



Nesting and Breeding Success of Red-vented Bulbul (*Pycnonotus cafer*) in Orchards, Parks and Agricultural Fields in Renala Khurd, District Okara, Punjab, Pakistan

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ABSTRACT

Nesting and breeding success of red-vented bulbul (*Pycnonotus cafer*) were studied in orchards, parks and agriculture fields in Renala Khurd, district Okara, Punjab, Pakistan. A total of 69 nests were located in the study area; breeding activity was observed in 51 active nests. The successful nests for breeding activity were recorded in parks (46%) followed by orchards (28%) and agricultural fields (27%). Highest percentage of successful nests was found on forks (48%) while nests on middle, terminal and other positions of plants were recorded as 17%, 10% and 25%, respectively. The preferred height for nest construction was recorded 1-2m (58%) followed by 2-3m (17%), 0-1m (16%), 3-4m (7%) and 4-5m (1%). The bulbul prefers to make nests on northern white cedar (*Thuja occidentalis*; 32%) followed by guava (*Psidium guajava*; 19%), mango (*Mangifera indica*; 9%), white mulberry (*Morus alba*; 9%), sweat orange (*Citrus X sinensis*; 9%), babul (*Vachellia nilotica*; 7%), banyan (*Ficus bengalensis*; 4%), weeping fig (*Ficus benjamina*; 3%) and date palm (*Phoenix dactylifera*; 3%). The highest number of nests were recorded with clutch size 3 (87%) followed by 2 (11%) and 4 (2%). A total of 154 eggs were observed in 51 nests, from which 10% eggs were infertile, 19% were predated and other losses counted 4%. A total of 104 eggs under observation were hatched, from which 28% chicks were predated and 6% fell out from the nest. The fledgling success was the highest in parks (65%) compared to orchards (25%) and agricultural fields (10%). It is concluded that bulbul preferred to construct nests on northern white cedar in parks. Moreover, breeding success was higher in parks compared to orchards and agricultural fields.

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Authors' Contribution

MZ and MSA conceived and design the study. MZ and AR conducted field work. MSA, BAR and AR analyze the data and draft the manuscript.

Key words

Breeding success, Clutch size, Hatching success, Fledgling success, Nest survival, Predation, Red-vented bulbul

INTRODUCTION

The bulbul family (Pycnonotidae) is the largest group of passerine birds with about 138 species. The Pycnonotidae family is widely distributed from Africa, South Asia, Islands of western Indian Ocean to Madagascar (Sibley and Monroe, 1990; Fishpool and Tobias, 2005). Five species of the bulbul are reported from Pakistan, red-vented bulbul is the most common and widely distributed in the Indus plains and cultivated areas of all provinces except deserts and Balochistan (Roberts, 1991; Lepage, 2007). According to IUCN red list of threatened species, red-vented bulbul is categorized as least concern (IUCN Red List of Threatened Species, 2018).

Many factors influence the breeding biology of birds,

such as availability of food, predation risk, selection of site for the nest, nesting materials and landscape (Newton, 1998). The changes in abiotic factors is also related to changes in breeding biology (Hughes, 2000). Long term studies are necessary for the detection of these changes (Sutherland, 1996; Newton, 1998; Thiollay, 2000). Red-vented bulbul is found to be abundant in cultivated lands, gardens, parks and forests. Two studies have been conducted recently on breeding biology of red-vented bulbul in Mansehra and Rawalpindi/Islamabad areas of Pakistan (Zia *et al.*, 2014; Awais *et al.*, 2015). Studies suggest that nesting and breeding parameters viz; nest position on plants, nest structure, clutch size, hatching success and fledgling rate differ due to habitats and/or landscapes (Bhatt and Kumar, 2001; Brooks, 2013; Manju and Sharma, 2013; Zia *et al.*, 2014). Red-vented bulbul is native to district Okara, Punjab that has unique habitats including orchards, parks and agricultural fields. There is no documented information available on nesting behavior and breeding success of red-vented bulbul in orchards,

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parks and agricultural fields of Tehsil Renala Khurd district Okara, Punjab, Pakistan. The present study was designed to investigate the nesting behavior (nest position on plants, nest morphometrics) and breeding success (clutch size, hatching and fledgling rate) of red-vented bulbul in orchards, parks and agricultural fields of tehsil Renala Khurd district Okara, Punjab Pakistan.

MATERIALS AND METHODS

The study was conducted in tehsil Renala Khurd, district Okara, Punjab. Based on reconnaissance survey, line transects of 100m long and 50m wide were established and observations were taken twice a week. A total of 3 km² (1km² each) comprising of orchards (mango, guava, lemon, grapefruit and orange; 30.8180° N 73.4816 E), parks (TMA Park, Family Park, Children Park and Wonderland Park; 30.9444° N, 73.6324° E) and agricultural fields (vegetables, cereals, wheat and rice; 30.8782° N, 73.5954° E) irrigated by Lower Bari Doab Canal were selected for data collection in tehsil Renala Khurd, district Okara (Fig. 1). The climate of the Renala Khurd is classified as BWh by the Köppen-Geiger System. There was no rain recorded during data collection period. Many migratory birds visit in summer for breeding and stay until October.

Nests and nesting sites were checked from all the study sites from March 5 (before breeding) to the October 27, 2017 (until no newly built nests were found) twice a week. After the start of breeding activity, nests were observed on daily basis in orchards, public parks and agricultural fields. A total of 69 nests were found and observed for nesting behavior and breeding success. All nests were observed by the same person. Nesting behavior in terms of nesting characteristics (nesting plant, nest height from ground), and nest position on plant (fork, terminal, middle and other) were recorded with measuring tape and nest morphometrics (inner and outer diameters, height and depth of the nest) were measured with digital Vernier caliper. Breeding success of red-vented bulbul was recorded in terms of date of first and last egg laid, clutch size, hatching time period and fledgling time period from active nests. The failed nests were also observed to record predation of eggs and nestling and other losses. The predators commonly found in the study area were also recorded. The data were organized by calculating percentages, mean and standard deviations. Hatching success and fledgling success were calculated by following formula suggested by Murray (2000).

$$\text{Hatching success} = \frac{\text{Number of chicks hatched}}{\text{Total number of eggs}}$$

$$\text{Fledgling success} = \frac{\text{Number of chicks fledged}}{\text{Total number of chicks hatched}}$$

RESULTS AND DISCUSSION

Breeding season of red-vented bulbul was observed from end of March to early September in tehsil Renala Khurd, district Okara, Punjab, Pakistan with peak from May to July. Our results are in agreement to the previous study that reported breeding season of red-vented bulbul from April to September and peak in August to September at Balaram-Ambaji Wildlife Sanctuary Gujarat, India (Prajapati *et al.*, 2011) in semi-arid condition. Other studies report different ranges of breeding season of bulbul starting from February to August (Balakrishnan, 2007), May to August (Awais *et al.*, 2015) in Mansehra, and March to October in Sikar region, Indian (Rao *et al.*, 2013). According to Manju and Sharma (2013), bulbul breeding season is from March to May in Haryana, India. According to Watling (1983), its breeding season spans from October to late February in Fiji (Oceania, Pacific Ocean, Tropical marine climate; only slight seasonal temperature variation). It has been established that variations in breeding season and peaks occur continuously from year to year (Newton, 1964; Rao *et al.*, 2013; Awais *et al.*, 2015).

Table I. Dimensions of red-vented bulbul (*Pycnonotus cafer*) nests in Tehsil Renala Khurd, district Okara, Pakistan (n=69).

	Means ± SD	Range
Outer diameter	3.6 ± 0.1	2.4-4.9
Inner diameter	2.6±0.2	1.9-3.7
Outer nest height	2.2±0.4	1.5-2.9
Inner depth	1.4±0.3	0.6-2.8

Nest characteristics

The data on morphometrics parameters of bulbul nests are given in Table I. The mean (cm) outer diameter, inner diameter, outer nest height and inner depth were recorded as 3.6 ± 0.1, 2.6 ± 0.2, 2.2 ± 0.4 and 1.4 ± 0.3, respectively. Our findings are in line with previous reports on bulbul nest morphometry from different regions Rawalpindi/Islamabad (Zai *et al.*, 2014), Fiji (Watling, 1983), New Delhi, India (Ali and Ripley, 1987), India (Balakrishnan, 2007, 2010) and Gujarat, India (Parajapati *et al.*, 2011). In the present study, it was observed that the bulbul nest was small bowl-shaped. Red-vented bulbul observes the location before selecting the nest site for 3 to 4 days, once selected the suitable place starts nesting. The nest is completed within 3 to 5 days. It depends on the availability of nesting materials viz; plant roots, twigs, grasses plastic fibers, plastic bag part and old spider web mostly present on keeker (*Vachellia nilotica*). Our results

Table II. Breeding success of red-vented bulbul (*Pycnonotus cafer*) in orchards, parks and agricultural fields of tehsil Renala Khurd, district Okara, Pakistan.

	Plant	Total nest (%)	Active nest (%)	Egg hatching (%)	g Fledgling (%)
Orchards	<i>Psidium guajava</i>	11 (15.96)	5 (9.8)	9(8.65)	7 (8.75)
	<i>Mangifera indica</i>	6 (8.69)	5 (9.8)	8 (7.69)	5 (6.25)
	<i>Citrus X sinensis</i>	6 (8.69)	4 (7.8)	9 (8.65)	8 (10)
	Total	23 (33.33)	14 (27.4)	26 (24.99)	20 (25)
Parks	<i>Morus alba</i>	6 (8.69)	4 (7.8)	9 (8.65)	7 (8.75)
	<i>Ficus benjamina</i>	2 (2.89)	1 (1.9)	1 (0.96)	1 (1.25)
	<i>Thuja occidentalis</i>	22 (31.88)	21 (41.2)	50 (48.07)	44 (55)
	<i>Phoenix dactylifera</i>	2 (2.89)	2 (3.9)	3 (2.88)	0 (0)
	Total	32 (46.35)	28 (54.8)	63 (60.56)	52 (65)
Agriculture	<i>Dalbergia sissoo</i>	4 (5.79)	3 (5.88)	5 (4.8)	2 (2.5)
	<i>Ficus bengalensis</i>	3 (3.34)	2 (3.9)	3 (2.88)	2 (2.5)
	<i>Vachellia nilotica</i>	5 (7.24)	4 (7.8)	7 (6.73)	4 (5)
	Total	14 (16.37)	9 (17.58)	15 (14.41)	8 (10)

are partially in agreement with previous studies by various reporting the use of similar materials in the construction of bulbul nests (Ali and Ripley, 1987; Balakrishnan, 2007; Zia et al., 2014).

Table III. Vegetation preference of red-vented bulbul (*Pycnonotus cafer*) for construction of nests in Tehsil Renala Khurd district Okara, Pakistan.

	Total nests Successful nests Failed nests		
	No. (%)	No. (%)	No. (%)
<i>Psidium guajava</i>	13(18.84)	7(13.73)	4(44.44)
<i>Mangifera indica</i>	6(8.69)	4(9.8)	1(11.11)
<i>Phoenix dactylifera</i>	2(2.89)	2(3.92)	1(11.11)
<i>Morus alba</i>	6(8.69)	4(7.84)	0(0)
<i>Citrus X sinensis</i>	6(8.69)	4(7.84)	2(22.22)
<i>Dalbergia sissoo</i>	4(5.79)	3(5.88)	0(0)
<i>Ficus benjamina</i>	2(2.89)	1(1.96)	0(0)
<i>Ficus bengalensis</i>	3(4.34)	2(3.93)	0(0)
<i>Vachellia nilotica</i>	5(7.24)	3(7.84)	0(0)
<i>Thuja occidentalis</i>	22(31.88)	21(41.17)	1(11.11)
Total	69(100)	51(100)	09(100)

Nesting success

The data on successful nests in orchards, parks and agricultural fields are given in Table II. The highest percentage of successful nests was observed in parks (54.8%) followed by orchards (27.4%) and agricultural fields (17.58). The bulbul preferred the leafy, dense bushes

and small leafy trees for nest construction (Table III). The bulbul preferred to make nests (32%) on northern white cedar (*Thuja occidentalis*), guava (*Psidium guajava*; 18.84%), mango (*Mangifera indica*; 9%), sweet orange (*Citrus X sinensis*; 9%), white mulberry (*Morus alba*; 9%), keekar (*Vachellia nilotica*; 7%), ahli or tali (*Delbergia sissoo*; 6%), banyan (*Ficus bengalensis*; 4%), khajoor or date palm (*Phoenix dactylifera*) 4% and 3% weeping fig (*Ficus benjamina*). The highest percentage of successful nests was on forks (48%) while nests on middle, terminal and other positions were recorded as 17%, 10% and 25%, respectively. (Table IV). Our findings are partially similar to those of Zia et al. (2014) that described highest successful nest were observed on forks (43%) followed by middle 29%, others 17% and terminal 11%. The preferred height from the ground for the construction of nest on the plant was recorded 1-2 m (58%) followed by 2-3 m (17%), 0-1 m (16%), 3-4 m (7%) and 4-5 m (1%). In the present study, preferred plant species for the construction of nest in parks, orchards and agricultural fields were northern white cedar (31.88%), guava (15.96%) and keekar (7.24%), respectively. Our findings are in agreement to the previous studies that described 1-2 meter as the preferred height for bulbul nest construction (Watling, 1983; Zia et al., 2014; Awais et al., 2015). Some studies however, reported 2-3 m as the preferred height for nest construction (Inglis, 1922; Dixit, 1963). It is pertinent to mention that red vented bulbul preferred medium sized trees for nest construction that varied from region to region mainly due to the variation in vegetation type (Balakrishnan, 2010; Zia et al., 2014; Awais et al., 2015). Awais et al. (2015)

reported that red-vented bulbul did not construct its nest on man-made structures. Similar observation was recorded in this study; probably because of availability of quality and quantity of vegetation that provided adequate prime habitat.

In the present study, bulbul constructed nests on 10 different plant species. However, many studies from Pakistan reported half the number of plant species for the construction of bulbul nests (Zia *et al.*, 2014; Awais *et al.*, 2015), although plant species differed in each study. Similarly, studies from India reported different number of plant species for nest construction ranging from 4-12 (Manju and Sharma, 2013; Rao *et al.*, 2013). It is suggested that selection of plants for construction of nests depends on the vegetation of an area.

Table IV. Nesting success of red-vented bulbul (*Pycnonotus cafer*) in Tehsil Renala Khurd district Okara, Pakistan.

		Total nest	Successful nests	Failed nests
		No. (%)	No. (%)	No. (%)
Position of nest	Fork	33(47.83)	30(58.82)	3(33.33)
	Terminal	7(10.14)	5(17.64)	2(22.22)
	Middle	12(17.39)	5(9.80)	1(11.11)
	Other	17(24.63)	7(13.72)	3(33.33)
	Total	69(100)	51(100)	9(100)
Height of nest (m)	0-1.0	11(15.94)	7(13.72)	3(33.33)
	1.1-2.0	40(57.97)	35(68.62)	2(22.22)
	2.1-3.0	12(17.39)	7(13.72)	2(22.22)
	3-0-4.0	5(7.24)	2(3.92)	1(11.11)
	4.0-5.0	1(1.44)	0(0)	1(11.11)
	Total	69(100)	51(100)	9(100)

Table V. Clutch size and reproductive success of red-vented bulbul (*Pycnonotus cafer*) in Tehsil Renala Khurd, district Okara, Pakistan (n=51).

Clutch size	Number of nest	Hatching success	Fledgling success
	Number(%)	Number(%)	Number(%)
1	0(0)	0(0)	0(00)
2	6(11.76)	12(9.16)	7(8.75)
3	44(86.27)	92(90.83)	73(91.25)
4	1(1.9)	0(0)	0(0)
Total	51(100)	104(100)	80(100)

Clutch size

The data on the clutch size and reproductive success of the bulbul are given in Table V. The clutch size ranged from two to four: 3 (86.27%), 2 (11.8%) and 4 (1.9%). Our findings are similar to the previous reports that reported majority of nests with clutch size 3 (Phillips, 1943; Ward, 1969; Ali and Ripley, 1971; Van Tyne and Berger, 1971; Fodgen, 1972; Vijayan, 1980; Ahmad and Brooks, 1990; Manju and Sharma, 2013; Rao *et al.*, 2013; Zia *et al.*, 2014; Awais *et al.*, 2015) and 2 (Whistler, 1928; Stuart, 1932; Balakrishnan, 2009). However, in Pycnonotids nests with 3 eggs were rare; nests with 2 eggs were recorded abundantly (Ali and Ripley, 1987). The color of bulbul eggs was pinkish with dark red spots on broad end (Jerdon, 1863; Zia *et al.*, 2014). It is believed that clutch size depends on the availability of food resources, large clutch size occurs when excessive amount of food is available and easy to approach (Vijayan, 1980).

Incubation, hatching and fledgling

In the present study, eggs were found incubated by both parents and incubation period ranged from 11 to 15 days, while fledgling period was recorded as 13 to 16 days. The incubation and fledgling periods are similar to the previous reports; incubation period ranged between 11-15 days and fledgling period 12-14 days in Mansehra, Khyber Pakhtunkhwa, Pakistan (Awais *et al.*, 2015). However, Ali and Ripley (1971) recorded incubation and fledgling periods as 14 and 12 days respectively. Prajapati *et al.* (2011) reported incubation period of 11-14 days. Manju and Sharma (2013) noted 9-12 days incubation period and 14 days fledgling period. Rao *et al.* (2013) observed 11-13 days incubation period and 12 days fledgling period. Zia *et al.* (2014) reported 11-13 days for incubation and fledgling period. It is suggested that the length of incubation and fledgling period depends on food availability, age of parents, height of nest and number of young ones in a brood (Dhanda and Dhanda, 1998). In the month of May, June and July eggs hatched in 11-12 days, while in April, August and September eggs took 13 to 15 days for hatching. Moreover, chicks hatched in April and August were observed more active than the ones hatching in June and July. The first egg hatched in the morning at 9:36 hours on April 9, 2017 and the last egg was hatched on September 12, 2017 at 15:58 hours. The nestlings of April were fledged within 13 days but nestlings of September were fledged in 14-16 days.

Breeding success

The data on the breeding success of red-vented bulbul are given in Table II. A total of 154 eggs were counted from different study sites in the present study. The percentage of

hatched eggs and fledged chicks was recorded 67.53% and 76.92%, respectively that is higher than previous record of hatching success 55.6% and fledgling success 59.4% (Awais *et al.*, 2015). Prajapati *et al.* (2011) recorded 50% successful hatching and 53% successful nests (fledgling). The higher breeding success is believed to be associated with suitable vegetation and availability of food. The higher hatching success was recorded in parks (60.56%) followed by orchards (24.99%), and agricultural fields (14.41%). Similarly, fledgling success was recorded 55%, 25% and 10% in parks, orchards and agricultural fields respectively. Higher percentage of hatched eggs was recorded in parks (60.56%) compared to orchards (24.99%) and agricultural fields (14.41%). Likewise, percentage of fledged nestlings was recorded in parks (65%), orchards (25%) and agricultural fields (10%).

Table VI. Eggs and nestling losses in red-vented bulbul (*Pycnonotus cafer*) in tehsil Renala Khurd, district Okara, Pakistan (n=51).

		Number(%)
Egg loss	Number of eggs	154(100)
	Infertile eggs	15(9.7)
	Predated	29(18.83)
	Other losses	6(3.89)
	Hatched	104(67.53)
Nestling loss	Number of nestlings	104(100)
	Predated	20(19.2)
	Fell out from nests	4(3.8)
	Fledged	80(76.92)

Egg and nestling losses

The data on egg and nestling losses of red-vented bulbul are given in Table VI. The infertile eggs were 9.7%, whereas predation and other losses were 18.83% and 3.89% respectively. Predation loss of nestlings was 19.2% whereas 3.8% nestlings fell out from the nests. In our study area, predation rate was recorded higher at egg and nestling stage compared to 6% for eggs and 9% for nestlings in Rawalpindi/Islamabad area as reported by Zia *et al.* (2014). However, other studies have reported 70% predation at egg and nestling stage (Watling, 1983; Kruger, 2004; Fishpool and Tobias, 2005; Balakrishnan, 2007, 2010) and 71% in in tropics (Robinson *et al.*, 2000; Stutchbury and Morton, 2001). In our study area, Bengal monitor (*Varanus bengalensis*), oriental garden lizard (*Calotes versicolor*), shikra (*Accipiter badius*), Eurasian sparrowhawk (*Accipiter nisus*), house crow (*Corvus splendens*), some species of snakes and eagle has been

recorded. Our predator species are different reported by Zia *et al.* (2014). The losses to the eggs and nestlings were associated with predation, cutting of tree, rain and storm. Capture of the bulbul for sale in bird markets is also one the reason of egg losses.

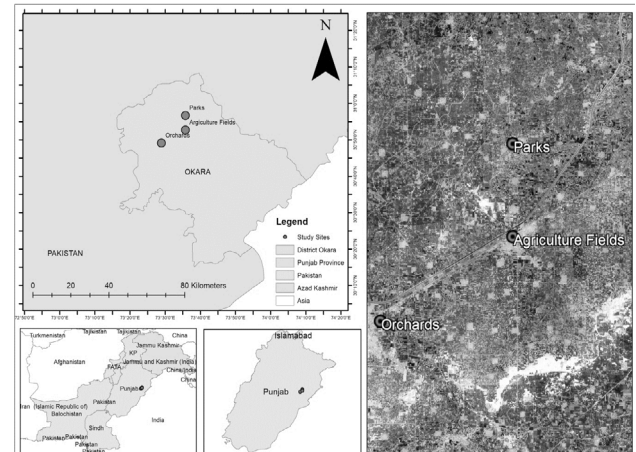


Fig. 1. Map of tehsil Renala Khurd, district Okara, Punjab, Pakistan showing locations of study sites (orchards, parks and agricultural fields).

CONCLUSION

It is concluded that bulbul preferred to construct nests on northern white cedar in parks, moreover breeding success is higher in parks compared to orchards and agricultural fields.

Statement of conflict of interest

The authors have declared no conflict of interest.

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