Nesting behaviour and biology of Indian great reed warbler *Acrocephalus stentoreus brunnescens* Jerdon, at Lake Wular, Kashmir (India).

Mustahson Farooq Fazili

Wildlife Research Division, Postgraduate Department of Zoology, University of Kashmir, Hazratbal Srinagar-190006, Kashmir.
drfaziliwl@yahoo com

Abstract: Some parameters of nesting biology and behaviour of Indian great reed warbler were studied for three successive years (2011-2013) in the lake Wular Kashmir, India. Breeding occurred from May to August and was initiated by nest building. Nesting sites were chosen in bushy willows and dense emergent reeds dominated by *Phragmites communis* where average reed density was 48.8 ± 9.5 per m^2 and average reed height 156.5± 10.3cm. Maximum percentage of nests (96%) was in reeds and among reeds *Phragmites communis* patches were mostly preferred for nesting (98% nests). Distance of the nests to open waters averaged 13.8 ± 6.2m. Nests were built in different habitats only by female warblers in 4-7 days. The nests on willows differed significantly both in diameter and in depth from those in reeds ($P<0.05$). In 80% clutches the eggs were laid daily between 7 hours and 10 hours and peak laying was from June, 18 to July, 7. Average clutch size was 3.2± 0.7 and mean egg measurements were 22.4 ±0.5 x 15.7 ± 0.16 mm. Incubation was performed by female warblers only during mean duration of 14.4± 0.66 days. Eggs lost 16% of weight during incubation. Daily survival rate of eggs during incubation was 0.97. Females spent 82% of day time in attending nest and mean attentive period was 44.9 minutes. Hatching period ranged from 8-12 hours and overall hatching success was 62.7%. Hatching success varied in different habitats. Nidicolous hatchlings weighed on an average 2.275± 0.25g. Fledging period varied from 13-15 days. Nestling survival during nestling period was 0.75 and breeding success calculated from exposure was 0.42. It was observed that predation was main cause of low breeding success.

[Mustahson Farooq Fazili. **Nesting behaviour and biology of Indian great reed warbler *Acrocephalus stentoreus brunnescens* Jerdon, at Lake Wular, Kashmir (India).** *J Am Sci* 2019;15(1):61-70]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 10. doi:10.7537/marsjas150119.10.

Key words: Nesting, Incubation, Clutch, Hatching, Breeding success, Wular Lake, Reed Warbler

Introduction

Indian Great Reed Warbler a regular summer migrant to the valley of Kashmir is present in all wetlands and marshy areas during summer months. This passerine bird generally prefers large reeds and bushy willows. Great reed warbler is the largest of all the warbler species (Simms, 1985) and over-winters in tropical and sub tropical regions of Indian sub-continent as far south west as Western Ghats (Bates and Lowther, 1952). Reed warblers breed in marshland habitats, almost exclusively in reed beds (Schulz-Hagen 1991, Cramp1992). In central and western Europe the reed warblers have relatively long breeding season which lasts from May until August/ September (Schulz-Hagen 1991, Cramp 1992). It is mostly monogamous but in good quality territories males undergo polygamy. The females take the quality of the nesting area, quantity of food and predation risk into consideration before determining the territory (Ali UZUN *et al* 2014).

The nesting studies are of paramount importance in designing conservation plans for maintenance and regulation of bird populations, as a good nesting site generally provides protection against predators, offers adequate stability and materials to support and construct the nest, and also influences hatching success (Ludwig *et al.* 1994; Kazantzidis *et al.* 1996; Hilaluddin *et al.* 2006), fledging success (Buckley and Buckley 1980) and nesting success (Fazili *et al.*2010). 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). The breeding success of wetland bird species is of considerable interest to ecologists because these species are useful indicators of wetland productivity, trophic structure, human disturbance and contamination of wetland ecosystems (Custer and Osborn 1977). The objective of the present paper is therefore to describe some aspects of nesting behavior and biology of Indian great reed warbler in relation to the lake ecology and to visualize whether there is any effect of nest-site parameters on the hatching success, fledging success and overall breeding success, of this migrant bird species from the data collected during three consecutive breeding seasons from 2011-2013 at Wular lake, Kashmir (India).

Material and methods

2a. Study area

The study was conducted from 2011 to 2013 at Wular Lake (34º15′ to 34º25′ N, 74º32′ to 74º42′ E), a Ramsar Site in the Baramulla and Bandipore districts of Jammu & Kashmir, India. The lake has a maximum depth of 4.9 m with an area of 111.71Sq. Km (Latief 2012), that remains covered with dense growth of free floating and emergent vegetation during the major part of the year. The common species are *Trapa bispinosa, Nymphoides peltatum, Nelumbo nucifera, Ceratophyllum demersum, Hydrilla verticillata, Potamogeton indicus, P. lucens, Butomus umbellatus, Carex sp., Phragmites communis, P. elephantoides, Typha angustata, Myriophyllum verticillatum, Sparganum ramosum, Lemna sp. and Saccharum spontaneum.* The dense floating vegetation and reed beds are partitioned by a series of boat channels varying in width between 1–6 m. There is a protective bank mostly on the southern and eastern sides of the lake. Inside the bank and at some places outside the bank there are dense willow plantations of both tall and bushy *Salix* tree species that provide best roosting and breeding grounds to a wide variety of resident and non-resident birds. In addition, outside the bank on southern side of the lake there are two large marshy areas attached to the lake locally known as Rakhi Saderkote and Rakhi Muqdemyoor. These rakhs (morases) have dense growth of reeds and emergent and free floating vegetation of *Phragmitis communis, P. elephantoides, Typha angustata, Saccharum spontaneum, Sparganum ramosum, Eleocharis palustris, Carex species and Butomus umbellatus.* These morases also harbour a wide variety of aquatic bird species. Besides several springs that are occasionally seen bubbling up to the surface and streams, especially, Erin, Mudhumati, and Ningal Nallah, the lake is mainly and chiefly fed and drained by the river Jehlum. It flows into the Wular on its south-eastern side, near the middle of the lake and leaves the lake at its south-western corner near Sopore (Figure 1).

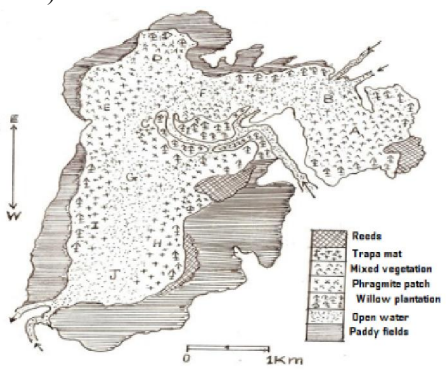

Figure1. Wular Lake

2b. Methods of observation

To observe the nesting behaviour, the lake was visited regularly during the breeding season, March–October. The activities of birds were recorded on every visit. Nesting site was defined as an area where mating, nest building, adult incubating and brooding occurred. Nests were searched systematically throughout the wetland. The nests of warblers were generally located in the study area by wading through reeds. Any residing place of a bird with one or more eggs was classified as a nest. Slender willow stakes flagged with strips of red cloth were used to mark nest locations so that nests could be relocated (Klett *et. al,* 1988). Nest numbers were marked on the flags with waterproof ink. In some cases plastic numbers were tied to the nest material. When a nest was spotted the following parameters were recorded: location, nesting material and plant species in the immediate vicinity of the nest. In addition, at each nest, the type, height and density of vegetation cover and its condition; shape, size and the position of the nest and concealing arrangements were recorded. To monitor outcome, the nests were visited thrice in a week. A nest was defined as successful if there was at least hatching of one chick in the nest or the presence of piping hole on the egg made by the chick. The newly laid eggs were weighed to an accuracy of 0.1 gm using digital balance. To determine egg laying and hatching intervals, the eggs were marked with waterproof ink and placed properly without disturbing the arrangement of other eggs in the nest. Morphometric measurements of eggs were taken to 0.1 mm using digital Callipers. The length and width were measured at highest points of the egg, obtained by sliding the callipers gently on the egg. The Volume and egg shape index were calculated by using the formulae V (cc) = K × L × B² (Hoyt 1979), where L is the length, B is breadth and K is constant the value of which is equal to 0.51and IS = (W/L) × 100 (Coulson 1963), Where W is egg width (cm) and L is egg length (cm). Incubation period was defined as the period since the laying of last egg of clutch until the hatching of first egg (Gill 1994). Hatching, fledging and breeding success were defined as the probability that eggs laid would hatch, the probability that hatchlings would fledge and the probability that eggs laid would survive from laying to fledging. These calculations were done as per Mayfield (1961,1975).

On hatching, each chick was weighed to nearest 0.1 gm using digital balance. Hides were constructed at distances of 6–10 m from the nests to record the behaviour of breeding pairs and chicks. Observations were made in shifts of at least two hours each, from egg laying till nestlings fledged.

Statistical analyses

Independent samples t-test was used to determine statistical significance in the difference of average nest heights, their diameter and depth in different habitats. Probabilities were two tailed, and significance level was set as 0.05. Statistical analysis was performed using SPSS16.

Results

3a. Nest site, Building and Structure

The nesting sites were characterized by thick emergent vegetation, dense enough to support the nest and at the same time provide sufficient concealment. Sites with dominance of *Phragmites* and bushy *Salix* were mostly preferred. The vegetation height varied from 75cm to 200cm with an average of 156.5 ± 10.3 cm and mean reed density 48.8 ± 9.5/m^2 (range 42-58/m^2). Nests however, were not always constructed inside the dense macrophytic vegetation but at times at the out skirts of these dense spots where reed density was low and averaged 40.2±5.4 and were close to open water. The average distance from the nest to open water was 13.8± 6.2m.

Only females collected nesting material and constructed the nests. The nests were woven of coarse lush grass with thin and delicate stems and fine blades around 3-5 emergent strands. The commonly used nesting material comprised of *Cynodon dactylon, Agrostis subaristata,* leaf blades of *Oryza sativa, Phragmites elephantoides, P. communis, Typha angustata* and the cottony material of *Phragmites.* The time taken to construct a nest varied from 4-7 days before laying of first egg. During 2011 and 2012, first signs of nest building were noticed on May, 2 and May, 5 respectively where as in 2013 it was initiated in last week of May (25th May).

Out of 217 nests observed in three consecutive years (87 in 2011, 77 in 2012 and 53 in 2013), 96% (n=208) nests were found in emergent vegetation where as 4% (n=9) were observed on willows. Among reeds 98% (n=204) nests were in *Phragmites communis.* The nesting material of the nests in both the habitats was almost the same with slight variation in their composition. The nests were located at varying heights from water surface. The nests on willows were located significantly higher than on reeds t (32) =6.46 P<0.05. In *Phragmites* the nest height ranged from 45cm to 150 cm with an average height of 90 ±29.9cm and on willows the nests were located at an average height 175 ±32.35 cm (range120-240cm). The nests of warblers located either on willows or in reeds were substantial cups of dead grass with well built concavity, which provided a marked depression for the deposition of eggs and prevented them from falling during heavy disturbances cither by fast blowing winds or by animals. The nests on willows had significantly greater depression for holding the eggs than those in the reeds, t (32) = 4.17 P<0.05. The nests on willows had an average depth of 7.5± 0.5cm and in reeds 6.4± o.7cm. The nests in reeds were larger with significantly greater diameter than those on willows t (32) = 2.9 P<0.05. The nests in reeds had an average diameter of 9.00±1.13cm and those on willows 8.2± 1.6cm.

3b. Clutch and Egg Biometry

The clutch size varied greatly from 2 to 4, with a mean of 3.2±0.7 (Table 2). Average clutch size did not remain the same but showed both inter and intra annual variation with a range of 3.14 to 3.3 and 3.11-3.33 respectively (Tables 2 & 3). In the early arrivals and those that completed their-nests earlier, the egg laying was initiated in 3rd week of May. However, during 2013 laying was initiated in 2nd week of June due to unfavorable climatic conditions. Though laying was initiated in May but majority of eggs 49.5% (n=344) and 38.27% (n=266) were laid in June and July respectively.

Table 1. Eggs per clutch/ No. of clutches in Indian great reed warbler**.**

	2	**3**	**4**	**Average**	**Total**
2011	15	40	32	3.2 ±0.7	**87**
2012	18	30	29	3.14±0.77	**77**
2013	6	25	22	3.3±0.672	**53**
Total	**39**	**95**	**83**	**3.2±0.7**	**217**

Table2. Completion of clutch in Indian great reed warbler.

	2	**3**	**4**	**Total**	**Clutch size±SD**
No. or nests	39	95	83	217	3.2±0.7
May, 19 to June, 10	10	16	28	54	3.33±0.77
June, 11 to June, 30	12	40	20	72	3.11±0.66
July, 1 to July, 20	13	23	27	63	3.22±0.77
July, 21 onwards	4	16	8	28	3.14±0.65

In 2013, 175eggs were laid in 53 nests and in 2011 and 2012, 278 and 242 eggs were laid in 87 and 77 nests respectively. Laying was brisk from June, 18 to July, 7 during three years of study (Fig.2). Eggs were laid daily in 92 % of known clutches and hourly counts of the number of eggs laid revealed that 80% eggs were laid between 7.00 hours and 10.00 hours.

Perhaps young and inexperienced females laid on alternate days. The eggs were glossless blunt ovals. They varied in colouration but the ground colour being white, grayish or greenish white with irregular blackish brown markings with underlying stone coloured red or lavender secondary markings. The shells were highly delicate coarse and brittle.

Table 3. Weight and size of eggs of Indian great reed warbler**.**

	Minimum.	Maximum	Mean ±S.D	Number. Measured
Weight of un-incubated egg (g)	2.750	3.750	**3.215±0.238**	110
Weight of incubated egg (g)	2.200	3.050	**2.600±0.128**	110
Length (mm)	19.3	23.1	**22.4±0.49**	140
Breadth/width (mm)	15.2	16.9	**15.7±0.16**	140
Volume ($cm^{3)}$	2.27	3.36	**2.82±0.43**	140
Shape index	69.43	78.75	**71.58±1.90**	140

As the incubation proceeded the eggs turned slightly dark grey with no change in markings. The weight of freshly laid eggs varied from a minimum of 2.75g to a maximum of 3.750g with an average weight of 3.215 ± 0.24g and length from 19.3mm to 23.1mm (average 22.4 ± 0.5mm) and breadth from 15.2 to 16.9 mm (average 15.7 ± 0.16mm). Average volume of the eggs calculated was 2.82 ± 0.43cm^3. The shape index of the eggs varied from 69.43 to 78.75 with a mean value of 71.58 ±1.9 (Table3).

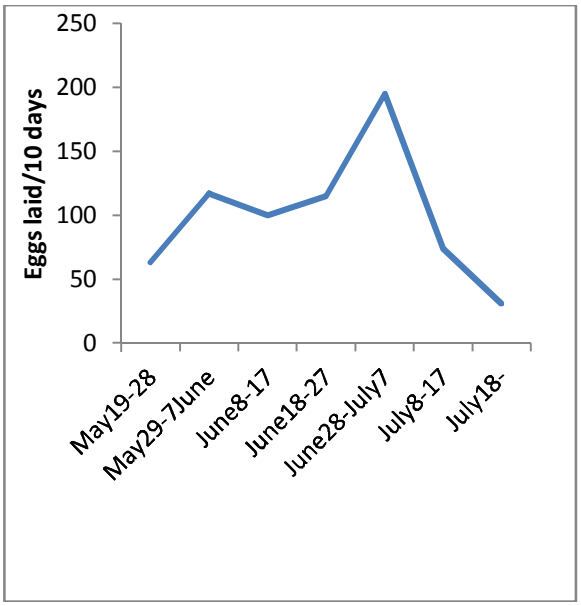

Figure 2. Peak Egg Laying by Warblers

3c. Incubation

Incubation was entirely by females as the-presence of brood patch was a definitive way to sex a bird as female. Incubation began after the completion of clutch generally after the laying of 3rd egg. During 74 hours of observation on nest attendance, female was observed to spend 60 hours and 40 minutes in incubating the eggs and 13 hours and 20 minutes away from the nest. The mean attentive period of 81 shifts was 44.9 minutes (range 9 minutes to 82 minutes). Mean recess period calculated for 80 shifts was 10 minutes (range 4 to 33 minutes). From the data it was inferred that females spend 82%of the day-time in warming and shading of the eggs from 6.00 to 18.00 hours.

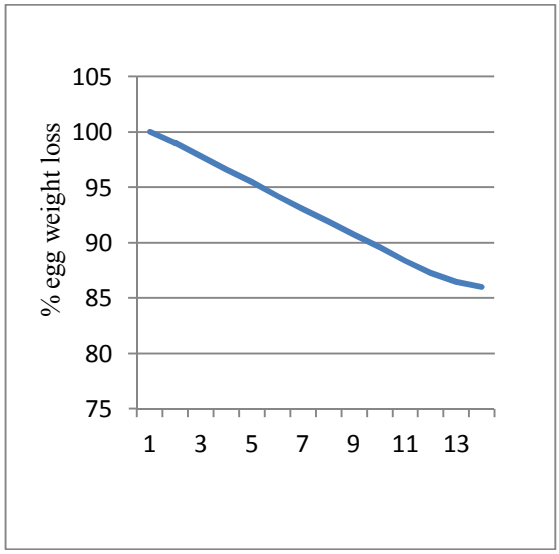

Figure 3. Egg weight loss in warbler

The incubating female warbler more often turned the eggs. Egg turning was observed throughout the day but more often during hotter parts of the day. In morning and evening hours the incubating female sat practically calm and frozen on the eggs with occasional shifts of position. However, during hotter periods of the day the wings were kept half open to shade the eggs from direct heat of sun and during rain the female sat tightly over the eggs to protect them

from cooling and dampness. Incubation period varied from 14 to 16 days with an average of was 14.4 ± 0.66 days (Table 4). The daily survival rate of eggs during incubation on the basis of exposure was 0.97 (Table 6). The eggs showed a gradual weight loss of 16% on an average during incubation (Figure3).

Table4. Length of incubation period of Indian great reed warbler.

Number of Clutches Observed	Number of Incubation Days			Mean Incubation Period (days)±S.D
	14	15	16	
52	35	12	5	14.4± 0.66

3d. Hatching and Hatching success

Chicks hatched asynchronously confirming the fact that incubation began prior to the completion of clutch. Small cracks in the broader half near the pole with occasional audible piping sounds were the indications of hatching. Hatching period varied from 8 to 12 hours. Egg shells were disposed by the female warbler, large pieces thrown in the water and small ones consumed. Hatching success showed both inter and intra-annual variation (Figure 4). 70.6% hatching occurred from 1st week of July to 3rd week of July. Hatching success varied from 58% to 87.5% during different months with an overall hatching success of 67.2% (Table 5). The eggs that were laid in different months highest hatching success of 84.7% was observed in those that were laid in May (Figure 4) and the lowest of 63.9% was observed in the eggs laid in July (Table5). Hatching success also varied in different habitats.

It was 55.38% in willows and 71.12% in reeds. Major causes of hatching failure were predation by common crow, night herons, pariah kite and faulty incubation. The nests were almost hidden during early stages of laying but by man's interference especially through grass cutting, majority of nests were exposed and a few destroyed completely that resulted decline in hatching success. The overall percentage of eggs lost through predation was 30.07% (Table 5).

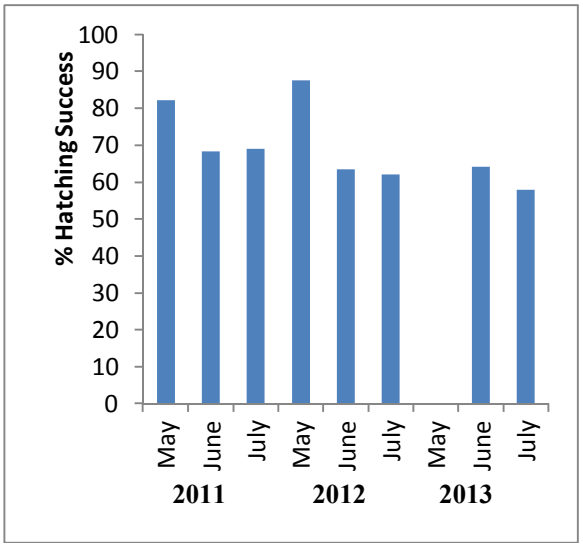

Figure4. Hatching Success in Indian great reedwarbler

Table 5: Hatching success in relation to month of laying in Indian great reed warbler

Month	No. of Eggs	Eggs lost through Predation		Eggs lost through desertion & faulty incubation		Hatching	
		No	%	No	%	No	%
May	85	11	12.94	2	2.36	72	84.7
June	344	110	32.00	9	2.6	225	65.4
July	266	88	33.08	8	3.02	170	63.9
Total	695	209	30.07	19	2.73	467	67.20

3e. Chick development, survival and Breeding Success

The chicks were nidicolous and freshly hatched ones weighed on an average 2.275±0.25g (range 1.900g to 2.550g). Their average beak, tarsus and wing lengths were 0.51 cm (range 0.45 to 0.54 cm) tarsus 0.64 (range 0.59cm to 0.69cm) and wing 0.61cm (range 0.51cm to 0.63cm) respectively. They were weak and could not hold their head till 2nd day when parents started feeding them. In polygamous ones only female fed the nestlings where as in monogamous ones males also assisted. After 4th day of their emergence the chicks started opening their eyes and eyes were completely open at the age of 8 days. The feathers developed from the age of four and were visible at 5th day. First, spinal, ventral and humeral tracts became prominent followed by femoral, alar and crural tracts. Pin feathers emerged on caudal tract at the age of 7. The feathers broke sheaths from 7-9 days age and became fully developed at the age of 10 but not completely covering apteria. The chicks became fully feathered at the age of 11to 12 days. Chicks completely left the nest at the age of 14-15 days when they were able to

take short flights. Beak, tarsus and wings attained maximum size at the age of 14-18 days.

As calculated from exposure chick survival during nesting was 0.75and breeding success 0.42 (Table 6). Low survival rate was due to high effect of predators. Nesting and breeding success calculated by traditional method were 79.2% and 53.2% respectively.

Table 6: Mayfield survival probability for different stages of little bittern

	Exposure Days	No. of eggs /nestlings	No. of eggs /nestlings Failed	Daily survival	Success Rate
Incubation	8749	695	228	0.97	0.65
Nestling	5762	467	97	0.98	0.75
Breeding	13860	695	325	0.97	0.42

Discussion

In many temperate species, onset of breeding season depends largely on the availability of nest sites and most of the aquatic birds often breed in relation to water level and suitable nesting material (Frith and Davies, 1958; Sudgen, 1979 and Shah, 1984). Lack of suitable nest sites may be a critical limiting factor in bird populations so after establishment of pair bonds and territories birds were observed engaged in selection of suitable nest sites that not only provide concealment and support to their nests but also protection to their nestlings from predators.

During present study females were found the sole nest site selectors without the role of males and the sites were chosen generally in *Phragmites* with dense reeds that support the hanging nest and provide concealment from predators and were also rarely in bushy willows. Among nests that were built in reeds, 98% were built in *Phragmites*. 4% nests were built on willows. Catchpole (1974) also reported *Phragmites* as the most preferable nest sites in reed warblers. Kluyver (1955) has shown in great reed warbler that the nests were built in reeds. Hasselquist (1994) has observed that 279 out of 280 nests were supported by the *Phragmites* and Dyrcz (1981) has found that great reed warblers mostly constructed nests in *Phragmites* and occasionally on *Salix*. Bates and Lowther (1952) have documented similar situation in India great reed warbler and Jedraszko-Dabrowsk (1992) has documented that nests of great reed warblers were found in reeds that support the nests platforms.

During most vulnerable period in the life cycle, birds construct their nests to protect themselves, their eggs and particularly their developing young from predators and from adverse weather conditions (Welty, 1979). The water birds resort to a great variety of nesting-sites; the herons use larger trees and make artificial platforms of twigs (Yocum, 1952). Bitterns, terns and gallinules construct simple platforms composed of aquatic plants and usually placed above shallow water (Fazili, 2002, 2010 & 2013). Indian great reed warblers constructed a woven cup like nests with thick base and margins supported by 3 to 5 *Phragmite* strands, grasses and leaf blades of a variety of aquatic plants placed at an average of 90± 29.9cm above water level. But on willows, the nests were placed on an average 175± 32.35cm above the water surface. Similar type of nests in great reed warbler has been observed by Kluyver (1955), Dyrcz (1981) and Hasselquist (1994) with slight variation in the heights of the nests that may be due to varied water table in their study areas.

Warblers show an elaborate system of nest building in which either both or only one member of a pair take active role in nest building. In fan tailed warblers *Cisticola juncidis* only males construct nests (Ueda, 1984). In elfin wood warblers both the individuals construct the nest (Arroyo-vazquez, 1992) while as during present study only females built and mainted the nest. Kluyver (1955) has reported similar observation of nest building for great reed warbler.

The first sign of nest building was observed in early May in reeds when they had attained a maximum height of 3 to 4 feet and on willows in the month of June and the time taken to complete nest varied from 4 to 7 days. So far as the elaborateness of the nests was concerned, Indian great reed warblers were fast workers, building in a short periods of 4 days only as compared to Cedar waxing (5 to 6 days; Putnam 1949), *Dicrurus macrocercus* (5 to 10 days; Lamba 1963) and black- billed magpies (40 days; Erpino 1968). The eggs were glossless blunt ovals with varied colouration but the ground colour being white, grayish or greenish white with irregular blackish brown markings with underlying stone coloured red or lavender secondary markings.

The mean dimensions of 140 eggs were22.4±0.49×15.7±0.16mm. Bates and Lowther (1952) have reported similar type of eggs with almost identical dimension for this species of warblers.

It is generally true that the clutch size of each species has been adapted by natural selection to correspond with the greatest number of young which the parents can normally raise (Lack, 1954). The clutch size of the great reed warbler ranges from 2 to 6 eggs, but the common clutch size is usually four or five eggs (Saitou, 1976). The average clutch size in *Acrocephalus bistrigiceps* has been noted as 4.50± 0.55 (Ueda and Yamaoka, 1994). Ezaki (1990) has shown that in great reed warbler early settling females

laid on average 5.2 (S.D= 0.5) eggs per nest and late settling females laid an average clutch of 3.8 (S.D= 0.6) eggs. Bates and Lowther (1952) have reported that Indian great reed warbler usually laid 4 eggs, quite often 3 only. During present investigation average cutch size was 3.2±0.7 (range 2- 4 eggs) however, the clutch size varied at different periods of laying but the variation was slight as compared to the observations of Ezaki (1990). Early settlers during study had an average clutch size of 3.33 eggs while as late settlers laid an average clutch of 3.14 eggs indicating that early breeders laid larger clutches than late breeders. A number of workers have reported that the birds breeding for the first time usually breed late in the season and lay smaller clutches than the older ones that start breeding earlier (Klujiver, 1951; Wilson, 1966; Crawford, 1980; Shah. 1984). It is also likely that the clutch size is related with the availability of food as has been elucidated by Gibb (1955).

With certain exceptions eggs were laid daily in Indian great reed warbler. Daily laying has been observed by Afik and Pinshow (1984) in Arabian warbler. In Indian great reed warbler egg incubation was initiated after completion of clutch, carried by only females and incubation period varied from 14 to 16 days with an average of 14.4 ± 0.66days. These findings were in accordance to those of Ezaki and Urano (1995), Nishuimi (1998). Kluyvcr (1955), Hasselquist (1994), Dyrcz (1981) and cetti's warbler (Bibby, 1979).

During the incubation there was 16% loss in egg weight probably due to evaporation rate, which increases with continued incubation and with rising temperature. Fazili *et al* (2013) have recorded a loss of 17.5% in the egg weight in pheasant tailed jacana and Fazili (2014) a loss of 16.67% in the egg weight of little bittern eggs. Bibby recorded in cetti's warbler that eggs lost weight linearly according to y= 207-0.022d, where d= days from clutch completion. Irrespective of size, eggs generally lose between 15 to 18% of their initial mass as water as incubation proceeds till hatching (Brown 1994). Only female incubated the eggs and spent 82% of the day time in this activity. The mean nest attentive time calculated was 44.9 minutes and the mean recess period of 10 minutes. Skutch (1976) has also reported for 19 species of passers in which only females incubate that the birds devote 62 - 85% of their time to incubation; the mean duration of nest attendance was from 12.1 to 93.2 minutes (mean of the means 55 minutes) and the mean duration of the un-attendance interval was from 3.5 to 39.1 minutes (mean of the means 15.3 minutes).In other species of the genus *Acrocephalus* studied in this respect, the nest attendance periods were either longer or shorter. In sedge warbler *Acrocephalus schoenobaensus* in which only female incubates, the mean duration of nest attendance was 49 minutes, the un-attendance period being 4 minutes (Koskimies 1991). In Blyth's reed warbler, *Acrocephalus dumetorum* both sexes incubate, the mean duration of sessions was 24 minutes (Koskimies 1991). In the marsh warbler *Acrocephalus palustris* male and female incubated regularly after shifts of 10 to 20 minutes (Schulze- Hagen 1991). The aquatic warbler, *Acrocephalus paludicola* in which only female incubates, Heise (1970) and Dyrcz (1993) found that nest attendance averaged 15.7 minutes and 11.1 minutes respectively and the corresponding total mean time devoted to incubation was about 70%. Though the present observations were almost in accordance with the findings of Skutch (1976), yet the reasons for the variation in the attendance and recess periods could be due to availability of food, relatively cool climate and lack of help on the part of the male during incubation.

Hatching was asynchronous as the eggs hatched in the order in which they were laid, because incubation started after the completion of the clutch either just alter laying of 3rd egg or 4th egg. Asynchronous hatching has been reported in a wide variety of birds. In altricial birds Clark and Wilson (1981) have examined the bases for existence of hatching asynchrony. Slagsvold and Lifjeld (1989) suggested that in addition to increasing the density, females also get benefited when their young hatch asynchronously because (1) first laid eggs hatch earlier, thus providing more time to the males in feeding the nestlings and thereby reducing the female's over all contributions and (2) it minimizes the amount of time males have to acquire additional females, there by maximizing the males potential contributions to the brood.

Hatching success showed both inter and intra-annual variation;70.6% hatching occurred from 1st week of July to 3rd week of July. Hatching success varied from 58% to 87.5% during different months with an overall hatching success of 67.2% In *Acrocephalus paludicola,* Dyrcz and Zdunek (1993) have reported hatching success of 82.1% and in *Acrocephalus scirpaceus* Catchpolc (1974) has reported hatching success varying between 53 - 91%. The variation in success was related to a number of factors including the habitat conditions. Warblers used both willows and *Phragmites* for nesting at Wular lake, hatching success was found high in nests among reeds (71.12%) as compared to the nests in willows (55.38%). Low percentage of hatching success on willows was because the nests were more or less exposed to predators and predators generally preferred willows for nesting as well as roosting purposes.

Freshly hatched chicks of Indian great reed warbler were altricial and weighed on an average 2.175gms. They became fully feathered at the age of 11-12 days and left the nests at the age of 13- 15 days. Dyrcz (1993) has reported that in *Acrocephahis paludicola* the altricial chicks leave the nest at the age of 15- 16 days but lower nestling periods like the present study have been reported by Brown and Davies (1949), Dowsett-Lemaire (1981) & Schulz-Hagen (1991). In grey warbler the nestling period is 17.2 days (Gill 1982). As calculated from exposure chick survival during nesting was 0.75and breeding success 0.42. Low breeding success was due to high effect of predators.

Conclusion

Indian great reed warbler one of the summer migrants to the wetlands of Kashmir after raising its new generation moves back to the southern parts of India especially Western Ghats for enjoying winter months. Females take the brunt of nest building and rearing of young ones with least support from the males. Due to human interference their eggs and chicks get exposed to predators, leading to low breeding success.

Acknowledgement

I am highly thankful to Mr. Mohd. Ashraf for providing boat facilities. My thanks go to all the officials that are at the helm of affairs in the department of Zoology, KU for providing necessary equipments to carry out the study. I am indebted to Dr. Tariq for statistical analysis.

Corresponding Author
Mustahson Farooq Fazili
Wildlife Research Division,
Postgraduate Department of Zoology,
University of Kashmir, Hazratbal
Srinagar-190006, Kashmir.
drfaziliwl@yahoo.com

References

1. Afik, Daniel & Berry Pinshow Notes on the breeding biology of the Arabian warbler *Sylvia leucomelaena* in the Arava (Rift Valley), Isreal. Ibis1984;126:82-89.
2. Arroyo-Vazquez Observation on the breeding biology of the Elfin woods warbler Wilson Bull.1992; 104(2):362-365.
3. Bates, R. S. P. & E. H. N. Lowther The Breeding Birds of Kashmir. Oxford University Press, London,1952.
4. Bibby Collin J. Breeding biology of the dartford warbler *Sylvia undata* in England. IBIS 1979;121(1): 41-52.
5. Brown and, P. E and M. G. Davies Reed Warblers –East Molesey, 1949.
6. Buckley, F. G and Buckley, P. A. Habitat selection and marine birds. Pp. 69-112 in J. Burger, B. L. Olla and H. E. Winn, eds. Behaviour of marine animals: marine birds Vol.4 New York: Planum Press,1980.
7. Catchpole, Clive K. Habitat section and breeding success in the Reed *Warbler Acrocephalus scirpaceus*. J Anim. Ecol.1974;43:363-380.
8. Clark, A. B. and D. S. Wilson Avain breeding adaptations: hatching asynchrony, brood reduction and nest failure. Q. Rev. Bio.1981;56:253-277.
9. Coulson, J. C. and Jean Harobin The influence of age on the breeding biology and survival of the Artic Tern *Sterna paradisaea*. J. Zool., London 1976;178:247-260.
10. Cramp S. Handbook of the Birds of Europe, the Middle East and West Africa. The Birds of Palaearctic, vol. VI-Warblers-Oxford University Press Oxford., New York.1992.
11. Crawford, R. D. Effects of age on reproduction of American coots. J. Anim. Ecol.1980;16:44-73. Custer T. W. & Osborn R. G. Wading birds as biological indicators: 1975 colony survey. US Fish and Wildlife Service Scientific Report Wildlife1977; No. 206.
12. Dowsett-Lemaire Franciose Eco – ethologicalaspects of breeding in the marsh warbler *Acrocephalus palustris* Terri vie 1981;35(3):437-492.
13. Dyrcz, Andrzej Breeding ecology of great red warbler *Acrocephalus arundinaceous* and reed warbler *Acrocephalus scirpaceus* at fish ponds in southwest Poland lakesin north west Switzerland Acta Ornithol (Warsa)1981;18(5*)*:307-333.
14. Dyrcz, Andrez. Breeding ecology of the aquatic warbler *Acrocephalus paludicola* on the Biebrza marshes, north east Poland,1993.
15. Dyrcz, Andrez and Wanda Zdunek. Breeding ecology of the aquatic warbler *Acrocephalus paludicola* on the Biebrza marshes (NE Poland). Vogelwelt11993;14(1*)*:2-15.
16. Erpino, M. J. Nest related activities of Black billed magpies. Condor 1968;70:154-165. Ezaki, Yasuo 1990. Female choice and the causes and adaptiveness of polygyny in great reed warblers. *Journal of Animal Ecology 59(1):*103-119.
17. Ezaki, Yasuo & Eiichiro Urano. Intra specific comparison of ecology and mating system of the great reed warbler *(Acrocephalus arundinaceous)*: Why different results from different populations. Japanese Journal of Ornithology,1995; 44(3*)*:107-122.

18. Fazili Mustahson Farooq. A study on the annual cycle of some migratory and non-migratory birds at Wular lake Kashmir. Ph. D thesis (Unpublished). University of Kashmir,2002.
19. Fazili Mustahson Farooq. Nesting Ecology and Breeding Success of Little Bittern in Wular Lake Kashmir, India. New York Science Journal 2014;7(3):109-118.
20. Fazili Mustahson F., G. Mustafa Shah, Ulfat Jan and Fayaz A. Ahangar. On some Breeding Parameters of Little bittern at Haigam Wetland Kashmir. Berkut 2010;19: 74-80.
21. Fazili M. F., G. Mustafa Shah & Ulfat Jan. Nest Characteristics, Egg Biometry, Incubation and Hatching Success of Pheasant tailed Jacana *Hydrophasianus chirurgus* Scopoli (Charadriformes: jacanidae) at Wular lake Kashmir (India). Hungarian Waterfowl Publication 2013;23:333-348.
22. Gibb, J. A. Feeding rates of great tits. Br. Birds1955;48:49-58. Frith, H. J & S. J. Davies. 1958. The Magpie goose. Aust. Mus. Mag. 12: 348 – 351.
23. Gill, Brain J. Breeding of the grey warbler Greygoneigata at Kaikoura, New Zealand. The Ibis J. of British Orn. Union 1982; (2*)*:123-147.
24. Gill, F. B. Ornithology W. H. Freeman and Company. New York. Heise, G.1970. Zur Brit biogie des Seggenrohrsangers Acrocephalus paludicola J. Orn.1994;11:54-67.
25. Hilaludin shah, J. N. and shawl, T. A. Nest site selection and breeding success by Cattle Egret Bubulcus ibis and Little Egret Egretta garzetta in Amroha, Utter Pradesh, India Waterbirds 2003; 26:444-448.
26. Hoyt D. F. Practical methods of estimating volume and fresh weight of bird eggs. Auk 1979;96:73-77 .
27. Jedraszko Dabrowska, Danuta. Reed asconstruction supporting great red warbler *Acrocephalus arundinaceous* and reed warbler *Acrocephalus scirpaceus* harem nests. Ecol. Pol.1992;39(2*):*229-242.
28. Kazantzidis S., Hafner, H. & Goutner V. Comparative breeding ecology of Little Egret *Egretta garzetta* in the Axios Delta (Greece) and the Camargue (France). Reve. Ecologie (Terée et Vie)1996; 49: 53 62.
29. Kim JS, DP Lee, TH Koo.1998. Breeding ecology of Black-Crowned Night Heron Nycticorax nycticorax. Korean J. Ornithol.1988;.5:35-46.
30. Klett, A. T, T. L. Shaffer and D. H. Johnson. Duck nest success in the Prairie Pathole region. *J*. Wildl. Manage.1988;52 (3); 431-440.
31. Kluijver, H. N. The population ecology of great tit Parus major. L Ardea1951; 39:1-135.
32. Kluyver, H. N. Das Verhalten des Drosselrohrsangers, Acrocephalus arundinaceus (L) am. Brutplatzmitbesonderer Beruckschtigungder Revierbehauptung. Ardea 1955;43: 1 – 50.
33. Koskimies, P. *Acrocephalus schoenobaenus* (Linnaeus 1758)- Schilfrohrsanger *Acrocephalus dumetrorum* Blyth 849-Buschrohrsanger. In Glutz von Blotzheim, U. N. (ed.) Handbuch der Vogel. Proc. Zool. Soc. Lond.1993:231-237.
34. Lack, D. Natural Regulation of Animal Numbers. Oxford 1954.
35. Lamba, B. S. The nidification of some common India Birds No.3. The black dronga, *Dicrurus macrocerus* (Vieillot). Res. Bull. Punjab Univ.1963; 14(1-11).1-9.
36. Latief, S. U. The Wetlands of Kashmir Valey. *Jamia Geographical Studies* (Ist Ed.) 256-280 Manak Publications, Pvt. Ltd.2012.
37. Ludwig, E., Vanicsek, L. Torok, J. and Csorgo, T. The effect of nest height on the seasonal pattern of breeding success in black birds *Turdus merula* Ardea 1994;83:411-418.
38. Mayfield, H. F. 1961. Nesting success calculated from exposure. *Wilson Bulletin*, 87: 456-466.
39. Mayfield, H. Suggestion for calculating nest success. Willson Bull.1975; 87: 456-466.
40. Nishiumi, Isao. Brood sex ratio is dependent on female mating status in polygynous great reed warblers. Behav. Ecol. Sociobiol. 1998;44(1):9-14.
41. Putnam, L. S The life history of Cedar waxing. Will. Bull.1949;61:141-182.
42. Saitou, Takashi. Breeding biology of Eastern Great Reed Warbler *Acrocephalus arundinaceus orientalis* Misc. Rep. Yamashina Inst. Ornith.1976; 8(2)*:*135-156.
43. Schulze Hagen, K. *Acrocephalus scirpaceus* (Herman1804-Teichrohrsanger-In: Gllurz v. Blorzheim, U. N. (ed.) Handbuch der Vogel Mitteleuropas 12/I. AULA Verlag, Wiesbaden, 1991; pp.433-486.
44. Shah, G. Mustafa. Birds of Hokarsar: Food, feeding and breeding biology of some resident and nonresident birds. Ph. D Thesis, University of Kashmir (Unpulished),1984.
45. Simms E. British Warblers. London: Collins, 1985.
46. Skutch, A. F. Parent Birds and their Young. Austin & London,1976.
47. Slagsvold, T. and J. T Lifejeld. Constrants on hatching asynchrony and egg size in pied flycatcher. Journal of Animal Ecology 1989;58:836-849.

48. Sudgen, L. G. Habitat use by nesting American coots in Saskatchewan Parks. Wilson Bull 1979;91*:* 599 – 607.
49. Ueda, Keisuke. Successive nest building and polygyny of fan-tailed warblers Cisticola juncidis Ibis 1984;136(4*)*:492-493.
50. Ueda, Keisuke & Ayako Yamaoka. Polygyny in Schrenck's reed warbler *Acrocephalus bistrigiceps*. Ibis1994;*36*(4*)*:492-393.
51. UZUN A., Zehra AYYILDIZ, Faruk YILMAZ, Belgin UZUN, and Mehmet SAGIROGLU. Breeding ecology and behaviour of the Great Reed Warbler *Acrocephalus arundinaceus,* in Poyrazlar Lake, Turky. Turk J Zool 2014; 38: 55-60.
52. Welty, J. C. The life of birds. Saunders College publ. Philadelphia, Pennsylvania,1979.
53. Wilson, M. F. Breeding ecology of the yellow headed black bird Ecol. Mong.1966;36(1)*:*51-77.
54. Yocum, C. F. Techniques to increase nesting of Canada Geese. J. Wildl. Manage.1952; 16:425-428.

1/20/2019