Chapter 3 Breeding Ecology

Breeding Habitats

From the literature surveyed it was apparent that the breeding season of the flamingos begins from late June to October. The breeding habitats of Lesser Flamingos were chiefly the costal creeks, saline mudflats in the Little Rann of Kachchh and Rann area in the Great Rann of Kachchh. During the study period regular breeding was observed only at Surajbari near the Cherwari Creek where breeding attempts up to the stage of egg laying were recorded successively for three years. The flamingos could not hatch their eggs and information on hatching success, fledging period etc could be not collected in all the three breeding attempts of the species. The Cherwari creek is an intertidal creek area whose mudflats get inundated with every high tide.

Nesting season

The nesting season of the Lesser Flamingos observed during the present study was from mid July to October in different breeding habitats surveyed such as Cherwari creek, Littler Rann of Kachchh, Great Rann of Kachchh. However, species may have bred outside its traditional breeding grounds that are inaccessible (in Great Rann of Kachchh) till November.

2009 Nesting season

A total of 2387 nests of Lesser Flamingos were recorded during the breeding season of 2009. Of these 2387 nests, 263 were nests with eggs (11.1%), These 2387 nests were grouped in to 32 different nest clusters with an average of 74.59 nests per cluster (maximum 240, minimum 10). The nest clusters were spread across an area of about 1.48 Ha (Fig 1, Plate 1 A, B, C).

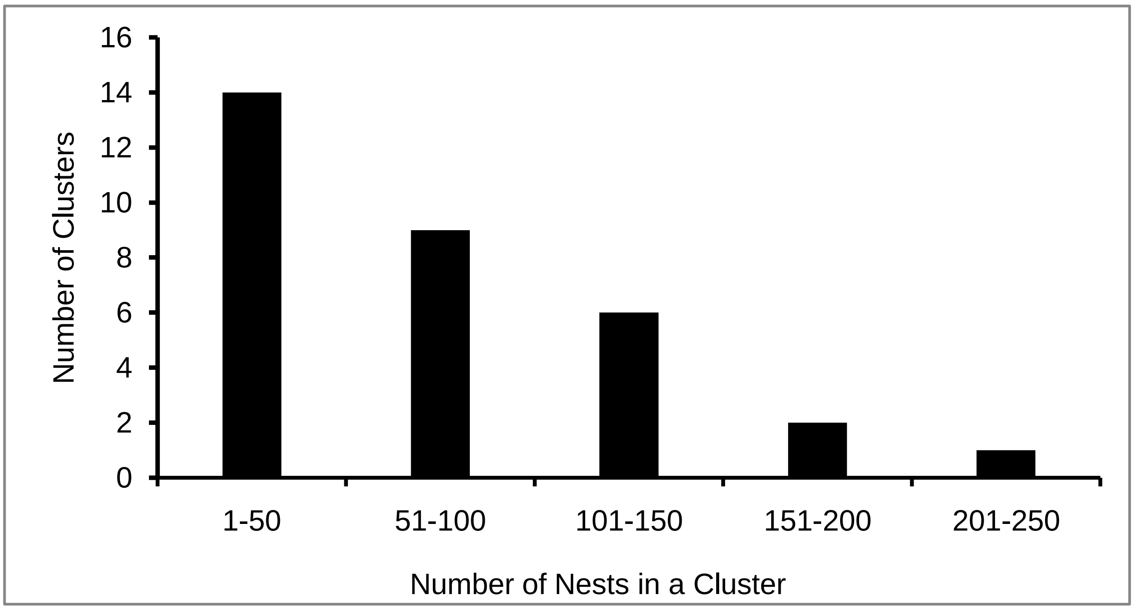


Fig 1: Nest clustering recorded during 2009 nesting season

Flamingos prefer to nest in small colonies. 14 colonies were recorded with clusters with number of nests less than 50, followed by nine clusters with number of nests between 50 and 100 nests. Thus, it appears that, as the number of nests in a colony/cluster increases the number of clusters decreases (Fig. 1).

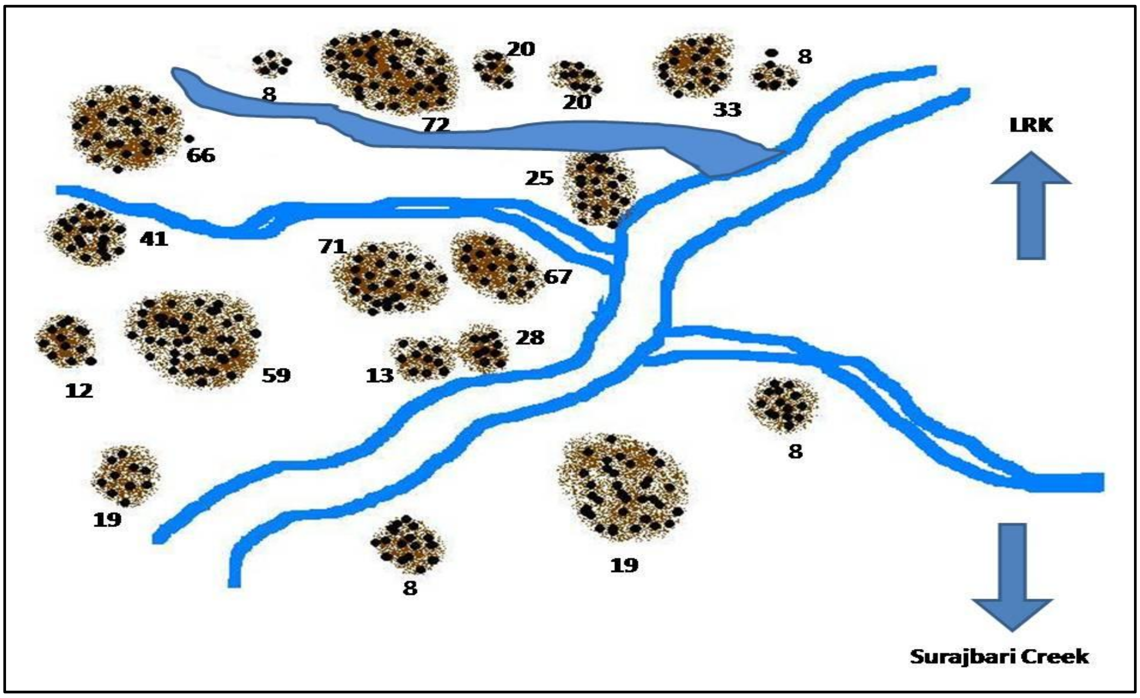


Fig 2: Graphical representation of nesting pattern at Surajbari (2009)

Nest Density

Nest density was calculated as number of nests per square meter. The mean density of the nests was 1.28 ± 0.48 nests per square meter (max 2.1 and min 0.37 for n=15) during the nesting season of 2009 (Table 1).

Table 1: Details of Lesser flamingo nests in 2009 breeding season at Surajbari

Colony	Nests	Length (mtr)	Breadth (mtr)	Area (Sq. mtr)	Density
1	82	10.6	8.7	92.22	0.89
2	16	5.2	2.1	10.92	1.47
3	14	4.4	3.2	14.08	0.99
4	15	3.2	2.9	9.28	1.62
5	46	7.4	4.8	35.52	1.30
6	10	7.3	3.7	27.01	0.37
7	178	18.4	11.8	217.12	0.82
8	35	10.5	3.5	36.75	0.95
9	15	9.3	1.1	10.23	1.47
10	14	3.3	2.5	8.25	1.70
11	36	6.7	4.1	27.47	1.31
12	15	4.5	3	13.5	1.11
13	15	3.6	4.2	15.12	0.99
14	134	7.4	8.8	65.12	2.06
15	135	8.5	7.4	62.9	2.15

2010 Nesting season

Nesting during the 2010 was comparatively much less and only 596 nests, spread across the 16 clusters were recorded. The average cluster size during 2011 was 37.25 nests/cluster, which was almost half the cluster size recorded in 2009 (74.59 nests/cluster in 2009) (Fig. 3) (Plate 2, A, C).

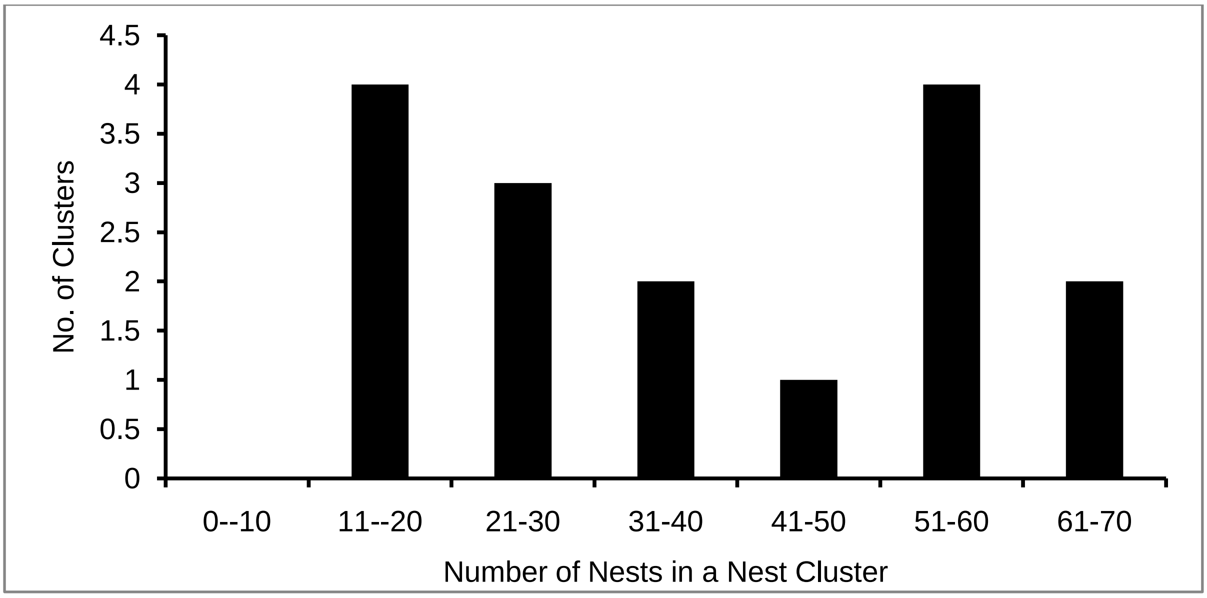


Fig 3: Nest clustering recorded during 2011 nesting season

Nest Density

Nesting during 2010 was not to the extent of 2009 nesting season; only 596 nests were recorded during the nesting season of 2010. Also, the colonies were small and were spread across the area of 0.94 ha only. The mean density of the nests during 2010 nesting season was 1.09 ± 0.39 nests per square meter (max 1.9 and min 0.64 for n=16) (Table 2 & 4).

Table 2: Details of Lesser flamingo nests in 2010 breeding season at Surajbari

Colony	Nests	Length (mtr)	Breadth (mtr)	Area (sq. m)	Density (Nest/sq mtr)
1	57	7.6	8.7	66.12	0.86
2	69	9.3	5.6	52.08	1.32
3	23	5.3	4.1	21.73	1.06
4	18	5.2	4.8	24.96	0.72
5	55	8.8	6.2	54.56	1.01
6	24	7.4	3.4	25.16	0.95
7	15	6.7	3.1	20.77	0.72
8	26	9.3	2.3	21.39	1.22

Colony	Nests	Length (mtr)	Breadth (mtr)	Area (sq. m)	Density (Nest/sq mtr)
9	17	4.2	5.3	22.26	0.76
10	36	2.6	7.3	18.98	1.90
11	55	8.3	6.1	50.63	1.09
12	61	10.2	7.3	74.46	0.82
13	51	6.4	6.2	39.68	1.29
14	35	4.7	3.8	17.86	1.96
15	12	5.8	3.2	18.56	0.65
16	42	7.2	5.5	39.6	1.06

2011 Nesting Season

Nesting during 2011 was larger than 2010 nesting season but was smaller compared to 2009 nesting season. About 1025 nests, spread across the 23 clusters were recorded during the breeding season of 2011. The average cluster size during 2011 was 44.48 nests/cluster, which was significantly smaller than the cluster size recorded in 2009 (74.59 nests/cluster) (Fig. 4) (Plate 2B, 7C).

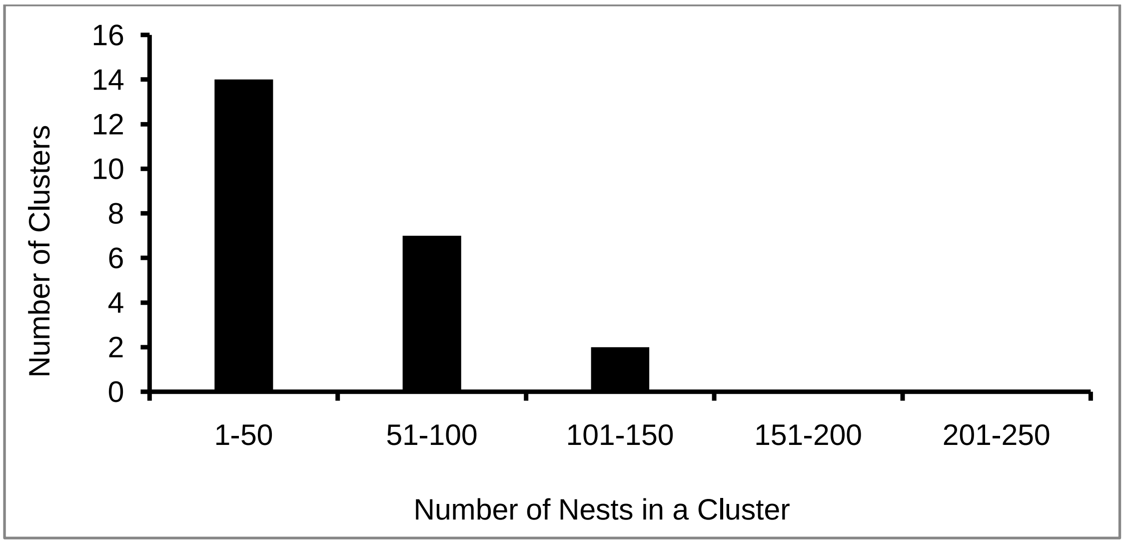


Fig 4: Nest clustering recorded during 2011 nesting season

Nest Density

A total of 1025 nests were recorded during the nesting season of 2011. The colonies were small and were spread across the area of 1.06 ha. The average nest density during 2011 nesting season was 1.13 ± 0.37 nests/sq. mtr. (max 2.07 and min 0.55 for n=14) (Table 3, Table 4)).

Table 3: Nesting area and density recorded during 2011 nesting season

Colony	**Nests**	**Length (mtr)**	**Breadth (mtr)**	**Area (sq. mtr)**	**Density (nests/sq. mtr)**
1	132	15	16	240	0.55
2	142	11.9	10.6	126.14	1.13
3	93	13	7.2	93.6	0.99
4	19	4	4.4	17.6	1.08
5	8	2.1	2.5	5.25	1.52
6	8	3.6	2.6	9.36	0.85
7	66	4.3	7.4	31.82	2.07
8	41	7.4	4.4	32.56	1.26
9	67	8.8	6.6	58.08	1.15
10	25	6.1	4.9	29.89	0.84
11	71	9.2	7.3	67.16	1.06
12	12	4.2	3.6	15.12	0.79
13	13	5.2	1.7	8.84	1.47
14	28	6.3	4.1	25.83	1.08

Table 4: Comparative statement showing nesting details of Lesser Flamingo at Surajbari nesting site

Sr. No.	**Year**	**Total No. of Nests**	**Area (ha)**	**No. of Nest clusters**	**Average No. of nests in a cluster (± SD)**	**Nest Density (nests/sq. mtr) (± SD)**
1	2009	2387	1.48	32	74.6 ± 60.2	1.28 ± 0.48
2	2010	596	0.94	16	37.2 ± 18.7	1.09 ± 0.39
3	2011	1025	1.06	23	44.5 ± 38.6	1.13 ± 0.37

Nest Morphometry

Lesser Flamingos regularly breeds at Cherwari mudflats, several nesting colonies were recorded from 2009-2011, 3.5 km north of Hadkiya Creek into the Little Rann of Kachchh spread across the approximate area of 1.5 Ha.

39 nests in 2009, 21 nests in 2010 and 19 nests in 2011 nesting season were selected randomly and were measured for height, diameter (top and bottom). Moreover, the sediment composition analysis of 5 nests was carried out during 2010 nesting season. Besides this, inter-nest distance, inter colony distance and nest cluster composition (group of joint nests) was studied to know nesting habitat characteristics of the species.

During 2009 breeding season, the mean height of nests was 30.8 cm ± 2.0 cm, in 2010 it was 29.8 cm ± 2.2 cm and in 2011 it was 29.5 cm. Thus, it was established that flamingos were precise in their nest building and were particular about the height of the nests (Plate 7 A,B).

The top and bottom diameter during 2009 nesting season was 25.6 cm ± 1.2 and 42.7 cm ± 1.3 cm respectively whereas in 2010 it was 25.2 ± 1.1 and 41.9 cm ± 1.3 cm (Table 5). During 2011 nesting season, top diameter was 26.5 ± 1.7 cm and bottom diameter was 40.2 cm ± 1.9 cm (table 5). These morphometric features of flamingo nests suggest that Lesser Flamingos are very precise in their nest size and shape (Table 5).

Diameter ratio of Flamingo Nest

A normal flamingo nest is a cylindrical in shape with a cone shaped in appearance wherein the upper part is smaller than the base. The flamingo nests showed a constant ratio between diameters at the bottom to the diameter of the top. The maximum ratio of bottom to top diameter was observed to be 1:1.9. Also, this ratio was very similar in all the three breeding season. The mean ratio observed in all the three breeding season was 1:1.63 cm ± 0.1 (range 1.4 - 1.9 cm, 95% CI (1.61-1.65)) (Table 5) (Plate 3 A, B). A moderately positive correlation was observed between top diameter of the nest versus bottom diameter of the nests (r= 0.50, p=0.02).

Table 5: Nest morphometry at Surajbari Nesting site (2009-11)

Sr. No.	Year	Total No. of Nests (n)	Nest Height (cm)	Nest Diameter-Top (cm)	Nest Diameter-Base (cm)
1	2009	39	30.8 ± 2.03	25.6 ± 1.23	42.7 ± 1.46
2	2010	21	29.8 ± 2.24	25.4 ± 1.2	42.1 ± 1.3
3	2011	19	29.5 ± 1.8	26.5 ± 1.7	40.2 ± 1.9

Inter nest distance (distance between two nearby nests) was measure so as to know the spread of the colony and space used/required by the flamingo during nest building. The mean inter-nest distance in 2009 was 40.8 cm ± 8.3 cm; in 2010 it was 50.3 cm ± 18.6 cm. In 2011, the inter-nest distance was highest and it was 65.7 cm ± 15.5 cm (Table 5).

The average distance between two nesting colonies measured during 2009 nesting season was 19.2 m ± 21.2 m (Range 3.0 mtr – 80.0 mtr, n=11).

Nest site characteristics

Site characteristics strongly influence lesser flamingo nest-building locations in the Surajbari nesting site. The nests are constructed in areas with clayey soils and seepage of water to the surface. In Surajbari creek area, the nests are constructed on the mudflats of creek, on the edges of smaller channels and between small creek water channels. Combination of various substrate characteristics and low water levels probably determine the factors in the utilization of Surajbari creek area by Lesser Flamingos for breeding.

Various habitat parameters were measured at the nesting site at Surajbari during the breeding season. The average values salinity was 33.7% ± 3.4%, soil pH was 7.2 ± 0.8, and DO levels were 8.2 ± 1.8 mg/lit.

Soil Texture Analysis

Soils can be classified based on the particle size distribution and soil texture is the relative proportion of sand silt and clay size particles in a soil sample. As per the United States Department of Agriculture (USDA) silty clay loam contains 50% or more silt, and 12 to 27% clay or 50-80 % silt and less than 12 % clay. During the present study, soil samples from five nests of Lesser Flamingo were collected for soil texture analysis. It was observed that, the nest soil contained an average of 3.6% silt ± 0.18, 1.9% ± 0.22 fine sand and 94.4% ± 0.38 clay. Thus, from the soil texture diagram the soil used for nesting by Lesser Flamingos falls under the texture category of 'Clay' (fig. 5).

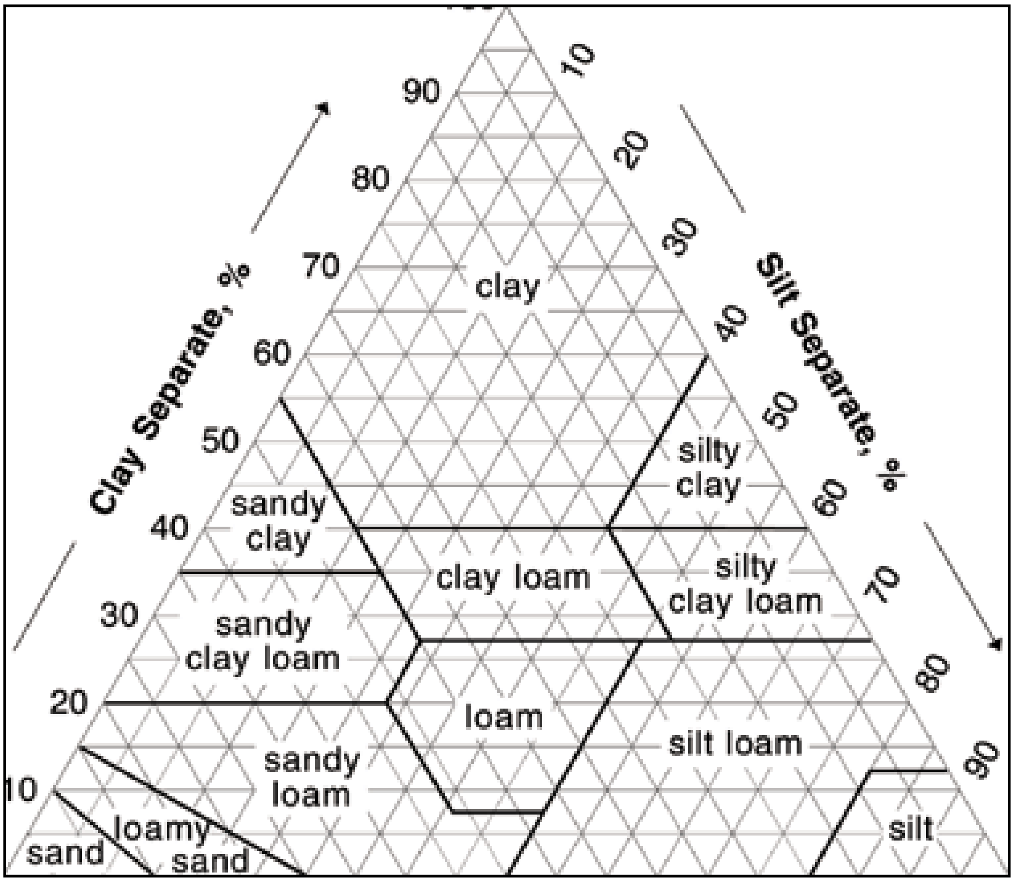


Fig 5: Soil texture diagram based on USDA soil classes

Table 6: Nest soil texture analysis of Surajbari nesting site

Type	Nest 1	Nest 2	Nest 3	Nest 4	Nest 5	Mean ± SD
Sand	3.4	3.87	3.73	3.58	3.51	3.6 ± 0.18
Silt	1.8	2.32	1.95	1.94	1.78	1.9 ± 0.22
Clay	94.8	93.8	94.3	94.5	94.7	94.4 ± 0.38

Egg details and size of egg

During the study both Lesser Flamingo and Greater Flamingo eggs were encountered from both Little Rann of Kachchh and Great Rann of Kachchh during different breeding seasons. Lesser flamingo egg dimensions were measured during breeding season at Surajbari (Plate 4C).

13 eggs were measured for length and breadth at Surajbari nesting site. The average size of flamingo egg was 72.83 mm (3.30 SD) X 49.15 mm (1.95 SD). The largest egg measured was 77.43 mm X 47.23 mm and smallest egg measured was 63.48 mm X 48.9 mm (Fig. 6).

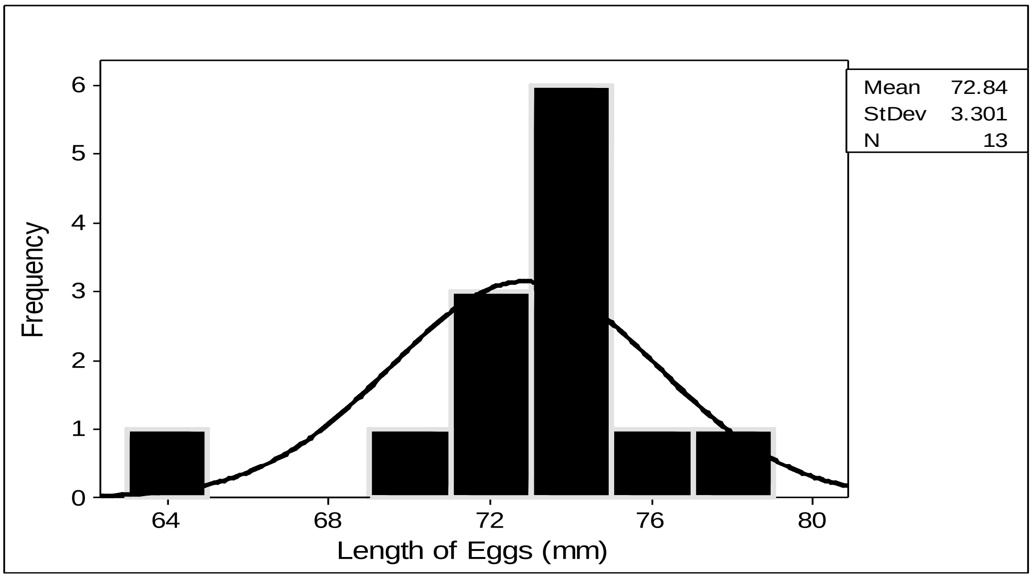


Fig 6: Length of 13 eggs measured at Surajbari Nesting site

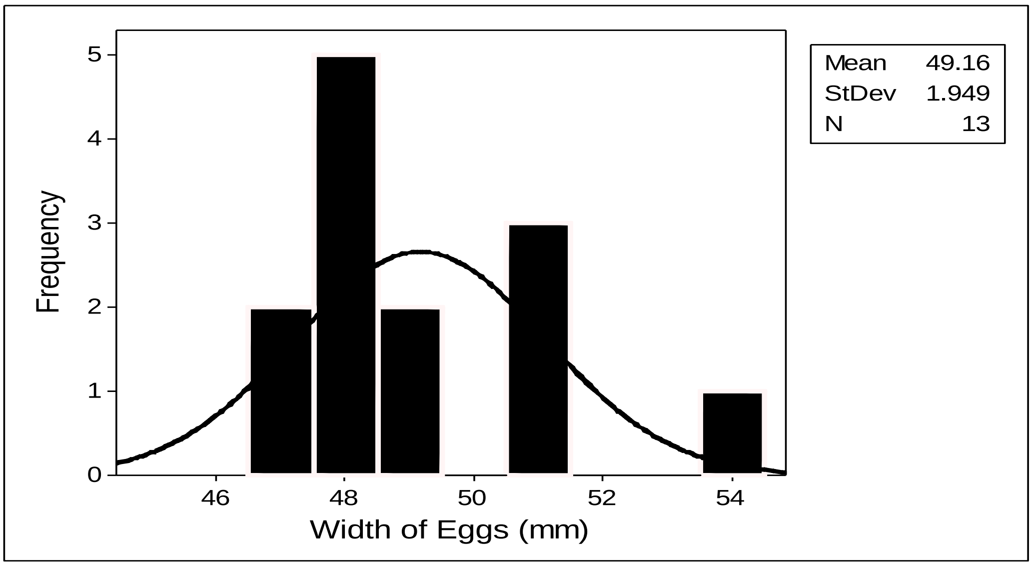


Fig 7: Width of 13 eggs measured at Surajbari Nesting site

Comparing nest density with Greater Flamingos

During the study, the field visits were carried out in Great Rann of Kachchh and Little Rann of Kachchh for nesting surveys. Breeding colonies of Greater Flamingos were also encountered in Great Rann of Kachchh (Flamingo City) during March 2011 and in Little Rann of Kachchh during October 2012. As during both the visits, Greater Flamingos had abandoned the nesting sites, it was possible to measure the nest dimensions to be compared with Lesser Flamingo Nests.

Flamingo City

More than 4000 deserted nests of Flamingos were observed at Flamingo city during March 2011. The nests were spread across the area of about 3.98 hectares. The mean nest height was 11.4 cm ± 1.7 cm. Nest density was comparatively higher at flamingo city than at Surajbari nesting site. The nest density at flamingo city was 1.93 nests/sq mtr ± 0.28 whereas mean nest density at Surajbari nesting site was 1.16 nests/sq. mtr. The reason for higher nest density at flamingo city can be attributed to the large nesting congregation at this site as this has been the traditional breeding site for flamingos. Moreover, the area of the Flamingo city beyt has reduced to half of what was during Salim Ali's visit in 1945 (11.2 hectares). This reduction in area induces flamingos to build their nests in smaller area compared to other sites (Plate 6 A,B,C).

The mean size of 23 eggs measured at Flamingo city was 80.42 mm (7.16 SD) X 55.42 mm ± 2.96, judging by the size, they were all of Greater Flamingos.

DISCUSSION

Lesser Flamingos like the Greater Flamingo do not necessarily breed every year. They breed only when conditions are suitable and optimum water levels are maintained throughout their breeding cycle (Brown and Root, 1971). Lesser Flamingos do not breed even if the climatic conditions or state of the mudflats appear suitable for nesting at certain sites (Brown and Root 1971). During the present study also, the nesting of the species was not recorded at its traditional breeding sites, including the well known Anda beyt or flamingo city (in 2011). The species also congregate in large numbers at Little Rann of Kachchh, but did not engage itself in nesting. In 2004, there were about 3 lakhs flamingos observed by Parasharya and Tere (2003) at Surajbari creek, however on 79,000 were engaged in display and only 296 built nests were found, suggesting the flamingos' sensitivity to prevailing environmental conditions as well as disturbance. Studies carried out in Africa have also reported large flocks and intense display activities at Lake Natron without any subsequent large scale breeding, even when the Lake Natron was suitable for building nests (Brown and Root, 1971).

Water level fluctuations have been found to affect flamingo breeding by wave destruction of nest mounds and lack of access to freshwater and food (Brown, 1973; Cezilly, et. al., 1995; Simmons, 1996). The incidence of Flamingos abandoning the nesting site in Little Rann of Kachchh was also recorded during 2011, where around 3000 abandoned nests with eggs and chicks were recorded during the present study. The colony was deserted as water receded from the nesting area. The cause of such a sudden reduction in water level is mainly due to the damming on rivers draining into Little Rann of Kachchh. Such damming of the rivers poses potential catastrophic consequences on the breeding grounds in LRK (Plate 4 A, B).

Nests of Lesser flamingo are conical in shape with basal diameter being about 1.1to 1.6 times that of the top. Nests are built in clusters ranging from 32 in 2009, 16 in 2010 and 23 in 2011. Number of nests in clusters also varied among different breeding seasons with 10 to 240 in 2009, 12 to 69 in 2010 and 8 to 142 in 2011. The studies carried out by other authors (Tere, 2005) have not reported cluster size at Surajbari nesting site. However, number of nests recorded in a cluster ranged from 2 to 90 nests which is significantly smaller than the cluster size recorded during the present study. Such clustering of nests has also been recorded at Lake Natron (Brown and Root, 1971).

Nest height measured by other authors at Surajbari site was 11.7 cm (min 6.4 cm and max 18.0 cm) (Tere, 2005). The present study recorded the nests with mean height of 30.1 cm (range 29.4 to 30.8) which is high as compared to studies carried out by Tere (2005). Studies carried out in Africa have also recorded 20.3 cm high nests (Brown and Root, 1971) which is slightly smaller than height of nests recorded at Surajbari from 2009 to 2011 nesting season. The basal diameter recorded during the present study was 41.7 cm (range 35.4 to 46.1).The studies carried out at the same site in 2005 (Tere) recorded mean basal diameter of 46.4 cm which is very much comparable to the present study, the basal diameter of the nests measured at African nesting site was 38.1 cm (Brown and Root, 1971), which also falls within the range shown during the present study.

Site characteristics strongly influence Lesser flamingo nest-building locations in the alkaline lakes of Africa (Simmons, 1996). The nests are constructed in areas with clayey soils and seepage of water to the surface. In Lake Nakuru, the nests are constructed around the Springs, near the lake shore drums and between Rivers Makalia and Nderit as the lake recedes (Somerren, 1984). The nest recorded at Surajbari creeks were constructed around small creeks and channels amongst the mudflats (Mundkur 1987, present study). Eggs measured for length and breadth at Surajbari nesting site were 72.83 mm (3.30 SD) X 49.15 mm (1.95 SD). The largest egg measured was 77.43 mm X 47.23 mm and smallest egg measured was 63.48 mm X 48.9 mm. The egg size recorded during nesting season in Africa ranged from 85.5-72.0 X 51.0 - 48.0 mm implying that, there is a minute difference in the egg size between the Asian and African populations

Plate 1

A. Lesser Flamingos nests during 2009 nesting season

B. Nest clusters at Cherwari mudflats in LRK

C. Nests on the edge of creek channels

Plate 2

A. Deserted nests at Cherwari nesting site

B. Abandoned nests with eggs – Cherwari site

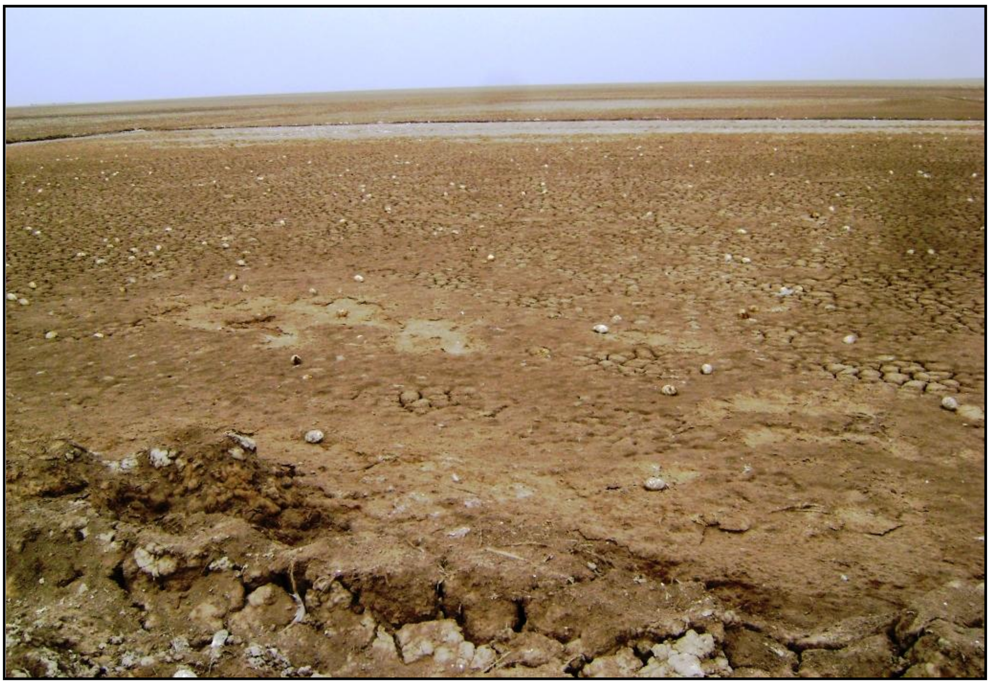
C. Nesting congregation at Cherwari mudflats

Plate 3

A. Abandoned nesting colony in Little Rann of Kachchh (2011)

B. Abandoned nests in saltpans in Little Rann of Kachchh (LRK)

Plate 4



A. Eggs washed away due to flooding in LRK

B. Dead chick near nests

Plate 5

A. Flamingo city in Great Rann of Kachchh (GRK)

B. Nests at Flamingo city in Great Rann of Kachchh

C. Greater Flamingo eggs at Flamingo city

Plate 6

A. A dead Greater Flamingo at Flamingo city (GRK)

B. Flamingo chick buried in salt encrustation (Flamingo city)

C. Abandoned nests and Greater Flamingos feeding in background

Plate 7

A. Old nests of Lesser Flamingo in Little Rann of Kachchh

B. Old nests of Lesser Flamingo near Bela-Mowana

C. A Lesser Flamingo at deserted colony at Cherwari