



Breeding and Nesting Behaviour of Red-Vented Bulbul (*Pycnonotus cafer*) in Shaheed Benazirabad District (Tropical Thorn Forest) Sindh Province of Pakistan

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ABSTRACT

In Pakistan, the Indus valley and agricultural areas are home to the red-vented bulbul (*Pycnonotus cafer*), which is the most common and widely spread bulbul species. To examine the breeding and nesting behaviour of red-vented bulbuls, a survey was conducted in Shaheed Benazirabad District, Sindh Province, Pakistan, in the year 2022. Our findings showed that (1) breeding seasons of red-vented bulbul was from February to October (spring, summer and autumn seasons); (2) the species preferred nesting at *Tamarix ramosissima* (Tamarisk; 51%), *Acacia* sp. (Kikar; 12%), *Ziziphus jujuba* (Ber Jhari; 8%), *Abizia lebeck* (Lebeck tree; 5%), *Citrus limon* (Lemon tree; 5%), *Arundinaria* (cluster of giant cane or reeds; 5%), *Bougainvillea glabra* (Paper flower; 3%), and Hedges (11%); (3) the species utilized twigs (63%) of *Tamarix ramosissima* and 37% of other materials (leaves, grasses hairs, hard shrubs, and cotton fibers) in nest preparation; and (4) the range of the height at which nests were located was 0.8 to 6 m above the ground.

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Awais Ali: Conceptualization, investigation, methodology, resources, software, validation, writing original draft. Shahida Laghari: Investigation, software, writing review and editing. Yaseen Laghari: Investigation, methodology, writing review and editing.

Key words

Passeriformes, *Pycnonotus cafer*, *Tamarix*, Reproduction, Ecology, Pakistan

INTRODUCTION

Birds are the most beautiful creatures in this cosmos, with diverse colours. Their morphology or intrinsic behaviours, such as nesting habits and parental care, make them a highly special and perfect species. The widespread distribution of birds has changed and varied the ecosystem, economy, trade, and business around the world in both beneficial and harmful ways (Whelan *et al.*, 2008). Over 10,000 bird species are known (Clements, 2022). The Family Pycnonotidae, which includes familiar species of bulbul, comprises of over 138 species (Sibley and Monroe, 1990). It is indigenous to Pakistan, Sri Lanka, and India and stretches eastward via southern China up to Vietnam.

This species can be found in many environments throughout its native and introduced range, including urban gardens and secondary growth (Fishpool and Tobias, 2005). In addition, it has been distributed to many other countries, such as the Arabian Peninsula (Kuwait, Qatar, Bahrain, the United Arab Emirates, Oman), Hawaii (Oahu), Polynesia (Fiji, Samoa, Tongatapu, Niuafo'ou), the United States of America, and New Zealand, where it is expanding (Fishpool and Tobias, 2019; Shirihai and Svensson, 2018). Furthermore, it is among the top hundred alien species that have become invasive worldwide (Lowe *et al.*, 2000). It is the most widespread and extensively dispersed bulbul species in Pakistan, found on the Indus plains and in the agricultural regions of every province, excluding Baluchistan and the deserts (Lepage, 2007; Roberts, 1991). The red-vented bulbul is listed as least concern in the list of threatened species among all threatened species on the IUCN Red List (Bird Life International, 2018).

In birds, nest formation is crucial for reproductive success and life's survival. Nest site selection, breeding success, and growth are influenced by a broad range of factors, including the availability of food, nesting materials, vegetation structure, the risk of predation, and nest ectoparasites (Biddle *et al.*, 2017). These factors

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have a significant impact on the ecology of bird nests. The thermal properties of the material and the size of the birds influence the selection of nesting material (Deeming and Mainwaring, 2015; Mainwaring *et al.*, 2014). Every species is unique, and it selects the location according to its needs. In some bird species, the design of a nest determines which mating partner is chosen. Bird populations and biodiversity have declined as a result of reduced nesting places and breeding success driven by increasing urbanization and changes in habitat. Because of urbanization and anthropogenic activities, native bird species are declining. This is attributed to habitat destruction, habitat change, and the introduction of alien species (Chace and Walsh, 2006). Due to lack of plant life, birds in metropolitan areas build their nests from man-made materials, including plastic, paper, cloth, and other domestic waste. Using waste material could be a limiting factor for the survival of birds (Townsend and Barker, 2014; Votier *et al.*, 2011; Wang *et al.*, 2009).

The red-vented bulbuls construct their nests at shrubs, slender branches of trees, hedges, stunted date palms, butt of pollarded tree and sometimes inside the buildings at a height between 1-9 m above the ground (Chishty *et al.*, 2020), like little flat cups built from small dried twigs, midribs of dead leaves, rootlets spider webs, and grass hairs (Biddle *et al.*, 2015). Sometimes, nests are established in a mud bank hole (Lamba, 1968), inside a bus (Jethua, 1998) and in tree cavities (Poole, 2000). The red-vented bulbul is known to breed year-round, peaking between January and October (Invasives, 2023). Each season, the birds can have up to three broods (Long, 1981). Approximately it lay two to four eggs, the eggs have a pinkish-white base colour with purplish-brown blotches (Long, 1981; Invasives, 2023). In addition, a red-vented bulbul's typical clutch consists of 2-3 eggs (Manju and Sharma, 2013). After around 14 days, the red-vented bulbul's eggs begin to hatch, and both parents begin to feed the chicks. When the bacterial level is low for the first several days, they wait for them to discharge before digesting the fecal sacs they produce. Later they take the faeces sacs and dispose them elsewhere (Ali and Ripley, 1971; McCann, 1931). The pied-crested cuckoo is the brood parasite of this species (Tooth, 1902). Fires, heavy rains, and predators are the leading causes of fledgling mortality (Prabhaka *et al.*, 1990).

Moreover, the nesting and breeding habits of red-vented bulbul's have been studied in various countries. For example, Society (1924) studied in India and found that the red-vented bulbul breeds from June to September. Also, breeding was found in Tamil Nadu in February in one case. They might have numerous clutches in a single year. The eggs are pale pink with deeper red markings that are denser at the broad end. Watling (1983) researched Fiji and

found that the rainy season is the specific breeding season for red-vented bulbuls. Dhondt (1977) studied Western Samoa and found that the red-vented bulbul usually has extended breeding, mostly coinciding with the monsoon season. Azin *et al.* (2008) conducted research in Iran and found that red-vented bulbul constructs its cup-shaped nest in a bush and lays two to five eggs in a clutch. Zohaib *et al.* (2021) conducted a study in Pakistan's Punjab region and discovered that the breeding season of this species was from the end of March to early September, and in comparison to orchards and agricultural fields, parks had greater breeding success rates for the red-vented bulbul, which preferred to construct its nests on northern white cedar there. Additionally, different species' mating seasons vary from location to location, and *Ziziphus mauritiana*, *Ziziphus jujube*, and *Acacia nilotica* were the preferred tree species for red-vented bulbul nesting (Ullah *et al.*, 2021). The variations in local habitat and ecological conditions that could influence the behaviour or adaptations of the species due to the availability of the food sources, nesting sites and presence of predators could impact the species' natural history or biology within a specific area (Jones *et al.*, 2023; Benmazouz *et al.*, 2021; Coates *et al.*, 2020). While political boundaries themselves do not directly influence the natural history or biology of the species, but specific habitat and ecological conditions within a district or ecoregion can play a role in shaping the behaviour and adaptations of the species population (Marske *et al.*, 2023; Jahn *et al.*, 2020). The climatic conditions in Pakistan vary across its length and breadth (Khan *et al.*, 2023). There is a scarcity of data about the breeding and nesting behaviour of red-vented bulbul in many parts of Pakistan. Therefore, we conducted this study to investigate the breeding and nesting behaviour of red-vented bulbuls in the tropical thorn forest of Shaheed Benazirabad District, Province Sindh, Pakistan. The main aims of the study were (1) to determine the breeding season of red-vented bulbul in the study region; (2) to identify the preferred nesting sites of red-vented bulbul in the study area; (3) to observe the nest formation process of red-vented bulbul; and (4) to assess the average period of incubation for red-vented bulbul eggs.

MATERIALS AND METHODS

Study site

Shaheed Benazirabad (SBA) District, formerly Nawabshah, is one of the most populous districts in Sindh Province (Fig. 1). The district is divided into administrative units: Nawabshah, Sakrand, Qazi Ahmed, and Daur (Laghari *et al.*, 2022). It is located on the east bank of the Indus River and famous for riverine and tropical thorn forest (Shafiq and Bhaagat, 2009). This region experiences

four seasons spring, summer, autumn and winter (Shakil, 2018). The district experiences temperature above 48 °C from May through August. The weather is often dry and hot, but in rare instances (about once every 25 years), it drops below 7 °C during December/ January.

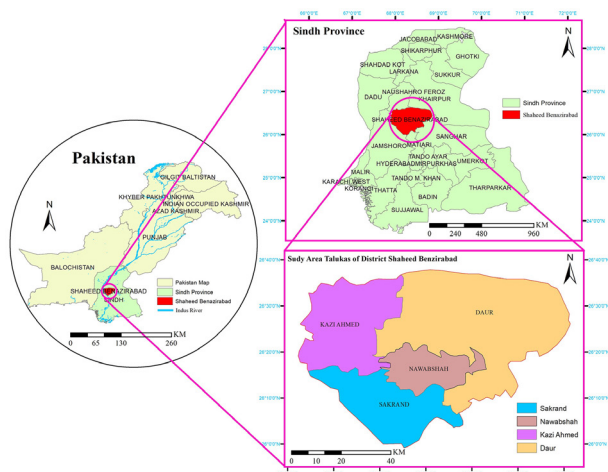


Fig. 1. Location of the study site in the Shaheed Benazirabad District (tropical thorn forest), Sindh Province, Pakistan.

Methods

The study covers a period of one year. The breeding and nesting behaviour were observed from the different areas of Shaheed Benazirabad District. From January 2022 (before breeding) through October 2022 (until no freshly built nests were detected), all of the study sites' nests and nesting locations were monitored twice weekly.

After breeding activity began, nests were seen every day in orchards, hedges, and agricultural fields. Olympus 8 x 40 DPS-I Binoculars were used to monitor the nesting behavior of red-vented bulbuls, and Sony Handycam was used to record video concurrently. The Canon 550 SLR camera with 18-135 mm lenses and the Canon 60 SLR camera with 150-500 mm lenses were used for photography and videography. We examined the behavior and display of breeding birds using the high-precision camera and lenses, following the procedures of Chishty *et al.* (2020).

With measuring tape, nest positions on plants and nesting characteristics such as nesting plant and nest height above ground were noted. The nest's height, depth, inner and outside diameters were all measured with a digital Vernier caliper, when they were breeding and laying eggs. In terms of the first and last egg's date of laying, clutch size, hatching time, and fledging time from active nests, the breeding success of red-vented bulbuls was noted following Awais *et al.* (2015).

RESULTS

Breeding season

The breeding season of red-vented bulbuls was from mid-February to end of October in the study area. The bulbuls were found to be monogamous and territorial. The mating occurs near the nesting site and may occur many times daily. Breeding activity peaked in May to June as measured by the number of clutches, hatchlings, and fledglings (Fig. 2).

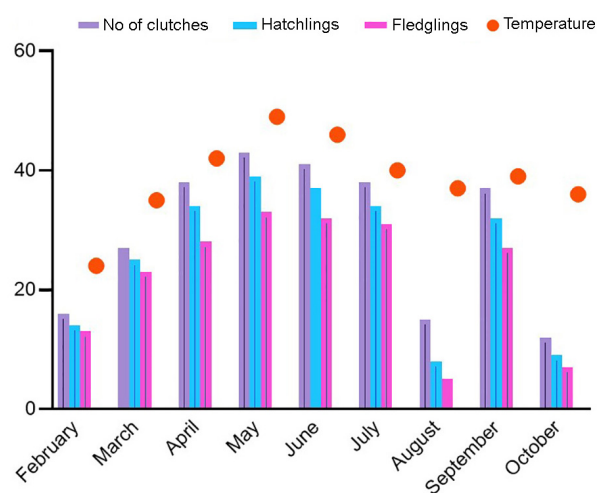


Fig. 2. Clutch size, hatchlings and fledglings of the red-vented bulbul recorded from February to October, 2022, from Shaheed Benazirabad District (tropical thorn forest), Sindh Province, Pakistan.

Nesting sites

The red-vented bulbul preferred assimilatory dense bushes and small leafy trees for nesting. In the study area, Red-vented Bulbul chosen as nesting plant species at *Tamarix ramosissima* (saltcedar or tamarisk, 51%), *Acacia* sp. (kikar, 12%), *Ziziphus jujuba* (ber jhari, 8%), *Abizia lebeck* (lebeck tree, 5%), *Citrus limon* (lemon tree, 5%), *Arundinaria* (cluster of giant cane (reeds), 5%), *Bougainvillea glabra* (Paper flower, 3%) and hedges (11%) (Fig. 3).

The nest formation

Red-vented bulbul first chooses a suitable location for the formation of the nest, and then both the male and female start searching for twigs and other materials for nest construction. The red-vented bulbul's cup-shaped nest is made up of twigs (63%), hard shrubs (18%), grass hairs (15%), leaves (3%), and cotton fibers (1%) (Fig. 4). The red-vented bulbul preferred nesting in shrubs, hedges, a cluster of giant cane (reeds), and smaller trees in orchards,

agricultural fields, public parks, and nearby houses. The ideal distance for building a nest on the plant from the ground was noted to be 2–3 m (44%), 1–2 m (28%), 4–5 m (8%), 5–6 m (5%), and 0–1 m (3%).

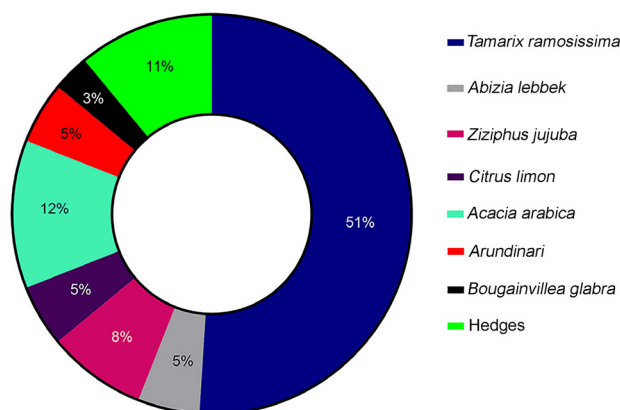


Fig. 3. Percentage of different vegetation and hedges used by red-vented bulbul for nesting.

It was observed that both male and female usually work on constructing a nest during the breeding season. The male performs his job more than the female, but in many cases, it was noticed that both play almost equal roles in forming a nest. Usually, the nests were built in bushes with split branches, bifurcated and trifurcated branches, or even

where four to five branches joined together. In the study area, after examining the nest, the red-vented bulbul used 63% of the small twigs of aerial dead branches of *Tamarix ramosissima* (Saltcedar or Tamarisk) and 37% of other materials, including leaves, cotton fibers, *Desmostachya bipinnata* (stem of Halfa grass or salt reed grass), and dry *Trifolium alexandrinum* (Berseem grass hairs) (Table 1). The present study site recorded the nest formation period as 4–6 days.



Fig. 4. Structure of nests of red-vented bulbul.

Table I. The structural evaluation of red-vented bulbul nests at various nesting locations.

Height (cm)	Depth (cm)	Diameter (cm)	Weight (g)	Total number of twigs	Total number of cotton fibers	Total number of leaves	Total number of grass hairs
7.1	5.1	9	35.6	433	0	1	5
7	4.9	10.1	30.1	456	0	0	0
6.6	3.8	8.9	28.9	402	0	0	0
5.7	3.4	8.3	32.2	366	0	0	0
6.6	3.7	9.9	27.7	389	0	3	6
7.2	4.9	9.2	26.3	412	0	0	0
6.7	3.3	9.5	26.1	245	0	0	0
6.3	3.9	8.2	26.9	287	0	0	0
6.6	4.3	7	32.1	376	0	2	9
7	5.1	7.4	33.4	233	0	0	0
5.9	4.7	9.3	32.2	244	0	0	0
6.5	4.9	10.4	34.8	334	0	0	0
6.6	3.8	9.3	35.1	267	3	0	0
6.2	3.9	8.9	33.7	254	0	3	4
6.8	4.2	9.2	28.5	312	0	0	0
6.1	4.7	9.7	29.2	419	0	0	0
7.1	3.9	8.6	29.7	367	0	0	0
6.3	3.6	10.3	30.2	269	0	0	0
6.7	4.4	9.6	29.3	287	0	0	0
5.6	4.1	9.1	33.6	302	0	1	3

The eggs

The female red-vented bulbul laid their eggs in the cup-shaped nest. The eggs are pale pink with deeper red dots that are heavier at the broad end (Fig. 4D). It was observed that the female red-vented bulbul laid two to three eggs in 2–3 days and then incubate them. The female red-vented bulbul generally takes care of eggs more than males, which we noticed during the fieldwork, but it was also observed that the male Red-vented Bulbul takes care of both the eggs and sitting female red-vented bulbul on eggs.

Period of incubation, nestling and fledgling

Our observations showed that the red-vented bulbul's incubation period lasted 11–13 days. The first nest containing eggs was spotted in the mid of February, and the last was spotted in the mid of October. The nestling period was recorded as 10–12 days. The first nestling was observed at the end of February, while the last was in ends of October. The fledgling period was observed 13–16 days.

DISCUSSION

Our study suggests that the breeding season of red-vented bulbul in the tropical thorn forest of Shaheed Benazirabad was from February to October. Previous available studies reported that this species breeds from May to August in dry temperate coniferous forest (Awais *et al.*, 2015), tropical thorn forest from May to July (Zohaib *et al.*, 2021), tropical dry deciduous forest from March to October (Rao *et al.*, 2013), moist deciduous forest from April to September (Prajapati *et al.*, 2011), and subtropical pine forest from Mach to May (Manju and Sharma, 2013). Our finding was consistent with the previous investigation (Zohaib *et al.*, 2021) and showed that the bulbul species is adapted to a wide range of habitat types in term of breeding.

In this study, the results demonstrated that red-vented bulbul built their nests on seven different plant species, including *Tamarix ramosissima*, *Acacia* sp., *Ziziphus jujuba*, *Abizia lebeck*, *Citrus limon*, *Arundinaria*, *Bougainvillea glabra*, and hedges. Previous established data found that this species in dry temperate coniferous forests builds nests on five different plant species, including *Zizyphus nummularia*, *Psidium guajava*, *Dalbergia sissoo*, *Dodonea viscosa* and *Phoenix dactylifera* (Zia *et al.*, 2014). Our study is contrary to these findings; this difference may be due to a difference in forest type. In addition, our study showed that red-vented bulbul preferred to build their nests 2–3 m above the ground. Published data showed that this species preferred to build its nest 1–4 m above the ground (Zia *et al.*, 2014), 1.5–3.0 m (Manju and Sharma,

2012), and 2.0–3.5 m (Rao *et al.*, 2013). In the present study region, red-vented bulbul used cotton fibers, grass hairs, hard shrubs, twigs, and leaves to construct their nests. According to Biddle *et al.* (2015) and Mainwaring *et al.* (2014), this species used the cobweb, grass, hairs, rootlets, twigs, and midribs of dead leaves; similarly, a study by Lamba (1968) reported that the twigs, plastic particles, grass blades, rootlets, and metal wires were used to build nests. However, no nests in the study site contained elements like rootlets, cobwebs, hair, plastic particles, or metal wires, despite the fact that all these materials were present there. This implies that the species may choose the materials based on preference.

Based on our investigation, the incubation period of red-vented bulbul was 11–13 days, and the nestlings period was 10–12 days. Manju and Sharma (2013) observed a 9–12-day incubation period and a 14-day nestling period; Zohaib *et al.* (2021) recorded an 11–15 days incubation period and a 13–16-day fledgling period; and Zia *et al.* (2014) noted an 11–13 days incubation and nestling period. This finding was partially in agreement with a previous study (Zohaib *et al.*, 2021; Zia *et al.*, 2014).

CONCLUSION

It is concluded that red-vented bulbul constructs their nest on different plant species and artificial structures (hedges) at different heights in rural areas and agricultural fields. The red-vented bulbul chooses nesting sites and materials primarily according to availability and their preferences. The breeding season, nesting materials, nesting plants, and nest height vary from region to region due to climatic conditions. In the study area, *Tamarix ramosissima* is the most abundant plant species; it is mostly found in the present study area. The red-vented bulbul also prefers to build their nest on *Tamarix ramosissima* and mostly uses its twigs for nest fabrication. However, throughout the winter season, the people of rural areas cut this plant and use it to make fire, which has a negative impact on bulbul's breeding. Therefore, it is suggested to consider management of these vegetation while designing any conservation programs for the red-vented bulbul.

DECLARATIONS

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Data availability

Data will be made available on request.

Statement of conflict of interest

The authors have declared no conflict of interest.

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