September, 2021)	4058	92	41.2	30.46	5776	210	58.7	69.53	9834	302

Social Behavior

Feeding, resting, preening, wing & leg stretching, drinking water, bathing and sleeping were found to be common self-directed activities. Alert posture, Wing-salute, Twist preen, Inverted wing-salute (Plate 1 & Plate 2) and broken neck posture constituted their signals of social behaviors, which did not involve any direct interaction with other individuals. Whereas, the social behaviors that involved direct interaction with other individuals were Ritual bickering, threatening and hooking.

Table 3 Comparison of mean % of time spent in Behavioral activities by adult Greater Flamingo in Najafgarh Jheel, from October, 2019 to September, 2021 in different time blocks (morning, afternoon and evening)

Time block				Activity			
	Resting	Preening	Feeding	Movement	Aggression	Alert	Wing- salute
Morning	38.86^{A}	14.69^{A}	30.31^{A}	6.55^{A}	2.01^{A}	3.34^{A}	1.31^{A}
Afternoon	24.05^{B}	13.36^{AB}	46.15^{B}	6.35^{A}	2.32^{AB}	3.73^{A}	1.66^{A}
Evening	12.30^{C}	12.68^{B}	59.44^{C}	6.20^{A}	3.73^{B}	3.90^{A}	1.67^{A}
Overall (2019-2021)	25.06	13.58	45.30	6.37	2.49	3.66	1.54

*The mean is not different in columns denoted by the same letter ($P > 0.05$).

It was observed that adult Greater Flamingos spend more time in preening, feeding and resting. The feeding activity was minimal during early morning hours (30.3%) and gradually peaks as the day progresses and get maximum during evening hours. Whereas, resting activity reached at peak during morning hours (38.86%) and gradually decreased as the day progressed and was minimum in the evening (12.30%) (Table 3, Figure 2).

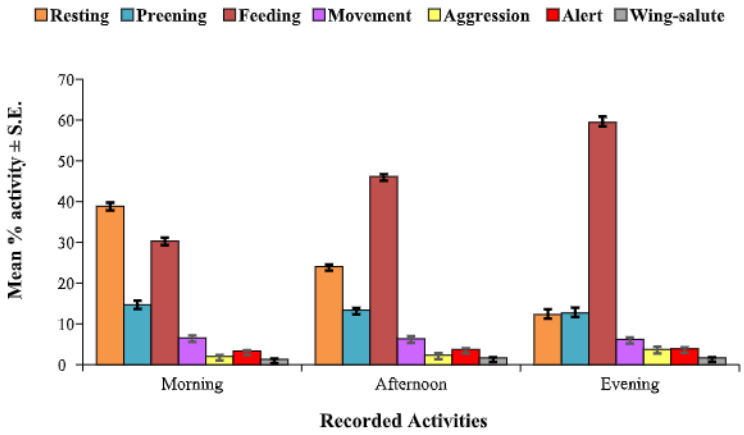

Figure 2 Mean Percent of time spent in different activities by adult Greater Flamingo in different time blocks of the day from October, 2019 to September, 2021

Plate 1 Behavioural Patterns in Greater Flamingo (A) Alert Behavior (B) Flock Formation (C) Dorsal-preen (D) Back-preen (E) Sitting Posture (F) Inverted Wing-salute behavior.

Resting, wing-leg stretching, drinking water, bathing, sleeping, alert posture, wing-salute, twist preen, inverted wing-salute, broken neck posture, ritual bickering, threatening and hooking were some of the behaviours observed during the present study.

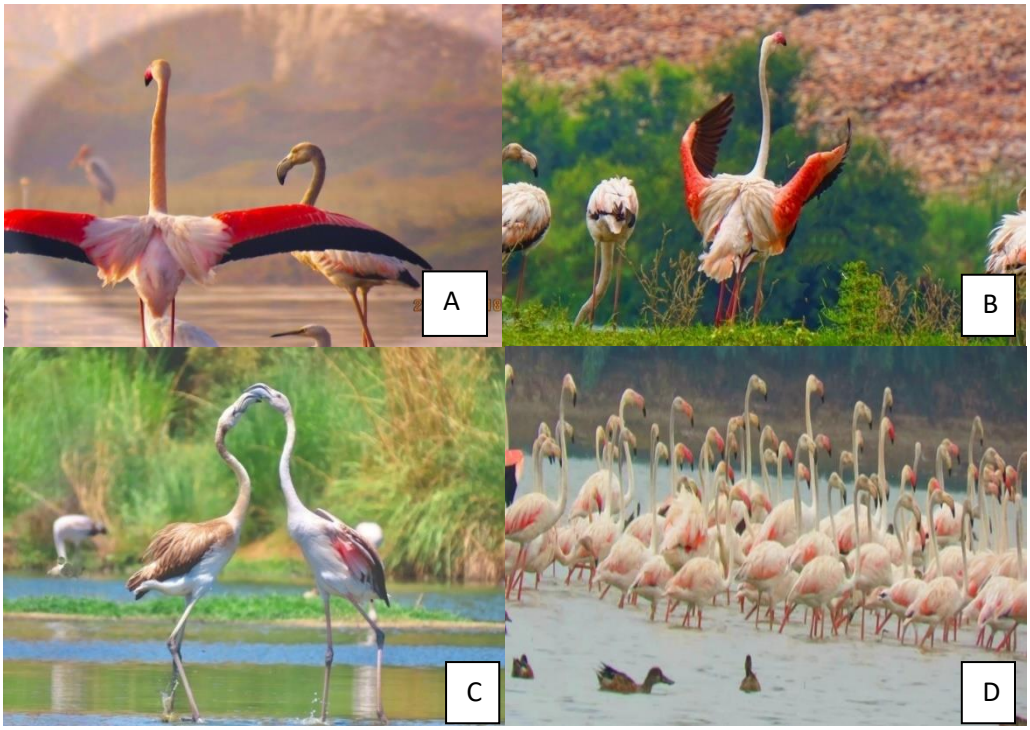

Plate 2 Behavioural Patterns in Greater Flamingo (A) Wing-salute (B) Wing Flapping (C) Combat (D) Marching

4. DISCUSSION

Flamingos display a wide range of behaviour patterns (Arengo and Baldassarre, 1995; Bouchard and Anderson, 2011). Agonistic behaviours are very frequently observed in Flamingos such as stretching the neck and striking or bite at another bird or do some threatening show-offs, specifically waving and neck hooking (Johnson and Cezilly, 2009). Agonistic behaviour (such as Ritual Bickering, threatening show-offs) can be exhibited when the Flamingo is close and on the nest (both in a sitting as well as in a standing posture). Comfort behaviour were also observed like self-grooming *i.e.,* preening (scratching, trimming, cleaning of feather with the help of their bill), outstretching (stretching or pulling out wings and legs) or scraping the neck with one leg in order to clean itself (Brown and King, 2005).

Greater Flamingos thus continually forage in huge groups (Baldassarre et al., 2000); that may reduce predation and increase effectiveness of obtaining prey or eliminating rival species (Bertram, 1978). Social behaviour fulfils their gregarious needs related to survival as a species (Tere, 2005). According to Johnsgard, (1987), Egocentric behavioural pattern includes certain types of individual survival and preservation activities that are different from social interactions such as aggressive, sexual and parental behaviours. These activities are individual-centric activities like eating, defecation, drinking, walking, resting and sleeping; which are self-directed and are essential to lead a healthy life (Johnsgard, 1983). Social behaviour involves communication or interaction between gregarious individuals, which may include direct or indirect contact between two or more individuals (Tere, 2005). At the time of nesting agonistic behavior is very frequently observed in Flamingos which includes type of threatening show-offs, specifically waving and neck hooking (Johnson and Cezilly, 2009). Agonistic behavior can be exhibited when the flamingo is close and, on the nest, (both in a sitting as well as in a standing posture). Comfort behaviour like self-grooming *i.e.,* preening (scratching, trimming, cleaning of feather with the help of their bill), outstretching (stretching or pulling out wings and legs) or scraping the neck with one leg are performed in order to clean itself (StuderTiersch, 1975; Brown and King, 2005).

Najafgarh Jheel supports the maximum population of Greater Flamingo, as its large area and the availability of water is one of the main reasons for their large aggregation throughout the year. The result of present study revealed that due to loss of wetland habitat, majority of the population of the Gurugram district get completely depends on the Najafgarh Jheel, because of vast expanse of shallow water. The ecological suitability of this site in Haryana is due to the large open shallow water area (includes mudflats with shallow and deep water) and absence of the urbanization. The Najafgarh Jheel is a freshwater reservoir that provides a vast

expanse of shallow water and food to sustain Flamingos all year round. Similar behaviours were also observed in Greater flamingo (Tere, 2005) as well as in Lesser Flamingos (Rameshchandra, 2014). The behavioural categories, used by previous investigators were adopted to describe and record the behaviours of Flamingos (Ogilve and Ogilive, 1986; Johnson and Cezilly, 2007). The Greater Flamingos devote a major portion of their diurnal time in activities such as feeding, resting and preening. Feeding was one of the most observed activities in both adults as well as immature during all the times of day and among the months which indicates their efforts of collecting a large amount of small food as they filter feeder (Jenkin, 1957).

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Ethical approval

Phoenicopterus roseus from Haryana, India was observed in the study. The Animal ethical guidelines are followed in the study for species observation & identification.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Allen RP. *The* Flamingos: Their life history and survival, with special reference to the American or West Indian Flamingo *(Phoenicopterus ruber)* (No. 5). Natl Audubon Soc 1956; 285.
2. Anderson K, Gaston KJ. Lightweight unmanned aerial vehicles will revolutionize spatial ecology. Front Ecol Environ 2013; 11(3):138-146.
3. Arengo F, Baldassarre GA. Effects of food density on the behaviour and distribution of non-breeding American Flamingos in Yucatan, Mexico. The Condor 1995; 97(2):325–33 4.
4. Baldassarre GA, Arengo F, Bildstein L. Conservation biology of flamingos. Water birds 2000; 23(Special Publication 1).
5. Bertram BCR. Living in groups: Predators and prey. In: Behavioural ecology, JR Krebs, HB Davies (Eds.). Blackwell Scientific, Englewood Cliffs, NJ 1978; 65–96.
6. Bird Life International. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg 2015.
7. Bouchard LC, Anderson MJ. Caribbean Flamingo resting behavior and the influence of weather variables. J Ornithol 2011; 152(2):307-312.
8. Brown C, King C. Flamingo husbandry guidelines; a joint effort of the AZA and EAZA in cooperation with WWT. Dallas: Dallas Zoo 2005.
9. Brown LH, Urban EK, Newman K. The Birds of Africa. Volume I. Academic Press, London 1982.
10. Forero MG, Tella JL, Hobson KA, Bertellotti M, Blanco G. Conspecific food competition explains variability in colony

size: A test in Magellanic Penguins. Ecol 2002; 83(12):3466-347 5.
11. Grimmett R, Inskipp C, Inskipp T. Birds of the Indian subcontinent 1998; 1-888.
12. Islam MZ, Rahmani A. Important Bird Areas in India: Priority Sites for Conservation. Indian Bird Conservation Network: Bombay Natural History Society and Birdlife Internatonal (UK) 2004; 1133.
13. Jarvis ED, Mirarab S, Aberer AJ, Li B, Houde P, Li C, Ho SYW, Faircloth BC, Nabholz B, Zhang G. Whole-genome analyses resolve early branches in the tree of life of modern birds. Science 2014; 346(6215):1320–1331.
14. Jenkin PM. The filter-feeding and food of flamingoes (*Phoenicopteri*). Philosophical transactions of the Royal Society of London. Biol Sci 1957; 240(674):401–493.
15. Johnsgard PA. Cranes of the World: 2. Individualistic and Social Behaviour. In: Cranes of the World 1983; 20.
16. Johnsgard PA. Diving Birds of North America: Front matter. In: Diving Birds of North America 1987; 2.
17. Johnson A, Cezilly F. The Greater Flamingo. T & AD Poyser, London, UK 2009.
18. Johnson AR, Cezilly F. The Greater Flamingo. T & AD Poyser, London, United Kingdom. 2007; 328.
19. Johnson AR, Cezilly F, Boy V. Plumage development and maturation in the Greater Flamingo *Phoenicopterus ruber roseus*. Ardea 1993; 81(1):25-34.
20. Ogilvie MA, Ogilvie C. Flamingos. Sutton Publishing Ltd, Gloucester, United Kingdom 1986.
21. Rameshchandra VV. Studies on Lesser Flamingo (*Phoeniconaias minor*) with special reference to ecology, threats and conservation management. PhD Thesis. M.S. University of Baroda, Gujarat 2014; 213.
22. Snow DW, Perrins CM. The Birds of the Western Pale arctic. Volume 1: Non-Passerines. Oxford University Press, Oxford 1998.
23. Studer-Thiersch A. Basle Zoo. In: Flamingos. J Kear, N Duplaix-Hall (eds.). T & AD Poyser, Berkhamstead, UK 1975; 120–130.
24. Sumathi T. Factors influencing the water bird populations with special emphasis on the Greater Flamingo *Phoenicopterus ruber roseus* Pallas 1811 in the Eastern part of the great Vedaranyam swamp point Calimere wildlife and bird sanctuary Southern India 2008.
25. Tere A. Ecology of Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo (*Phoenicopterus minor*) on the wetlands of Gujarat. PhD Thesis. The M.S. University of Baroda, Gujarat, 2005; 193.
26. Weimerskirch H, Zimmermann L, Prince P. Influence of environmental variability on breeding effort in a long-lived seabird, the yellow-nosed albatross. Behav Ecol 2001; 12:22-30.
27. Wijesundara CS, Wanniarachchi S, Hettiarachchi T, Galappaththi S, Weerawardhana A, Rajkumar P. Population size and movements of the Greater Flamingo (*Phoenicopterus roseus*) in the Jaffna peninsula, Sri Lanka: Results from a long-term study. Ceylon J Sci 2018; 47(4):373-378.