Habitat selection of breeding birds in an urban environment, Sulur, Coimbatore, Tamil Nadu, South India

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Abstract

An attempt was made to find out the nest of birds in different habitat of Sulur, Coimbatore, Tamil Nadu, South India to assess the factors affecting the breeding seasonality and success to enumerate the nest and nest-site features and to examine nest-site selection. Totally of seven habitats were selected. A total of 1022 birds belonged to 35 family 61 species were recorded. Totally 121 nests of 19 species of birds that belonged to 14 families were recorded. Among the 14 families a greater number of nests were recorded from Columbidae (n=36) and minimum number of nests were recorded in Alcinidae (n=2). The number of nests, had no significant positive correlation with temperature and wind speed and negative correlation with rainfall. Totally 612 plants were recorded in the study area of which 47 plants were utilized for nesting. Plants that belonged to the Arecaceae family were occupied more *ie.*, nearly 62.09% of the total abundance followed by Malvaceae family (14%). Among the 121 nests 36% of nests belonged to open nest type, 19% of the nests were recorded as ground nest and 17% cup nest. Other nests include 12% of hole nests, 11% of ball nests and 7% of pendent nest. Among the different types of nests, success rate was recorded high in ball nests (94%) followed by cup nests (73%).

Key words: birds, breeding success, habitat, nest type, urban environment

INTRODUCTION

Bird use the long-time tradition to select particular habitat (Kendeigh, 1945, Fretwell, 1972, Block and Brennan, 1973). The factors potentially influencing nest-site selection include, moisture regimes, floristic composition, amounts and kinds of food available in the substrata, structure of the plant community and risks of nest predation (Steele, 1993; Martin 1993). Tropical birds have high nest predation, high adult survival and small clutch size (Lack, 1968). Hence, avoidance of nest predators plays a major role in specific choices of nest sites (Powell, 2001). Selection occurs when there are habitat differences between successful and unsuccessful sites and this may influence and modify habitat use for nesting over long period of time (Martin 1998). An attempt was made to find out the nest-site selection of birds in different habitats of Sulur and Coimbatore, Tamil Nadu, South India, by assessing the factors affecting the breeding seasonality, breeding success and enumerating the nest and nest-site features and examine nest-site selection.

METHODOLOGY

Sulur is a taluk located in Coimbatore, which is a major city in the Indian state of Tamilnadu.Sulur is located at 11.03°N 77.13°E. It has an average elevation of 340 metres (1115 feet). The town is divided into two parts by the holy Noyyal River. Sulur is the East –end of the new Coimbatore district. The study area nearly 7 km in between Muthugoundanpudur and Sulur market. It has a variety of habitats such as dry land, shallow land, coconut farm, River edge, Mixed garden and Road edge. These area is surrounded by Educational institutions. The average annual temperature is 26.3°. The average annual rainfall is 618 mm.

Total of seven habitats were selected for the study in and around Sulur. The habitats included dry land, mixed garden, shallow land, shrubs, plantation, river edge, road edge. Birds were observed by laying transects in each habitat. Most of the nests were searched by direct observation by intensive search in suitable habitat and following the bird activity as described by Martin and Geupel (1993) and Martin *et al.* (1996). Each nest was numbered separately. Located nests were monitored once in 3 to 5 days intervals to determine the fate of the nest. Care was taken to avoid trampling or disturbance to the birds and vegetation at nest sites.

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To determine breeding seasonality, active nests with eggs were considered (Lack, 1968). The relationships of nest abundance with rainfall, temperature and availability of food were observed. After completion of nesting activity, nest-site variables were measured. Details of vegetation and nest-site characteristics were recorded for each nest. The method for determining nest-site selectin was similar to that applied in a number of other studies (Bechard *et al.*, 1990). Nest-site variables were measured at two spatial scales; nest site (micro-habitat level) and nest-patch (meso-habitat level). Concealment was estimated at 1, 3, 5 and 7 m in all four cardinal directions (Martin and Roper, 1988). Based on the points from where the nest was seen, the concealment was calculated as low 13-16 points (0-25%), medium 9-12 points (25-50) high 5-8 points (50-75%) and very high 0-4 points (75-100%). Girth at breast height (GBH) of the trees (in cm) was recorded, size measured and categorized as small (<15 cm), medium (15-45 cm) and large (>45 cm).

Nesting success was calculated from intensive monitoring of nests. Nest survival rates included a simple calculation of the number of successful nests divided by the total number of nests with eggs found (Murray, 2000; Jehle *et al.*, 2004) and productivity as the number of young produced per pair. The nest that fledged at least one young was considered successful and that which lost all eggs at one shot is considered as preyed upon. Observation of fledgling in or near the nest was taken as evidence of a successful nest. Depredation was assumed when eggs or nestlings disappeared. Nests failed because of predation, exposure or abandonment and damage were listed as unsuccessful (Bibby *et al.*, 1998). Initiation dates, placement and concealment of the nest were quantified to examine the influence of these factors on nest success.

Data Analysis

♦ Pearson correlation was used to compare the number of nests in different months with environmental factors such as temperature, rainfall, humidity, wind speed, rainfall, wind speed and temperature

♦ Ivlev's Index of selectivity (Ivlev, 1961) was carried out to understand the species specific utilization (preference) of nesting trees. Ivle's index of selectivity = U-A/U+A where "U" denotes per cent utilization and "A" denotes per cent availability. Selectivity values range between -1 and +1, where '-' indicates avoidance while + indicates the preference.

♦ The hatching success was calculated as percentage of the chicks fledged from eggs laid

$$\text{Hatching success} = \frac{\text{Number of egges hatched}}{\text{Total number of eggs laid}} \text{x100}$$

RESULTS

Overall abundance

Totally 1022 birds belonging to 35 families and 61 species were recorded from seven transects laid in four

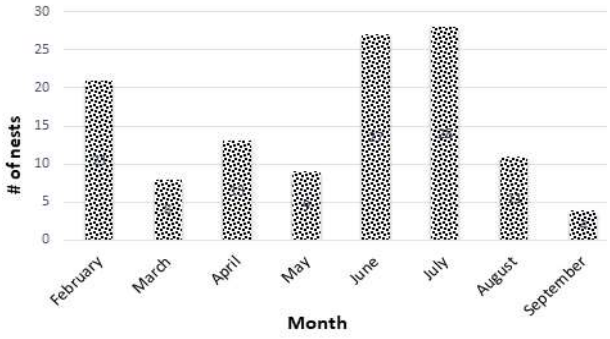

Fig. 1. Number of bird nests recorded during different month of study period

Table 1. Family-wise record (number and percentage) of bird nests recorded during the study period

Family	# of Nests	% of Nests
Alcedinidae	2	2
Charadriidae	8	7
Cisticolidae	3	2
Columbidae	36	30
Corvidae	5	4
Estrildidae	11	9
Leiothrichidae	9	7
Motacillidae	4	3
Nectariniidae	8	7
Passeridae	8	7
Phasianidae	15	12
Psittacidae	4	3
Pycnonotidae	5	4
Sturnidae	3	2
Total	**121**	100

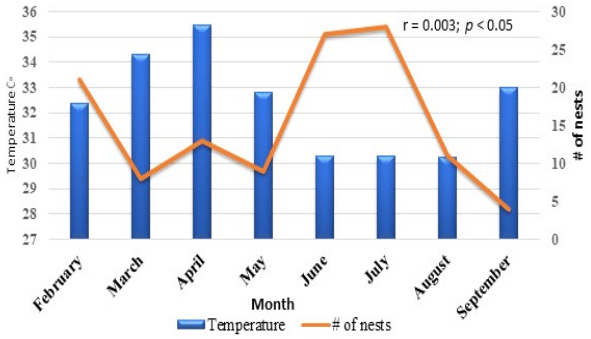

Fig. 2. Correlation between number of bird nests and Temperature during the study period

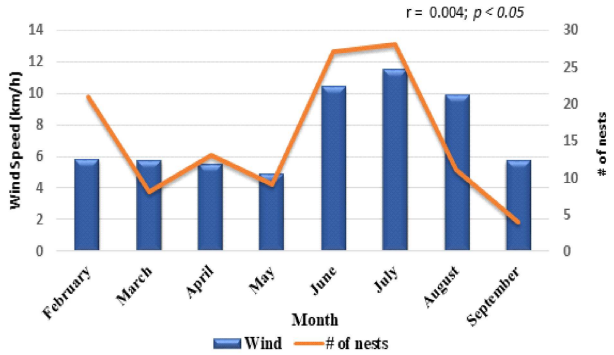

Fig. 3. Correlation between number of nests and wind speed during the study period

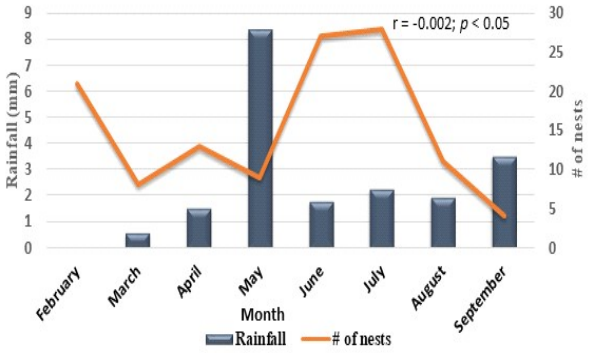

Fig. 4. Correlation between number of bird nests and rainfall during the study period

different habitats during nine months from February 2018 to September 2018. Total by 121 nests of 19 species of birds belonging to 14 families were recorded. Of the 121 nests 83 were recorded with eggs and 38 nests without eggs. More number of nests were recorded during the month of July (28), followed by June (27) and very less number were recorded during the month

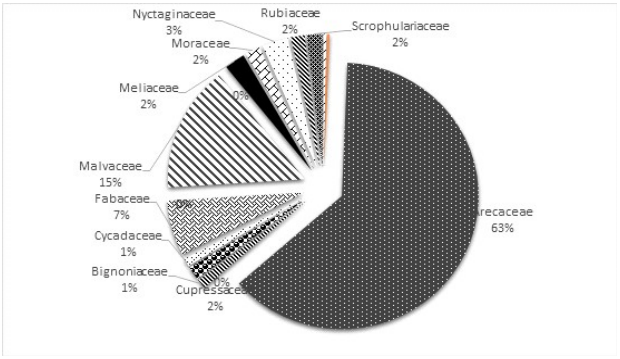

Fig. 5. Percentage abundance of bird nests in different plant families

of September (4) (Figure 1). Among the 14 families a greater number of nests were recorded from Columbidae (Doves and Pigeons) (n=36) and minimum number of nests were recorded in Alcinidae (White-breaste King fisher) (n=2) (Table 1).

Month wise abundance of bird nests with reference to weather

The number of nests had no significant positive correlation with temperature (r = 0.003, p>0.05) (Figure 3)wind speed (r = 0.004, p> 0.05) and no significant negative correlation with rainfall (r = -0.002, p> 0.05) (Figure 2-4).

Nesting plants and their utilization

During the study period, out of 121 nests 65 were recorded in different types of plants species belonged to thirteen families. Total of 612 plants were recorded in the study area of which 47 plant were utilized for nesting. Plants belonging to Arecaceae (*Phoenix sylvestris* and *Cocos nucifera*) were occupied more 62.09% of the total abundance, followed by Malvaceae

Table 2. Tree species utilization by the birds for nesting

Family	Tree name	# of Trees	# of Trees used	% of use	E
Annonaceae	*Polyalthialongifolia*	2	2	100	0.2
Araucariaceae	*Araucaria heterophylla*	2	1	50	-0.33
Arecaceae	*Phoenix sylvestris*	5	5	100	0.52
Arecaceae	*Cocos nucifera*	380	4	1	-0.98
Bignoniaceae	*Tecoma stans*	7	2	29	-0.56
Cupressaceae	*Juniperus chinensis*	10	2	20	-0.67
Cycadaceae	*Cycas revolute*	6	2	33	-0.33
Fabaceae	*Delonix regia*	26	2	8	-0.86
Fabaceae	*Pongamiapinnata*	11	2	18	-0.69
Fabaceae	*Vachellia leucophloea*	4	1	25	-0.6
Malvaceae	*Abutilon indicum(shrub)*	86	2	2	-0.95
Malvaceae	*Thespesia populnea*	7	2	29	-0.4
Meliaceae	*Azadiracta indica*	15	4	27	-0.58
Moraceae	*Ficus microcarpa*	11	3	27	-0.57
Nyctaginaceae	*Bougainvillea spectabilis*	19	7	37	-0.27
Rubiaceae	*Ixora coccinea*	10	3	30	-0.54
Scrophulariaceae	*Leucophyllumfrutescens*	11	3	27	-0.57

Table 3. Number and percentage use of plants for nesting by different species of birds

Family	Tree species	Abundance	# of Bird species	# of nests	Bird species nesting	Total nests	% of utilisation
Annonaceae	*Polyalthia longifolia*	Uncommon	1	2	Purple-rumped sunbird	3	4.62
				1	Olive backed sunbird		
Arecaceae	*Phoenix Sylvestris*	Common	6	1	Scaly breasted munia	17	26.15
				5	Spotted dove		
				3	Mourning dove		
				1	Common myna		
				3	House sparrow		
				4	White headed babbler		
	Cocos nucifera	Abundant	2	4	Rose-Ringed parakeet	4	6.15
Araucariaceae	*Araucaria heterophylla*	Uncommon	1	1	Scally-breasted Munia	1	1.54
Bignoniaceae	*Tecoma stans*	Common	1	2	Red-vented bulbul	2	3.08
Cupressaceae	*Juniperuschinensis*	Rare	1	2	Olive backed sunbird	2	3.08
Cycadaceae	*Cycas revoluta*	Common	2	2	White headed babbler	3	4.62
				1	Common Myna		
Fabaceae	*Delonix regia*	Common	2	1	House Crow	2	3.08
				1	White-headed babbler		
	Pongamiapinnata	Abundant	1	1	Spotted dove	1	1.54
	Vachellialeucophloea	Uncommon	1	1	Paddy field pipit	1	1.54
Malvaceae	*Abutilon indicum*	Abundant	1	2	Paddy field pipit	2	3.08
	Thespesia populnea	Abundant	2	2	White-headed babbler	3	4.62
				1	House crow		
Meliaceae	*Azadiractaindica*	Common	2	1	Common Myna	4	6.15
				3	House crow		
Moraceae	*Ficus microcarpa*	Uncommon	1	3	Red-vented bulbul	3	4.62
Nyctaginaceae	*Bougainvillea spectabilis*	Abundant	5	4	scaly-breasted munia	11	16.92
				2	White-rumped munia		
				2	Spotted dove		
				2	Olive backed sunbird		
				1	Purple-rumped sunbird		
Rubiaceae	*Ixora coccinea*	Abundant	1	3	Common tailor bird	3	4.62
Scrophulariaceae	*Leucophyllumfrutescens*	Uncommon	2	1	White-rumped munia	3	4.62
				2	Scaly-breasted munia		

family species such as *Abutilon indicum* and *Thespesia populnea*(14%)(Figure 5). Preference index was calculated for 17 species, results showed that birds preferred *Phoenix sylvestris* (E=0.52) and *Polyalthia longifolia* (E = 0.20). For other plants though nests were recorded, the availability of plant species was more than demand (Table 2).

Totally twenty plant species belonging to twelve families were used by fourteen species of birds for nesting. Of this twenty plants, *Phoenix sylvestris* was utilized maximum of 26.15% by six bird species namely Scaly-breasted munia (n=1), Spotted dove (n=5), Mourning dove (n=3), Common Myna (n=1), House sparrow (n=3) and white-headed babbler (n=4). Next to *Phoenix* sp. 16.92% of nest was recorded in *Bougainvillea spectabilis* which was used by five species

Table 4. Success rate of bird nests recorded during the study period

SCIENTIFIC NAME	# of nest	Nest with egg	# of Egg	# of egg hatched	% of Success
Halcyon smyrnensis	2	1	4	2	50
Vanellus indicus	8	3	8	5	63
Orthotomussutorius	3	3	9	6	67
Columba livia	25	20	40	25	63
Zenaida macroura	3	2	4	3	75
Spilopeliachinensis	8	6	12	8	67
Corvussplendens	5	3	12	6	50
Lonchura punctulate	8	6	32	28	88
Lonchurastriata	3	3	16	16	100
Turdoidesaffinis	9	4	8	6	75
Anthusrufules	4	2	8	6	75
Cinnyrisjugularis	5	3	5	3	60
Leptocomazeylonica	3	3	6	4	67
Passer domesticus	8	5	12	6	50
Francolinuspondicerianus	5	5	20	14	70
Pavocristatus	10	4	8	5	63
Psittacula krameria	4	2	5	3	60
Pycnonotuscafer	5	5	15	11	73
Acridotherestristis	3	3	9	8	89

Table 5. Success rate with reference to nest type

S.No.	Family	Scientific name	Nest type	# of Egg	# of egg hatched	% of Success	% of success of nest type
1	Cisticolidae	*Orthotomussutorius*	Cup	9	6	67	73
2	Leiothrichidae	*Turdoidesaffinis*		8	6	75	
3	Motacillidae	*Anthusrufules*		8	6	75	
4	Pycnonotidae	*Pycnonotuscafer*		15	11	73	
5	Estrildidae	*Lonchura punctulate*	Ball	32	28	88	94
6	Estrildidae	*Lonchurastriata*		16	16	100	
7	Charadriidae	*Vanellus indicus*	Ground	8	5	63	65
8	Phasianidae	*Francolinuspondicerianus*		20	14	70	
9	Phasianidae	*Pavocristatus*		8	5	63	
10	Passeridae	*Passer domesticus*	Hole	12	6	50	53
11	Alcedinidae	*Alcedoatthis*		4	2	50	
12	Psittacidae	*Psittacula krameria*		5	3	60	
13	Columbidae	*Columba livia*	Open	40	25	63	69
14	Columbidae	*Zenaida macroura*		4	3	75	
15	Columbidae	*Spilopeliachinensis*		12	8	67	
16	Corvidae	*Corvussplendens*		12	6	50	
17	Sturnidae	*Acridotherestristis*		9	8	89	
18	Nectariniidae	*Cinnyrisjugularis*	Pendent	5	3	60	64
19	Nectariniidae	*Leptocomazeylonica*		6	4	67	

of birds, namely, scaly-breasted Munia (n=4), White-rumped Munia (n=2), Spotted dove (n=2), Olive-backed sunbird (n=1), Purple-rumped sunbird (n=1)(Table 3).

Nest concealment and success

Of the 121 nests the nest variables of 56 nests were recorded. Concealment was recorded high in common tailor bird with 3 points (95% concealment), ball nest birds such as scaly-breasted munia, white-rumped munia with 4.1 to 4.7 points (90% concealment) and very less concealment was recorded in hole nest bird with 14 points (5 to 10%). Nesting success of birds were calculated by considering available nest with egg. The calculation was done by just calculating number of eggs and number of eggs hatched. Successes rate was more in Estrildidae which includes Munia. Of which White-rumped Munia the success rate is 100 % and for scally breasted Munia 88 %. Whereas success rate was recorded minimum in House sparrow, House crow and White-breasted Kingfisher (50% each) (Table 4).

Nest type

Among the 121 nests 36% (n = 44) of nest belonged to open nest type, which includes five species of birds namely spotted dove, mourning dove, blue rock pigeon, common myna and house crow. Following open nests, 19% (n = 23) of the nests were recorded as ground nests.Three species, namely, peacock, red-wattle lapwing and grey francolin kept ground nests. The nests of four species, namely, common tailor bird, white-headed babbler, paddy field pipit and red-vented bulbul-built cup nest which occupies nearly 17% (n=21). Other nests include 12% of hole nest (n =14), 11% (n=14) of ball nests, 7% (n=8) of pendent nests. Two sunbird species, namely, olive-backed sunbird and Purple-rumped sunbird built pendent nests. Among the different type of nests, success rate was recorded high in ball nests (94%) followed by cup nests (73%) and open nests (69%) (Table 5).

DISCUSSION

Leaving offspring to succeeding generation is the most important aspect of animal life. Though all month nests were recorded. More number of nests were recorded during the month of June and July which is reported in many community studies in urban lands. Nests of 15 species of birds were recorded from 17 plant species belonging to thirteen families. The factor which regulates the nesting Goth and Vogal, 1996, Das 2008). In this study breeding season correlates with increasing temperature and had negative correlation with rainfall. In warmer weather birds need less food to maintain themselves (Perrins and Birkhed, 1983). Temperature and rainfall were reported to be the major factors which regulate the breeding season of the forest birds by earlier studies as well (Vijayan *et al.,* 1998; Das 2008). Increased rainfall is correlated with increased food abundance and hence monsoon is regarded as an appropriate season for insectivores' birds to breed (Das, 2008). Abundance of food increasing with onset of rain was observed in many studies (Nirmala, 2002, Gokula, 1998). Sodhi found that rainfall has strong influence on the breeding of the birds. Rainfall and clutch size may be linked *via* food availability (Goth and Vogal, 1996).plant preference is the architectural suitability to place the nests (Das, 2008). *Polyalthialongifolia* and *phoenix sylvestris* were the most preferred nesting trees. *Phoenix* tree have dense cover of leaves whihc the birds might desire for nest protection. Locating cluster of plants close to existing patches of habitat allows for easier travel by birds. Maximum number of nests were recorded in Bougainvillea tree, which is rapid growing tree, maturing to 10 to 60 feet tall, and is having dense cluster of stems which are attracted many birds to nest within. Numerous species of birds nested in this tree. *Leucophyllumfrutescens* is a pretty shrub preferred by ball nest birds both species of munias were noted to nest in this tree.Juniperus plants were preferred by sunbird speccies. It is a tree found growing in open areas in full sun, and is an evergreen tree. It provides excellent year-round cover, food nesting sites and nest-building material for birds (Chamber *et al.,* 2009).

Out of six nest types a greater number of nests belonged to the open nests. In this study five species were recorded to keep open nest. Almost, thorughout the year their nests was recorded. These birds (myna, pigeon, dove and crow) were very common and seen around human habitations, they can easily adapt with disturbance. Myna built bulky nests with heavy vegetation as reported in many studies (Ali, 1945). Myna nest made with materials lime steels, twigs, dry leaves, feather, polythene bites and loose coir pith. Mostly it nests in the habitations of man.

Totally five nests of house crow were recorded. Most of the nest recorded on tall trees. The house crow mate on the floor or on branches not in the air. The nest materials were twigs arranged into a large cups as reported in many studies (Salvati, 2002).

A greater number of nests was occupied by Columbidae family which includes pigeons and doves. Columboids are symmetrical with environmental conditions (Dawson *et al.,* 2001,). These birds require only scanty habitats (Dawson, 2002). They are less sensitive to disturbance, and also can make many clutches in single breeding season.

Less number of nests were recorded for the kingfisher which is a hole nesting bird. Henc it is needed to assess habitats for hole availability as their requirements are

much more specific. Furthermore, hole breeders often contest nest sites interspecifically (Ogasawara, 1976). This kingfisher nest during dry months at which the water level in the canals goes down which facilitates the easy sighting of fish.

Parrots preferred trees in the hole, nests were recorded both in live and dead trees. They use already existing hole in the trees. The wide variety of exotic ornamental and fruit trees planted in the habitat supplies adequate food for parrot (Forke 1981, Hall, 1988).

In this study house sparrow nest building was recorded mainly from February, and a smaller number of nests were recorded during other times of the year. Totally eight nests of house sparrow were recorded. Nest of sparrow made up of soft cotton grass species some nest with anthropogenic nest material which could be a beneficial resource enabling nest construction in place where natural materials are limited. In our study we observed human hair as binding material in house sparrow nests. The gradual decrease in usage of plant matter towards urban areas was reported in other studies as well (Anderson, 2006). Dhanya *et al* 2006 reported house sparrow nest was made up of 90% plant materials and 10% anthropogenic materials.

Two species of Munia were noted to build ball nests. Totally eight nests of Munia were recorded. Their ball shaped nests were constructed with bushy or thorny plants. Scally breasted Munia can breed during any month of the year (Payne 2010).

Four species of cup-nesting birds were recorded in this study. Of which white-headed babbler nests were recorded in four months. It is earlier reported that, in India, egg-laying of babblers varies locally to cover almost the whole year, but occurs mainly during March–July and June–September(Moosavi *et al.,* 2011). Cup nests are usually made with dried grasses and twigs that are stuck together using globs of saliva.

Pendent nests created an elongated sac suspended from a tree branch and made from pliable materials. Totally eight pendent nests of two species of sunbirds were recorded. Nectarivores birds can be expected to have close associations with a habitat (Snow and Snow, 1980). Sunbirds mostly confined to hot regions of the world (Klasing, 2004). In this study their nests were built in human habitats and just few meters up from the ground. This finding is similar to that of Wesley (2004) and in contrast to the findings of Raval (2011).

Three species of birds were noted to build nest in the ground and kept under thick bush. The monogamous grey francolin breeds during April to June as reported in Bro *et al.,* (2004) in Pakistan but Roberts (1991) in his studies he recorded nesting francolin during September and October after monsoon rains. Their nests were well concealed inside clumps of grasses in thorny bushes and, in a depression on the ground having few blades of grass or dead leaves, similar to the report of Roberts(1991). A simple grass lined nest was reported for the species by Ali (1945) and Bro *et al.,* (2004). Hosking and Newberry, (1944) reported that the sandy colour of the hen helps provide protection to the eggs while incubating. The present observation revealed that nests of grey froncolin were located on the ground below natural vegetation. These findings are in agreement with Hussain *et al.,* (2012) and Bro *et al.* (2004).

Although a greater number of nests was recorded in the open nest on building, success rate was recorded high in ball nesting birds. This may be due to the high concealment nature of ball nest birds which result in less predation ('rare site hypothesis' Martin 1998, 1993, Filliater *et al.,* 1994). It was earlier observed that lower predation risk enables birds to have larger clutch size and high breeding efficiency (Martin, 1998).

This study has shown that the resident birds has distinct microhabitat preferences within mixed forests which in turn lead to the patchy distribution of the species. The prevailing fragmentation hypothesis suggests that predation rates are higher in fragmented area than in continuous forest (Rabinson *et al.,* 1995). As such conserving several small patches would not be as efficient as considering large protected area (MacArthur & MacArthur, 1961; Davidar *et al.,* 2007).

Sulur is having a lot of construction works in and around the study sites, which results in removal of trees. So, planting of trees on the road side, in and around the houses could help the birds for nesting. Considering all these factors, management should ensure that adequate protection is given to birds and their habitats in the present study area.

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