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RESEARCH ARTICLE

REPRODUCTIVE PARAMETERS OF LITTLE EGRET *EGRETTA GARZETTA* IN HOKERSAR WETLAND AND KASHMIR ARTS EMPORIUM PARK

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ABSTRACT

The study of reproductive parameters of little egret *Egretta garzetta* was carried out during breeding season of 2012 in Hokersar wetland, North- Kashmir and Kashmir arts emporium park Srinagar. Breeding parameters namely nest site, egg laying date, clutch and brood size, egg biometry and breeding success were examined. Breeding was initiated with selection of nesting sites. Nests were bowl shaped of dried willow twigs. Mean egg dimensions were 45.05±1.12mm×34.78 ±1.11mm. Mean egg weight was 27.44±0.93g and clutch size averaged 3.85 ± 0.59. Both sexes incubated the eggs with major role of females and incubation period averaged 23.15±1.21 days. Hatching was asynchronous and hatchlings were nidifugous. Hatching, fledging and nesting success calculated were 62.38%, 57.35% and 58.62% respectively. Main causes of low nesting success were predation, nest abandonment and faulty incubation.

INTRODUCTION

The reproductive biology and success of long-legged wading birds is of considerable interest to wildlife and land ecologists because these species are useful indicators of wetland productivity, trophic structure, human disturbance and contamination of wetland ecosystems (Custer and Osborn 1977). The breeding success in waterbirds changes remarkably depending on the inter and intra-species relationships in the colony, food resources and predator pressure (Frederick and Collopy 1989). Their reproductive parameters may be the most sensitive bio-indicators of their population, community and ecosystem because they reveal primary responses to the environmental changes (Temple and Wiens1989). Therefore, studying and monitoring breeding success can act as a good indicator of the quality of aquatic ecosystems for species dependent on them (Van Eerden *et al*., 1995). Nest site selection influences the reproductive success of wild birds (Buckley and Buckley 1980, Burger 1979). Interaction of colonial birds at their nest sites are well documented for species nesting in trees. The size, structure, shape and orientation of the nest are important in providing shelter against adverse weather, particularly high winds, gales and storms (Kim *et al.*, 1998). Proper nesting habitat provides protection against predators (mammals, humans, birds of prey, etc.), offers adequate stability and materials to construct the nest, and is accessible to abundant feeding areas within the foraging range (Hafner *et al.*, 1987). Further, the nest site also promotes hatching (Ludwig *et al*., 1994) and successful rearing of young individuals, which is important for the survival of the species (Buckley and Buckley, 1980). Birds probably nest in colonies to decrease the probability of nest depredation (Brown 1994). Little work has been done from South - Asian subcontinent on this bird species. So the main aim of present paper is to determine repreductive parameters of little egret, a wading bird of family Ardeidae from data collected during breeding season of 2012 at Hokersar wetland and Kashmir arts emporium park.

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MATERIALS AND METHODS

Study Areas

Hokersar wetland

Hokersar (34°06’ N lat., and 74° 06’ E long) one of the major wetland of Kashmir valley, situated 10 kms to the west of Srinagar on Srinagar- Baramulla highway covering an area of 9.6 sq. km (Fig.1). This wetland is mostly fed by Doodhganga and Sukhnag stream in the west. This wetland is traversed by narrow boat channels about 4 - 10m wide. Typical marsh vegetation complexes inhabit like *Phragmites communis*, *Typha angustata*, *Eleocharis palustris*, *Trapa natans and Nymphoides peltata* etc. The periphery of the wetland is surrounded by willow trees (*Salix sp).* This wetland provides excellent feeding and breeding grounds to a large number of migratory waterfowls in summer.

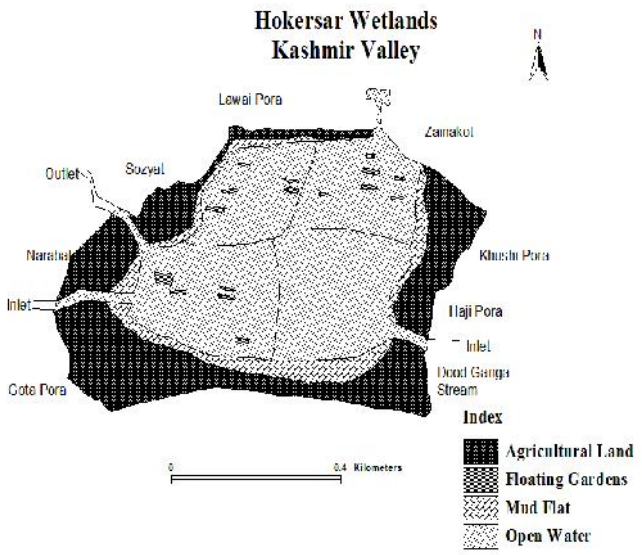

Fig. 1.

Kashmir arts Emporium Park

Kashmir arts emporium located in the heart of Srinagar city on the western side of Abdullah bridge. Situated on the bank of river Jhelum this park has an area of 8000 sq m. Most of the area of the park is dominated by Chinar trees *platanus Orientalis* and Cidrus deodara *Pinaceae*. These trees acts as best nesting and roosting grounds for little egret, cattle egret, night heron, pond heron etc.

Methods of observation

The breeding studies were carried out in two sites viz Hokersar wetland and Kashmir arts Emporium Park only because these sites had willows and long old trees of Chinar respectively which provided preferable nesting sites and acted as heronries. Site1 Hokersar was divided into three compartments. First compartment contained open water and submerged vegetation second had long dense emergent vegetation and third one contained bushy willows that were mostly used by egrets for nesting. Site 2 Kashmir arts emporium was divided into two compartments depending on presence or absence of trees. Compartment first has open area with ornamental flowering plants while second one is occupied by trees. All the trees in the heronry were marked numerically in increasing order by paint. Parameters like, tree species, tree height, girth at chest Height (GCH), species nesting on the tree, number of nests, distance between two nests and nest height were measured. Nest height and tree height were estimated with a measuring tape in cm. The nests of the bird species were identified by observing and identifying the species guarding the nests. The nest design and nest materials were also used to identify the species nest. Nests were detected either from the ground or a boat using 50×70X binoculars. When a nest was found it was marked with small wooden plaque placed below it and following measurements were recorded, outer greater diameter, outer lesser diameter and nest depth. At each nest, the height and position of the nest and its concealing arrangement was also recorded. A nest was defined as successful: if there was at least hatching of one chick in the nest, the presence of eggs with piping hole made by the chick, or by observing the behaviour of incubating bird. During laying season nests were visited thrice a week and newly laid eggs were weighed to the nearest gram. Length and breadth of eggs was calculated with the help of digital callipers and egg mass was taken using electronic balance. Freshly laid eggs were marked with indelible marker pen and were placed in the nest without disturbing the arrangement of other. After laying until hatching eggs were weighed on alternate days to determine weight loss.

In order to observe behaviour of birds and chicks on the nest and in the field Super Zenith binoculars of 50x70 X magnification were used. To avoid disturbance hides were constructed on the adjacent trees to observe behaviour of breeding pair. A rope ladder was used to climb the trees for studying nests. For taking photographs sony still camera with zoom lens of 70mm to 300 mm was used. Egg volume was calculated by using the formulae: $V = K \times L \times B^2$, where L is length, B is breadth and K is constant (0.51) and Egg shape index as B/L×100 respectively (Hoyt, 1979). To determine variation if any in egg dimensions the clutches (3 egg clutches) were divided into three groups, the clutches that were laid from 3 to 29th May were considered as early clutches, the clutches that were laid from 1 to 24th June were considered as intermediate clutches and the clutches that were laid from 1 to 6th July were considered as late clutches. Incubation period was defined as the period since the laying of last egg of clutch until the hatching of first egg (Gill, 1994). Hatching period was calculated from appearance of cracks (due to piping of chicks) to complete emergence of chick. Nesting, hatching and fledging success were defined as the probability that, eggs would hatch, the probability that hatchlings would fledge and the probability that eggs laid would survive from laying to fledging on exposure days (Mayfield, 1961).

Stastistical analysis

For calculating Mean and SD Microsoft excel was used. One way ANOVA followed by post- hoc tuckey's test was used to compare eggs of early, intermediate and late clutches. Independent samples t - test was used to compare the height, diameter, and depth of nests on trees in Hokersar wetland and Kashmir arts emporium park. For all these statistical analysis Spss16 software was used.

Results: 1. Pair formation

The first noticeable activity was observed after 13th April when egrets started aggregating in groups and occupying different trees some of which had already constructed nests of the previous year. Some egrets occupied these nests and started reviving their already established bonds. In majority of cases the new pair bonds were formed. During this activity males displayed their colours and other behavioural clues like various types of body movements like fluffing of body feathers, raising of crown feathers, opening of bill and emission of voices to influence the females. Pair formation was terminated with the bowing of both sexes towards each other followed by mutual preening and bill rubbing.

Territory

Little egrets were found territorial as males established small territories in immediate vicinity of the nest. The territorial size

ranged from 0.75 sq m to 1 sq m and was maintained till the hatchlings fledged.

Nest

(a) Nest site

The nest site was chosen in dense willows and long old chinars whose height varied from 3.5 – 6.3 m with an average of 5.42± 0.95m and from 11 – 15m with an average of 12.6±1.63 m respectively. Density of willows on an average was 11/100m² (range 5-16/100m²) and chinars 5/1000 m². The nests on willows were constructed at 2m-4m height with a distance of 1-2 m apart while as on chinars they were built at 5m- 9 metres height with an average of 6.76 ± 1.58 m. Nests on willows were placed significantly at lower levels than nests build on chinar trees (Table 1).

Table 1. Nest dimensions

Nesting site	No. of nests	Nest depth(cm) Mean± SD	Outer diameter(cm) Mean±SD	Nest height (m) Mean±SD
Willows	21	7.21± 0.75	17.4±1.21	3.02±0.64
Chinars	8	8.73±1.00	25.11± 0.93	6.76 ± 1.58
t		t=3.5	t=11.29	t=6.5
p		P<0.05	P<0.05	P<0.05

(b) Nest building

The first sign of nest building was noticed in the last week of April on willows and Chinar trees. It was initiated by male bird which began construction by forming loose platform of large twigs. Later it was accompanied by the female which mostly arranged the twigs that were collected and carried to the nest site by the male. Both the sexes took part in nest construction and other architectural works, but males did more than females. In most of the cases it was observed that older nests were reconstructed and repaired. It took a pair 7- 9 days to construct new nest and 3-5 days for repairment of old nests.

(c) Nest structure

Little egrets constructed very ordinary and simple nests, comprised of a loose platform of hollow twigs with slight depression which neither looked too strong, nor too good. The material used for nest building were dry and naked twigs. Length of twigs varied from 13.1-14.3 cm with an average of 13.43 ± 0.73 cm. The outer and inner nest diameter varied from 15.3-19.7 and 12.3- 15.2 cm with an average of 17.4±1.21 and 14.04±1.01 cm (N= 21) and depth varied from 6.5- 8.2 cm with a mean of 7.21 ± 0.75 cm (N= 21) on willows. Nest diameter on chinar varied from 23.2- 26.5 and 12.7-15.3 cm (N= 8) with a mean of 25.11± 0.93 and 14.64 ± 0.95cm. Depth varied from 7.7 - 10.2 cm with an average of 8.73±1.00cm. The nests on chinars were significantly larger in outer diameter, height and depth than those on willows and a t – test was used to compare the height, outer diameter and depth (Table 1).

Courtship and Mating

The pair formation displays continued even after the pair bonds were established. Copulation generally took place in the nest and the responsive female generally performed these displays while stepping in the nest. During courtship behaviour the male grasped the bill of the female and pulled her head upward and backward, and both partially spread their wings and tail. Next the male lowered the post back, crossed bill and tail region with many movements of the wings and tail till the cloaca comes in contact with that of the female and courted it two to three times before descending from the back. This mating behaviour lasted for 5-7 minutes.

Egg

(a) Egg laying

Egg laying began after completion of nest. During egg laying the female did not fly much away from the nest and stayed always in vicinity of nests. First egg was laid on 3rd May. A total of 109 eggs were laid out of which 41 were lost. Peak laying was in the month of May when a total number of 64 eggs were laid (Fig 2). Eggs were laid in alternate days. The main predators were found to be Magpies and common crows.

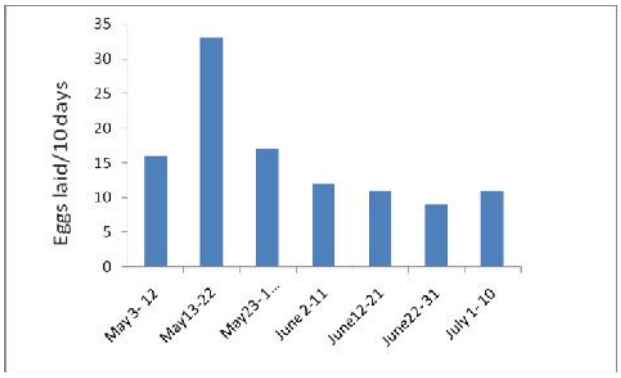

Fig 2. Peak laying

(b) Shape, size,weight and clutch size

Eggs are oval, elongated and greenish – blue in colour fading to an off white without any markings. The average weight of un-incubated eggs was found to be 27.44 ± 0.93 (g) while as the weight of incubated eggs was 20.61 ± 1.90 (g). The average length and width of eggs was found to be 45.05 ± 1.12 mm and 34.78 ± 1.11 mm respectively. Volume and egg shape index calculated was found to be 27.80 ± 1.92 cm³ and 77.27 ± 3.08 respectively. (Table 2).

The clutch size varied from 3- 5 eggs with an average clutch size of 3.85 ± 0.59 (N=29). It was observed that clutch size was positively co-related with nest diameter i.e. as the clutch size increases there was also increase in nest diameter (Fig 3). On comparing the dimensions it was found that length, breadth, volume and shape index of eggs differed significantly between early, inter media telateclutches and statistically significant differences were observed (Length: F30=125.1,

P<0.005;Breadth:F30=93.16,P<0.005;Volume:F30=151.3,P<0.005; shape index: F30= 0.91, P< 0.005) Table 3.

Table 2. Egg Dimensions

Egg parameter	Minimum value	Maximum value	Mean ± SD	N
Length mm	43.1	46.9	45.05±1.12	60
Breadth mm	32.2	36.9	34.78 ±1.11	60
Weight g(un incubated)	25.2	29.8	27.44±0.93	60
Weight g(incubated)	17.89	21.75	20.61± 1.90	60
Egg volume cm^3	23.8	29.4	27.80±1.92	60
Egg shape index	73.2	84.8	77.27±3.08	60

Table 3. Egg dimensions of Early, intermediate and late clutches

	Length (mm)	Breadth (mm)	Vol. (cm^3)	Shape index (SI)
Early(n=30)	45.35±0.87 a	34.88±0.99 a	28.12±1.59 a	76.86±3.03 a
Intermediate (n=30)	44.91±0.99 a	34.67±1.00 a	27.51 ±1.96 a	76.19±3.16 a
Late (n=30)	41.56 ±1.07 b	31.77±0.95 b	21.53±1.14 b	74.94 ±3.12 b
P	P < 0.005	P <0.005	P <0.005	P <0.005
F	F= 125.1	F= 93.16	F= 151.3	F= 0.91

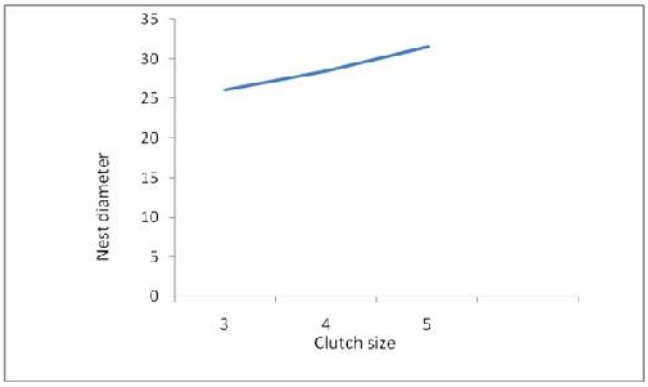

Fig 3. Relationship between clutch size and nest diameter

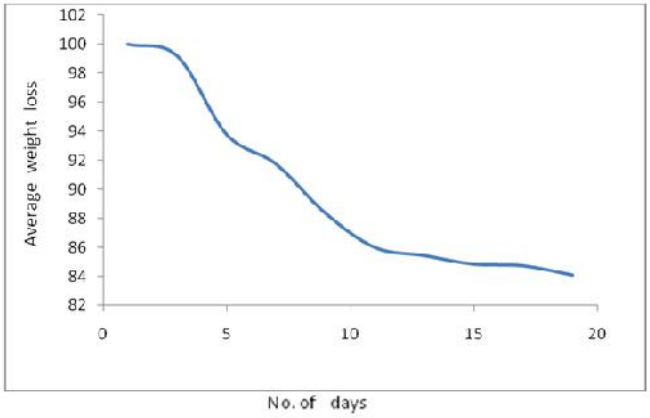

Fig. 4. Average weight loss

Incubation

Incubation usually started with the laying of first egg. Both the mates incubated the eggs but females incubated for longer time. The duration the bird spent on incubating the eggs varied from a minimum of 45 minutes to a maximum of 240 minutes. The incubation period varied from 21- 25 days with an average of 23.15±1.21 days (N=13). During incubation the eggs lost their weight and on an average the eggs lost 18.67% of their original weight (Fig. 4).

Hatching, fledging and nesting success

Eggs hatched asynchronously thus confirming the fact that incubation started with the laying of first egg. The duration of hatching from development of cracks to complete emergence from the shell varied from 1-2 days. In all 29 nests containing 109 eggs were studied during the course of investigation. Overall hatching success when calculated traditionally was 62.38% (Table 4) but when calculated on the basis of exposure days it was only 53% (Table 7). Low hatching success was mainly due to predation and faulty incubation. 19.26 % of eggs

Table 4. Hatching success in relation to month of laying

Month	No. of eggs	Eggs lost through predation		Faulty incubation		Hatching	
		No	%	No	%	No	%
May	64	11	17.18	11	17.18	42	65.62
June	34	7	20.58	8	23.52	19	55.88
July	11	3	27.27	1	9.09	7	63.63
Total	109	21	19.26	20	18.34	68	62.38

Table 5. Fledging success

Month	No of chicks	Chick lost by predation		Chick lost by human disturbance		Fledging	
		No	%	No	%	No	%
June	27	8	29.62	5	18.51	14	51.85
July	41	11	26.82	5	12.19	25	60.97
Total	68	19	27.94	10	14.70	39	57.35

Table 6. Nesting success

Month	No of nests	Successful nests		Abandoned nests		Predated nests	
		No	%	No	%	No	%
May	17	11	64.7	2	11.76	4	23.52
June	9	5	55.55	1	11.11	3	33.33
July	3	1	33.33	1	0	2	33.33
Total	29	17	58.62	3	10.34	9	31

Table 7. Mayfield survival probability for different stages of little egret

	Exposure days	No. of eggs/ nestlings/nests	No. of eggs/ nestlings/ nests failed	Daily survival	Success rate
Hatching	1499	109	41	0.97	0.53
Nesting	776.5	29	12	0.98	0.52
Fledging	1132	68	29	0.97	0.51

were lost due to predation and 18.34% due to faulty incubation. Magpies *Pica pica* and common crows *Corvus splendens* were found common predators.

Out of 68 successfully hatched chicks in 17 nests, all did not fledged successfully. 29 chicks were lost resulting in fledging success of 57.35% (Table 5) when calculated by traditional method but on the basis of exposure days there was fledging success of 51% (Table 7). Most of the chicks were lost due to predation by common crow *Corvus splenden*s and magpies *Pica pica* (27.94%). In addition human disturbance was also responsible for chick loss (14.70%). Last-hatched chicks usually starved, being unable to compete for food with older siblings, or were expelled from the nest. On falling on the ground they either died or were preyed. Out of 29 nests observed 12 failed. Total nesting success of 58.62% was calculated by traditional method of Mayfield while it was 52% on the basis of exposure days (Table 7).The major causes of nest failure were predation (31%) and abandonment of nests by the female (10.34%) which resulted in total of 58.62% nesting success (Table 6). There was an overall breeding success of 35.77%. Low breeding success was due to heavy predation.

DISCUSSION

The process of breeding is an excellent expression of co-relations of various activities and adaptations evolved as a result of physiological and anatomical changes that lead to production of future generations. In most of the birds the entire breeding cycle is completed once in a year, but in some two or three broods may be raised as in case of *Turdus marula* - (Mayer, Gross and Perrins, 1962), *Ixobrychus minitus payesii* - Langley1983). Morel 1964 has reported that *Estrildine lagonosticta sengela* raised four successive broods in about 9 months by west Africa. During present study on little egret, a single breeding season extending from late April to early July has been noted at Hokersar wetland and Kashmir arts emporium park during which only one brood was raised. Ashoori (2010) also reported a single breeding season for little egret but from March to May. Fazili and Raheela (2013) also reported a single breeding season from April to August in night heron. The delay in the onset of breeding season during present studies may be due to low temperature and incliment weather conditions. The first noticeable activity of little egrets at the study site observed in the 2nd week of March was change in the colour of males and other behavioural patterns displayed to females for pair formation and courtship. The gradual and seasonal colour changes in the bill and soft parts have been well documented in different bird species including herons. (Blaker, 1969; Meiklejohn, 1952; Milstein *et al.,* 1970; Ruttledge, 1949; Tomlinson, 1976; Tucker, 1949). The pair formation terminated with the bowing of both sexes towards each other followed by mutual preening and bill rubbing which seemed to be in accordance with the findings of Allen (1961). Little egrets were territorial to some extent during nesting. A male was seen not allowing other males to begin nesting until his female had completed her clutch. Territories in the present study were small 0.75 - 1sq m. Burger (1979) has also reported that little egrets are territorial with size ranging from 0.75-0.95 m. Small territories in egrets were also reported by Palmer (1962).

The water birds restore to a great variety of nesting sites, the herons use large trees and make artificial platforms of twigs Yocum (1952). Nesting site was so chosen during present study that it provided sufficient cover and concealment to the bird and its clutch, with little exposure to direct sunlight and aerial predators. Nests were build on willows and chinar trees during present study. Different workers have reported that egrets make use of different trees for nesting: Ashoori (2010) has reported that nests were build on Alder twigs. Hilalluddin (2006) has reported that nests were build on wide variety of trees as *Ficus* spp., followed by *Dalbergia sissoo*, *Mangifera indica*, *Azadirachta indica* and *Eucalyptus* spp. The time taken in the completion of nest varied from 7- 9 days for a pair. So far as the elaborateness of nest was concerned, the little egrets were fast workers and build nest within short duration of time as compared to Black- billed Magpies which constructed nests in 40 days (Erpino, 1960). Both sexes took part in nest construction. They constructed very ordinary and simple nest comprising of loose platform of hollow twigs with slight depression which neither looked too strong, nor too good. Ashoori (2010) and Hilalluddin (2006) have also reported that both the sexes took part in nest construction but males begin construction by forming loose platforms of large twigs. During present study it was noticed that most of the older nests were reconstructed and repaired. These observations seem to be in accordance with the findings of Zaffar (2007) and Frederick (1997) who also reported repairmen and reuse of older nests in herons.

Egg laying began after 7-9 days of completion of the nest. Fazili and Raheela (2013) have reported egg laying after 6-7 days of completion of nest in night heron in Hokersar wetland. Frederick (1997) has reported egg laying after 9 days in Tricolored heron. Eggs were oval, elongated and greenish – blue in colour without any markings fading to an off white. Ignat and Gache (2005) have reported that eggs are oval, elongated with slightly pointed ends, matt, green- blue and sometimes discoloured during incubation, while Frederick (1997) has reported egg shape ovate to oval; elliptical ovate or elliptical oval. Egg size is an important parameter as the chicks from large eggs usually survive better than those from small eggs (Parson 1975; Batt and Prince, 1979; Krapu 1979). Different workers have reported varied egg dimensions: Egg dimensions during present study for 60 eggs of little egret were 45.05×34.78mm. Frederick (1997) has reported 44.1×32.3 mm in tricolored heron; Durmus and Adizel (2010) 49.33×32.19 mm in night heron and Ashoori (2010) 45.82 × 33.88 mm in little egret. Egg size generally depends on the age, size and health condition of the female Fazili (2010) and also on the species to which the female belongs. The dimensions of eggs observed during present study seem to be more or less similar to the findings of Ashoori (2010). The eggs of early and intermediate clutches during present investigation had significantly greater dimensions as compared to eggs of late clutches. The reason could be availability of less diet for late breeders and inexperienced females which breed late in the season. These findings are in accordance with the findings of Fazili and Raheela (2013). Egg weighed on an average 27.44 ± 0.93 g and their volume and shape indicies were 27.80 ± 1.92 cm³ and 77.27 ± 3.08 respectively. Ashoori (2010) has recorded 26.89 ± 2.48 cm³ and 74.05 ± 3.47 as volume and egg

shape index respectively while Durmus and Adizel (2010) gave egg shape index as 65.57 ± 5.02. The volume and shape index variation in different studies could be due to varied egg dimensions. During present investigation the clutch size varied from 3- 5 eggs with an average of 3.85 eggs. Different workers have reported varied average clutch sizes: Kazantzidis *et.,al* (1996) 4.1 eggs; Fazili (2013) 3.85 eggs; Prosper and Hafner (1996) 4.3-4.6 eggs.

During present investigation incubation started with the laying of first egg. However, in some Ardeids like European race of bitterns incubation starts with the laying of second egg Witherby *et.,al* (1937) and in *Egretta tricolor* it started after laying of second or third egg Jenni (1969). Incubation period during present study varied from 21- 25 days. Uzun and Tabur (2006) has reported incubation period from 21- 22 days, Fazili and Raheela (2013) have reported incubation period of 21- 23 days in night heron. During incubation there is loss in egg weight probably due to evaporation rate, which increases with continued incubation and with rising temperature. In present study there appeared a gradual loss of 18.67% in weight of eggs of little egret. Shah (1984) has recorded a weight loss of 10.5% in the egg weight of moorhen. Fazili (2002) has reported egg weight loss of 16- 18% in eggs of different bird species. Ahanger (2009) reported that eggs lose 17.17% of their weight during incubation in Mallards.

Hatching success recorded during present investigation was 62.38% while hatching success of 82.65% has been reported by Ashoori (2010) in little egret in Karfestan. The low hatching success during present investigation may be due to high effect of predation and incliment weather conditions prevailing in the valley. The fledging success of 57.35% was recorded during present investigation. Ashoori (2010) has reported fledging success of 80.6%. The low fledging success during present study may be due to high effect of predators as most of the avain predators like common crows and Magpies used same trees for nesting as used by egrets. The reproductive success of waterbirds varies depending on the species composition of the colony Frederick and Collopy (1989). Nesting and overall breeding success during present investigation was found to be 58.62% and 35.77% respectively. The most important factor for reduced breeding success probably is intraspecific aggression that resulted falling and death of many chicks. In addition predation of eggs and chicks by common crows and Pariah kites also seemed a pertant cause for low breeding success during present study. Fazili (2002) reported that common crow and Pariah kite (*Milvus migrans*) to be the main egg predators of wetland breeding birds. Fazili and Raheela (2013) have reported common crow (*Corvus splendens*) and Magpie (*Pica pica*) as main predators of eggs and chicks of night heron. While as Durmus and Adizel (2010) have reported that Jackdaws (*Corvus monedula*) and Magpies (*Pica pica*) often attacked juveniles when they were alone in the nest.

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