



Breeding Performance and Nest Characterizations of Red Vented Bulbul (*Pycnonotus cafer*) in Bajaur Valley, Khyber-Pakhtunkhwa, Pakistan

Rahmat Ullah Khan^{1*}, Karim Gabol¹, Asif Sadam², Waheed Ali Panhwar³, Hamidullah⁴ and Abdul Rahim¹

¹Department of Zoology, University of Karachi, Karachi-75270 Pakistan

²College of Life Sciences, Hainan Normal University, Haikou-571158 China

³Department of Zoology, Shah Abdul Latif University, Khairpur, Sindh, Pakistan

⁴Department of Zoology, The Islamia University Bahawalpur Campus, Bahawalpur, Pakistan

ABSTRACT

Red vented bulbul *Pycnonotus cafer* is a common passerine and eternal breeder of Pakistan. However, this bird is locally found abundantly in Bajaur valley, but the basic data on its status and breeding performance have not been collected. To stipulate all the associated data about its breeding and nest characterizations, complete research was carried out in the cultivated areas of Bajaur valley during 2020. The breeding season starts from mid-April and lasts until July. Nests were explored orderly in all the probable sites with help of the landowners. Overall, 52 nests were found mainly built on five different types of vegetation at an average height of 2.87 ± 1.3 m above the ground. The shape of the nest was round to oblong, in the center or on the branch fork of plants. The nests were mainly constructed using local dry grasses (48%) followed by crop leaves (35%), plastic string (10%), and unidentified materials (7%). The average outer diameter of the nest 12.00 ± 1.1 cm, inner diameter 9.13 ± 2.3 cm and inner cup depth was 4.99 ± 2.1 cm. This bird has one brood per season. Overall breeding cycle lasted for 90 days. The shape of the eggs was oblong and white pinkish, with darker red spots. The average incubation and nestling periods were 12.03 ± 1.3 and 13.21 ± 1.08 days respectively. The average clutch size was 2.66 ± 0.5 eggs; brood size was 2.66 ± 0.5 nestlings. The average number of young fledged was 2.66 ± 0.98 young, fledging success was 94.2%, and overall breeding success was 62.2%. Results suggest that agricultural trees, especially thorny plants, represent an attractive habitat for bulbul. Factors such as avian predation, nest destruction, heavy storm, nest failure, and the presence of potential predators are affecting the breeding success of red-vented bulbul in the area.

Article Information

Received 09 October 2021

Revised 21 December 2021

Accepted 05 January 2022

Available online 18 May 2022
(early access)

Authors' Contribution

The manuscript is extracted from the Ph.D. research work of RUK, supervised by KG. AS, WAP, Hamidullah and AR helped in writing and formatting of the manuscript.

Key words

Agricultural habitat, Bajaur, Breeding success, Bulbul, Clutch size, Fledging, Nestlings

INTRODUCTION

Red-vented bulbul *Pycnonotus cafer* is a local breeder, attractive, melodic passerine bird, known for its crown on head and red featherings encircled anus (Grimmett *et al.*, 2016). During the breeding season, it plays various voices for breeding pairs: attraction, social interactions, awareness of threats and danger (Geoff, 1996). It belongs to the family Pycnonotidae that consists of 130 species worldwide, out of these 5 exist in Pakistan (Roberts, 1991).

In Pakistan, it is largely spread throughout the Indus plains and agriculture areas of all provinces, excluding sandy lands like Balochistan (Roberts, 1991). Both males and females of red-vented bulbul have a similar morphology. The main body is covered with dusky brunet feathers with a flaking design, while the head is covered with black feathers. The origin of red-vented bulbul is basically agricultural lands and adjacent forests (Dickinson *et al.*, 2002). A comprehensive study carried out over 54 sites in India summarized that forest was the only key factor that reflected the distribution of the species. Red-vented bulbuls are frugivorous and insectivorous that uses various fruits, shoots, nectar, and insects as dietary materials (Raju *et al.*, 2003). The breeding biology of red vented-bulbul has also been studied both in Rawalpindi and Islamabad It was found that nesting sites were mainly destroyed due to urbanization and environmental pollution (Zia *et al.*, 2014).

However, from many regions, reports about breeding biology and nest characterization of red-vented bulbul

* Corresponding author: rahmatullahkhanpk@gmail.com
0030-9923/2022/0001-0001 \$ 9.00/0



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are published, but no study has been conducted in district Bajaur. The current study aimed for the first time about the basic information about breeding performance and nest characterization of red-vented bulbul in the agricultural lands of Bajaur, Khyber Pakhtunkhwa, Pakistan.

MATERIALS AND METHODS

Study area

The data about breeding habits and nest characterization were recorded from the basic habitat of cultivated ranges of Khar (34°42.921 N, 071°27.346 E), Salarzai (34°46.091 N, 071°34.289 E) and Mamund (34°46.623 N, 071°25.359 E) in district Bajaur, Khyber Pakhtunkhwa Pakistan (Fig. 1). The watering source for these cultivated areas is mainly rain water and some lands are irrigated by tube wells. The entire area of Bajaur valley excluding mountains, is around 1290 km². It is situated at a distance of about 120 kilometers from Peshawar (Khan *et al.*, 2021), (Khan and Gabol, 2021). Bajaur has a common border of 52 km with Konar a province of Afghanistan, northern and eastern side are bounded by Dir and Malakand districts while the south west side joins district Mohmand. The area contains mountainous locations with tough weather conditions. Bajaur avails all four seasons, with heavy rainfall during winter and in spring seasons. In the study area, diverse type of flora is present which provides habitat, feeding, protection and nesting sites. The agricultural landscape includes three components: (i) agricultural crops, (ii) grasslands and (iii) tree species, both local indigenous trees and ornamental trees that provide nesting habitat to many bird species. Besides that, the ground flora of herbs, shrubs, and ground weeds are present that also provide food source to many birds (Khan and Gabol, 2021).

All the nests were searched and studied systematically in agricultural habitats from early April to the middle of July 2020. Nests were explored by searching all the potential nest sites in the area, flushing the bird from the nest, noting the nest-building activity of adults, and by accidental encounters in the study area. The local farmers and shepherds also helped in the identification of potential nest sites. A total of 52 nests were found in the area. All nests were checked after every 2 days to record egg-laying date, clutch size, brood size, hatching, and nest failures (Marini *et al.*, 2012; Gabol and Khan, 2021). When the exact egg-laying date was not known, it was estimated from the known dates of other eggs or laying interval. To record egg-laying date, each nest was inspected in the morning causing minimal disturbance to birds and nests. Incubation period was estimated as the interval between the dates last egg was laid, and the date last egg hatched. When the exact

date of incubation was not known, then egg-laying date was estimated from other known dates or laying intervals (Martin, 2002). Nest diameter, inner diameter and nest depth of each nest was recorded. Nest site characteristics like nest height from the ground, nesting tree and types of nesting material were recorded. Eggs that disappeared due to nest destruction or nest disappearance were excluded from clutch size calculation.

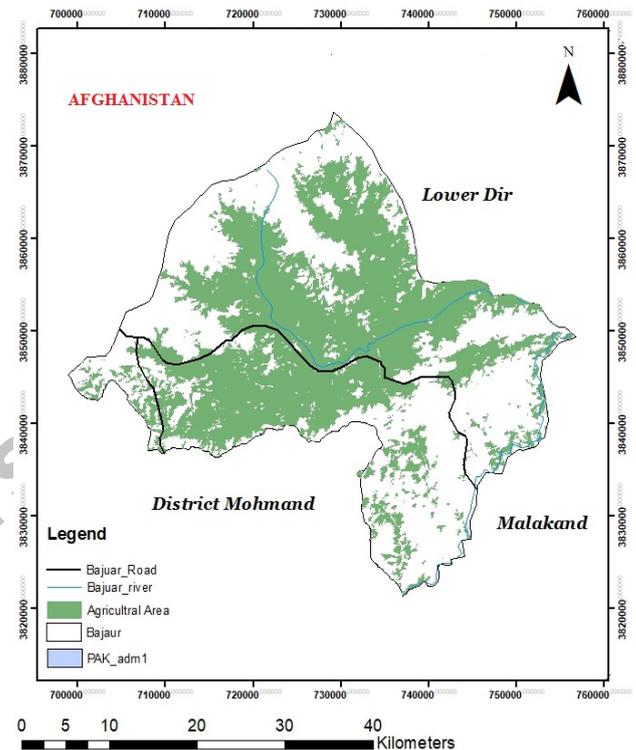


Fig. 1. Map of study area Bajaur, showing agricultural lands.

Nest disappearance was assumed when the nest or its contents completely disappeared from the site. Nest destruction was assumed when the nest was completely damaged at egg-laying stage. Some nests had disappeared after the night storm. Egg failure was assumed when the laid egg did not hatch. Nestling disappearance was assumed when the hatched nestling was not found in the nest. Hatching success was defined as the number of nestlings hatched/ total number of eggs laid. Fledging success was defined as the number of nestlings before fledging/nestlings after hatching.

The total breeding success was calculated by using the following formulae:

Breeding success = Hatching success × Fledging success/ 100%.

Statistical analysis

The nests that were missing or destroyed during the breeding period were not included for the analysis. As all nests of red-vented bulbul were found in the same habitat, and we could not find enough nests in other habitat types in order to compare breeding parameters for differences. Data are presented in the form of percentage and mean \pm SD.

RESULTS

The current study was carried out to record the facts about the breeding habits nest characteristics and the main barriers responsible for the breeding catastrophe of red-vented bulbul in Bajaur valley during the breeding season.

Habitat and nidology

All the nests were explored thoroughly by surveying all the targeted sites of cultivated areas in the breeding period from April to early July 2020. Many nests were observed during construction phase. Based on field observations of two nests, both males and females participated in nest building activities by bringing nesting material. Nest building duration lasted for 4 days. Of 52 nests, 11 nests failed and remained unattended for the entire season, 6 were destroyed while 5 nests were destroyed in night storm. Nest failure occurred mainly after the disappearance of the first egg laid.

Of the 52 nests 7 (13.46%) nests located on the fork of *Eucalyptus camaldulensis*, 12 (23.07%) on a branch of mulberry *Morus alba*, 14 (26.92%) on *Ailanthus altissima* whereas 9 (17.30%) nests were located in bakain *Melia azedarach* (branch) and 10 (19.23%) on phulai *Acacia modesta* (Fork) plantation (Table I). All nests were recorded about the center of the trees, while none was recorded on the extremes of tree branches. Of the 19 failed nests (31.57%) loss was noted for the *Acacia modesta* trees followed by *Ailanthus altissima* (26.31%) and (15.78%) each for *Eucalyptus camaldulensis* and *Melia azedarach* the lowest net loss (10.52%) was in *Morus alba* trees (Table I). In all inhabited trees species, the nests were positioned at a height from the ground ranging 2 to 6 m with an average of 2.87 ± 1.3 . Average external and internal diameter of the nest was 12.00 ± 1.1 and 9.13 ± 2.3 inches respectively. The nest shape was round to oval cup with an average depth of 4.99 ± 2.1 inches (Table I). Materials used for the construction of the nest were mostly dry grasses (48%), local crops dry leaves (35%), plastic strings (10%) and some unidentified materials (7%) (Fig. 1).

Egg production, clutch range and incubation

The physical look of the eggs was oval and pinkish

white in color with blackish spots. Twenty targeted nests were visited on a daily basis in order to record egg laying dates; after the first eggs laid, second to last eggs were laid consecutively or with a gap of one day. The egg laying period was recorded from 25 April to 4 July. The average clutch size of 52 nests was 2.78 ± 0.9 eggs (Table II). On the whole 142 eggs were laid of which 11 (7.74%) eggs did not hatch and 37 (26.05%) went missing (Table IV). When eggs laying was completed the female incubated eggs continuously for 10-14 (12.03 ± 1.3) days to complete the incubation till hatching. A fruitful incubation was recorded only in 28 nests whereas 24 nests failed, destroyed or disappeared due to predation or natural disaster (Table III).

Table I. Total failed nests in each plant species and nest site characteristics of red-vented bulbul in Bajaur.

Facts	Total nests	Failed nests
<i>Morus alba</i> (Branch)	12 (23.07%)	2 (10.52%)
<i>Ailanthus altissima</i> (Middle)	14 (26.92%)	5 (26.31%)
<i>Melia azedarach</i> (Middle)	9 (17.30%)	3 (15.78%)
<i>Eucalyptus camaldulensis</i> (Fork)	7 (13.46%)	3 (15.78%)
<i>Acacia modesta</i> (Fork)	10 (19.23%)	6 (31.57%)
Total	52 (100%)	19 (31.57%)
Facts	Average (Cm)	Extent (Cm)
Height from surface	2.87 ± 1.3	2-6 (m)
Nest exterior diameter	12.00 ± 1.1	4.8-18.2
Nest inside diameter	9.13 ± 2.3	4.1-15
Cup depth	4.99 ± 2.1	2.6-8.1

Table II. Clutch size and brood size of red-vented bulbul in Bajaur valley 2020.

Days	Number of nests	
	Incubation period	Nestling period
10	5	
11	5	2
12	6	4
13	8	12
14	4	6
15		4
Mean \pm SD	12.03 ± 1.3	13.21 ± 1.08

Egg incubation and hatchling success

All the targeted nests were observed very carefully, though with respect to the number of successful nests, hatching was 58.12% (Table VI). The average number of hatchlings was 2.66 ± 0.5 ranging from 1 to 4 nestlings.

However, 11 eggs after complete incubation did not hatch. On the whole 94 eggs hatched successfully, 6 (6.38%) nestlings were missed when about to leave the nest and fly (Tables II and IV). Both the parent birds fed the nestlings equally by various dietary materials for the entire nestling period i.e. about 10-15 (13.21 ± 1) days. In the current study, the first fledging attempt of nestling was noted during early June. Out of 29 nests fledging was successful in 27 nests with a total success percentage of 93.11%; one nest with two nestlings was missed before fledging (Table V, Fig. 2). House crow predated on eggs and a snake was also seen climbing on the tree nearer to the location of the failed nests. Along with natural disasters, jungle cats and spotted owlets were abundant at the sites of failed nests, which may be considered potential predators of eggs and nestlings. Local farmers of the area reported that children of the area also collected the eggs and destroyed the nests. All nests with at least a single nestling were recorded as successfully fledged. In all successful nests the number of nestlings fledged ranged from 1 to 4 with an average of 2.66 ± 0.98 young (Table VI).

Table III. Incubation period and nestling period of red-vented bulbul in Bajaur during 2020.

Brood range	No of nest	Brood range	No of nest
1		1	4
2	10	2	9
3	14	3	10
4	4	4	3
Mean \pm SD	2.78 \pm 0.9	Mean \pm SD	2.66 \pm 0.5

Table IV. Overall egg and nestling loss in red vented-bulbul in Bajaur during 2020.

	Facts	Total no	% age
Egg destroyed	Total No. of eggs	142	100
	Unsuccessful eggs	11	7.74
	Egg disappeared	37	26.05
Chicks demolished	Number of nestling	94	100
	Nestling disappeared	6	6.38

Table V. Number of young fledged of bulbul in Bajaur during 2020.

No. of chicks fledged	range of nest
1	3
2	10
3	7
4	7
Mean \pm SD	2.66 \pm 0.98

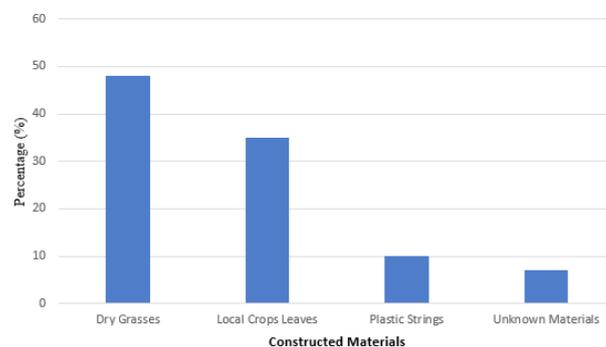


Fig. 2. Various types of materials used by red vented bulbul for construction of nests.



Fig. 3. Fledging dates of red vented bulbul chicks.

Table VI. Whole hatching success, demolished nest, fledging success and failure of red-vented bulbul in Bajaur valley during 2020.

Facts	Range of nest
Total nests	52
Hatching success	29.71
Success rate %	58.12
Failed nests	11
Nest destroyed	6
Destroy in storm	5
Nest examined	29
Fledging Success	27
Success rate %	93.11
Nestling disappeared	2
Facts	Range eggs and nestling
No of eggs laid	142
No of nestlings	94
Hatching rate %	66.19
No of young fledged	88
Fledging rate %	94.2
Entire breeding success	62.2

Overall breeding success

The overall breeding success (hatching success x fledging success/100%) was 62.2%. As a result, the whole breeding duration of red-vented bulbul was about 3 months in which 142 eggs were laid, 94 nestlings were hatched and 88 nestlings with an average of (2.66±0.98) were fledged (Table VI). Red vented bulbul performed breeding once per annum and breeding failure was mainly caused due to the destruction of nests, predation by house crows, hawks, jungle cats and local children's collection activities.

DISCUSSION

Red-vented bulbul breeding habits and the main barriers responsible for breeding catastrophe were explored in Bajaur. All the nests were recorded on trees of agricultural areas during the breeding season from April to early July 2020. Both male and female were equally involved while nest building, activity lasted for 3-5 days. Of the 52 nests, 11 nests failed, which were unattended for the entire period, 6 were destroyed while 5 nests were demolished in the night storm. According to a report by Huan *et al.* (2015) red whiskered bulbul *Pycnonotus jocosus* built their nests in the tree species of agricultural fields in Southwest China, while some ecological factors like storm, hail and predation were responsible for nest failure (Huan *et al.*, 2015). Similarly, Zia *et al.* (2014) reported that both male and female of red vented bulbul constructed their nests in local plants during March-July in Islamabad, but rapid urbanization was responsible for breeding failure.

Bulbul prefers to construct the nest about the middle location of medium to large sized trees species. According to the results of Vijayan (1980) that *Pycnonotus cafer* and *Pycnonoyus luteolus* built their nests on central branches of bushes. Balakrishnan (2010) recorded approximately similar result that black bulbul made successful nests in the middle branches of trees.

The current study noted that red-vented bulbul inhabited 5 types of plant species for nest construction at a range of height. Most nests (26.92%) were recorded on *Ailanthus altissima* followed by mulberry (23.07%), (13.46%) nests were located on *Eucalyptus camaldulensis*, although 9 nests were located in bakain branches and 10 on *phulahi* (fork). Lan *et al.* (2013) studied 98 nests of Light vented bulbul (*Pycnonotus sinensis*), in 10 different plant species. Zia *et al.* (2014) reported about the nest height of red vented bulbul from 64 to 144 cm above ground with an average of (96.08 ± 20.55) cm (Zia *et al.*, 2014).

All the nests were round with a somewhat oblong shape. The average outer diameter of the nest 12.00±1.1, inner diameter 9.13±2.3 whereas average cup depth was

4.99±2.1. Nest building materials were grasses (48%) followed by local crops (35%), plastic strings (10%), and unidentified vegetation (7%). Similar results were recorded by (Watling, 1983; Vijayan, 1980; Ali *et al.*, 1987; Balakrishnan, 2007, 2010; Prajapati *et al.*, 2011).

The look of eggs was oval and pinkish white with blackish spots. The average clutch size of 52 nests was 2.78±0.9 eggs. Our results match that of Phillips (1943), Balakrishnan (2011), Bates *et al.* (2014), and Thibault *et al.* (2018). However, Vijayan reported that the average clutch size of red-vented bulbul was about 2-3 eggs in southern India Vijayan (1980). An approximately similar result was reported by Huan *et al.* (2015) that the average clutch size of red-whiskered bulbul was 2.50±0.48 eggs.

A day after egg laying was completed the female continued to incubate eggs for 10-14 (12.03±1.3) days to complete incubation, whereas mean nestling period was 13.21±1.08 days. Watling reported about the incubation period of red vented bulbul ranged from 11-13 and an average of 11.9±0.5 days and nestling duration of about 12 days. Groves (2016) and Huan *et al.* (2015) investigated that the slight discrepancy in the incubation period may be the result of ambient temperature (Groves, 2016). The statistics of our results matches with all species of bulbul existing both in Africa and Asia (Krüger, 2004; Fishpool and Tobias, 2005; Balakrishnan, 2007, 2010).

In all 52 nests, a total of 142 eggs were recorded but only 94 eggs hatched successfully while the remaining 48 (33.79%) eggs were recorded as predated by house crows, snakes, collection of eggs by local children, destruction of nests and disappeared. During nestling period 6 (6.38%) chicks were missed while near to fly and left the nest. As a result, the entire hatching success was 58.12%. Huan *et al.* (2015) reported 27 successful nests out of 29 nests i.e. success percentage of 93.11%, similar to our results. They also reported about 64% hatching success of Asian red-eyed bulbul *Pycnonotus brunneus*. Groves (2016) reported that unsuccessful hatching and fledging of Asian red-eyed bulbul was due to ecological factors like aerial and arboreal predation. According to Quan and Li (2015) snakes were also the possible nest predator of bulbul nests.

The overall breeding success of red-vented bulbul in the study area (hatching success x fledging success/100%) was 62.2%. The whole breeding period lasted for about 3 months. Brosset (1971) reported a mean survival rate of fledgling stage of 17% for 8 West African bulbul species and discussed the different reproductive strategies of two of these, yellow-whiskered bulbul *Andropadus latirostris* and Green-tailed Bristlebill *Bleda eximia* by the same way Watling (1983) described that *Andropadus latirostris* was an irregular but seasonal breeder which reared an average of 2.22 broods, whereas *Bleda eximia* bred each season

and reared an average of 1.24 fledglings. The probable cause of egg disappearance and nest loss was the house crows, hawks, jungle cats and local peoples, intervention.

CONCLUSIONS

The current study concluded that the breeding pairs of red-vented bulbul performed the breeding activity during the breeding season in Bajaur valley. But there are some factors that are barriers to breeding success like predation on eggs and chicks by common crow, common myna *Acridotheres tristis*, jungle wild cats *Felis* spp, spotted owlets *Athene brama* and snakes. Kids of the local area were also actively involved in nest destruction and hunting.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the University of Karachi, Pakistan, which provided a chance to complete (Ph.D.) the doctoral degree in Zoology.

Statement of conflict of interest

The authors have declared no conflict of interest.

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