



Nidification and Breeding Success of Spotted Dove (*Streptopelia chinensis*) in District Dir Lower, Khyber Pakhtunkhwa, Pakistan

Tariq Ahmad^{1*}, Anum Razzaq², Hira Shahzadi², Faiz Ur Rehman⁴, Li Bo¹, Saif Ullah², Omama Saqib¹, Muhammad Tayyab Khan⁵, Muhammad Suliman¹ and Ayesha Zulfiqar³

¹Northeast Forestry University No.26, Hexing Road, Xiangfang District, Harbin City, Heilongjiang Province, China.

²Department of Zoology, Wildlife and Fisheries, PMAS-Arid Agriculture University, Rawalpindi, Pakistan.

³Department of Zoology, University of Jhang, Jhang, Pakistan.

⁴Government Superior Science College, Peshawar, Pakistan.

⁵Department of Forestry and Wildlife Management, University of Haripur, Haripur, Pakistan.

ABSTRACT

Nidification and breeding success of Spotted Dove (*Streptopelia chinensis*) was conducted in Village Takoro, District Dir Lower, Khyber Pakhtunkhwa Province (KP), Pakistan in March-July 2021, as there is no documented information available in Pakistan. The present study was designed to investigate the nidification and breeding success of spotted dove in the study area. A total 87 nest cavities were observed of which 31 contained active nests whereas 56 were failed nests. The highest percentage of successful position of nidification was found in the middle (44.82%) of the tree followed by fork (35.63%) and terminal (19.54%). The findings on nest height indicate that spotted dove preferred (32.18%) nest height of 3.6-4 m, which was followed by (24.13%) and (21.83%) with heights of 3.1-3.5 m and 4.1-4.5 m, respectively. Successful nest cavities were noticed on *Quercus incana* with 29.03% followed by *Olea ferruginea* (22.58%), *Broussonetia papyrifera* (19.35%), *Quercus dilatata* (9.67%), *Rosa bronii* (9.67%) and *Ailanthus altissima* (6.45%) trees. A total of 62 eggs were found in active nests with 70.96% hatching success and a low percentage of nestlings fledged i.e. (29.03%). The percentage of fledgling success was lower than the hatching success. One was at the North pole, the other was at the South pole, one was at the west pole thus the other was at east. It's interesting to note that the spotted dove's new young ones lie at 180° angle as the clutch size is two. Some of the major threats are fledgling failure, egg loss and nestling loss of spotted dove during breeding success which were due to human predation on nests (i.e., removing young from cavities) and predators (i.e., snakes, civets, cats, and crows). Furthermore, the egg loss percentage was also noticed due to hunters (19.35%) whereas the predators showed 12.90% damage. The nestling loss due to hunters was 34.48% whereas the predation loss rate and nestlings fell out from nests were 20.68% and 18.39%, respectively.

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Authors' Contribution

TA and AR designed the study. TA collected field data. TA and AR interpreted results and wrote up the research article. HS, FR, SU, OS, MTK, MS and AZ participated in statistical analysis. LB revised the draft. All the authors read and approved the manuscript.

Key words

Spotted Dove, Nidification, Breeding, Dir Lower, Illegal hunting

INTRODUCTION

Nidification and breeding behavior are of primary importance of bird biology as it plays a key role in

shaping the relationships between adults and young. One of the prime interests of an ornithologist is to study the nesting and breeding ecology, as birds far more than any other animal, are notable for their tendency to build a home in which they raise their young ones (Collias, 1997).

The spotted dove (*Streptopelia chinensis*), is one of the commonest columbid and most familiar species of birds around human habitations. This bird species is facing many threats especially in laying eggs and nestling poaching. It is a small long-tailed buff brown bird with a white-spotted black collar patch on the back and sides of the neck. The tail tips are white and the wing coverts have light buff spots. This is a common resident breeding bird across its native range on the Indian sub-continent and

* Corresponding author: Tariq.zoologist@yahoo.com
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Southeast Asia (Ali and Ripley, 1983).

It is commonly present in open forests, secondary growth, wooded and cultivated country, parks, gardens, verandas of houses, inhabited bungalows, and agricultural fields (Ali and Ripley, 1983). It is sometimes also called the Chinese dove, mountain dove, pearl-necked dove, or lace-necked dove. According to IUCN red list of threatened species, the spotted dove is categorized as least concern (LC) (IUCN Red List of Threatened Species, 2018).

Spotted dove is a monogamous breeder. They breed throughout the year, most activity being from September to December. Male dove performs a display flight, which involves a sharp rise and noisy wing-clapping. When it reaches 30 or 40 m in the air, spreads its wings and tail and glides back down to a perch. It also bows his head up and down in front of a female, fluffing up the black and white patch on its neck (Kumar, 1981).

The adults build their nest with equal contribution in a bush or a tree. The nest is a cavity of loosely combined twigs, grasses, and roots. The female lays two slightly glossy white eggs. The altricial chicks are covered sparsely with pale down after 14 to 16 days of incubation by parents. Their parents constantly brood and look after them for the first week. When young fledge around the age of two weeks, their parents immediately begin a new clutch (Saxena *et al.*, 2008).

This species is vulnerable to habitat loss from human developments, agricultural herbicides and trapping in some countries for the pet trade (Rajashakar, 2011). The breeding and nesting ecology of spotted dove is a topic of interest while there is no report on nidification and breeding behavior of spotted dove in District Dir Lower, Village Takoro, Khyber Pakhtunkhwa, Pakistan. Hence, the present study was designed with the objective to investigate the nidification and breeding success of spotted-dove and to identify the threats.

MATERIALS AND METHODS

Study area

The study was carried out at Village Takoro of District Dir Lower, spanning from 34° 52' N latitude and 071°44' E longitude in northern part of Khyber Pakhtunkhwa (KP) during 2021, Pakistan. The climate of the study area, according to the meteorological station shows that the pattern of rainfall, relative humidity, and temperature increases progressively from January to June and then gradually declines up to December (Wahab *et al.*, 2008). The average maximum and minimum temperature in summer ranges between 34.4 to 11.5°C, respectively. The mean relative humidity ranges between 30 to 70% (Ahmad *et al.*, 2022).

Study design

On weekly basis, reconnaissance survey was conducted to identify the nests and marked as occupied. GPS, cameras, selfie sticks, and ribbons or permanent markers were used to mark the nesting trees in the field following Rakha *et al.* (2021). Data were collected by direct observation and marking the nests and nesting sites with little disturbance to the birds. The study area was thoroughly investigated for possible nesting and breeding locations. During the study period, suitable nest sites were checked once a week. Field observations on the nests (nest characteristics, nest structure, and position) such as number of eggs and period of egg-laying, hatching period, breeding success, were recorded.

Nidification characteristics

Nest search was conducted during the breeding season (from March to July 2021). Nest site characters were recorded including dominant tree species. Data were collected including nest height, nest diameter, nest materials, and nest characteristics. The nests and eggs were observed throughout the study period and taking photographs with a digital camera (22 Megapixel) for records.

Clutch size and hatching characteristics

The eggs were recorded from the start to end of incubation which was carried out by both parents. The color and shape of eggs was noted. The egg size could not be determined since handling the eggs during breeding season could have affected their incubation. If the hatching date and clutch size are known, the laying date can be estimated by back-dated system (Patterson, 1982).

In the study period, after completion of laying stage during the breeding season, clutch size was counted by using direct method and recorded by digital camera. After hatching, coloration and morphological characters of young were recorded before fledging period.

Reproductive Success

A nest is successful, if one or more eggs are hatched. For the failed nests, they were recorded as either predated or lost for unknown reasons. If egg shells and hatching remains were found, they were assumed to have been predated. The data were organized by calculating percentages. Hatching and fledging success were calculated by using the Murray (2000) formula which is given below:

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

$$\text{Fledging Success} = \frac{\text{Number of chicks fledged}}{\text{Total number of chicks hatched}}$$

Egg and nestling losses

Signs of predation, loss and failure of breeding due to broken eggs, hatchling loss, poaching, fallen from cavity nest and abandoned nests (usually from loss or theft of eggs and nestlings) were recorded. The predators commonly found in the study area were also recorded during field surveys.

RESULTS

Nidification success

A total of 87 nests of spotted dove were examined and observed adorning their nest cavities with straw, grass, small twigs, and other materials. This species starts nest building during courtship period. The nesting and breeding season ranged between the months of Mid-March to July 2021. Spotted dove preferred to build nests in trees about 11 feet from the ground. Ideal nesting sites provide warmth in the winter, shade in the summer and also protect young ones from predators. Nests were built during early morning up to noon for about 7-20 successive days. Nests constructed using twigs as a joint effort of both the parents with equal contribution from both the partners. Spotted doves use twigs, grasses, feathers and rotted leaves of the same tree into the nest construction and the female places the twigs in shape by intertwining and plaiting them, while the male collects the building material. The nest is a broad, flat and elliptical structure, is often quite easy to see the eggs through the underside of the nest.

The data on the nidification success of spotted dove is given in Table I. Spotted dove built nests at different positions and at different heights on different trees. Notably, this specie prefers to make nests at different positions such as in the middle of the tree (44.82%) followed by fork (35.63%) and terminal (19.54%). The most successful position of nidification was found usually in the middle and on the fork of tree where the tree's top branches conceal it (Figs. 1, 3B).

The simple flat nest is usually situated at a height of 3m to 5.5 m from the ground on the branches (Table I, Fig. 1B). The findings on nest height indicate that spotted dove preferred (32.18%) nest height of 3.6 – 4 m, which was followed by (24.13%) and (21.83%) with heights of 3.1– 3.5 m and 4.1 – 4.5 m, respectively and 12-14 cm in diameter. The spotted dove shows less preference with height of 4.6 to 5.5 m for nest building.

During this study, six tree species built their nests on trees of *Quercus incana* (31.03%) followed by *Broussonetia papyrifera* (16.09%), *Olea ferruginea* (16.09%), *Quercus dilatata* (13.79%), *Ailanthus altissima* (12.64%) and *Rosa bronii* (10.34%). However, the reproductive success of spotted dove in these trees varied with nidification success.

Table I. Nesting success of spotted dove (*Streptopelia chinensis*) in Village Takoro, District Dir Lower, Khyber Pakhtunkhwa Province, Pakistan (n = 87).

	Total nests	Successful nests	Failed nests
	No. (%)	No. (%)	No. (%)
Position of nest			
Terminal	17 (19.54)	6(19.35)	11(19.64)
Middle	39(44.82)	13(41.93)	26(46.42)
Fork	31(35.63)	9(29.03)	22(39.28)
Total	87(100)	31(100)	56(100)
Height of nest			
3.1– 3.5m	21(24.13)	7(22.58)	14(25.0)
3.6– 4m	28(32.18)	9(29.03)	19(33.92)
4.1–4.5 m	19(21.83)	8(25.80)	11(19.64)
4.6-5m	11(12.64)	3(9.67)	8(14.28)
5 m-5.5m	8(9.19)	2(6.45)	6(10.71)
Total	87(100)	31(100)	56(100)
Vegetation			
<i>Quercus dilatata</i>	12(13.79)	3(9.67)	9(16.07)
<i>Ailanthus altissima</i>	11(12.64)	2(6.45)	9(16.07)
<i>Broussonetia papyrifera</i>	14(16.09)	6(19.35)	8(14.28)
<i>Quercus incana</i>	27(31.03)	9(29.03)	18(32.14)
<i>Olea ferruginea</i>	14(16.09)	7(22.58)	7(12.5)
<i>Rosa bronii</i>	9(10.34)	3(9.67)	6(10.71)
Total	87(100)	31(100)	56(100)

Out of the 87 nest cavities, 31 cavities were successful whereas 56 were failed. The successful nest were on trees were on *Quercus incana* with (29.03%) followed by *Olea ferruginea* (22.58%), *Broussonetia papyrifera* (19.35%), *Quercus dilatata* (9.67%), *Rosa bronii*(9.67%) and *Ailanthus altissima* (6.45%) whereas the 56 failed nests were on *Quercus incana* (32.14%) followed by *Broussonetia papyrifera* (14.28%), *Ailanthus altissima* (16.07%) and *Quercus dilatata* (16.07%) (Table I). The possible reason for the reproductive failure on successful nesting trees were the local residents of the village and hunters.

Table II. Mean clutch size of spotted dove at Village Takoro, District Dir Lower, KP Province, Pakistan.

Mean clutch size	2.0
Range	2-2
Number of eggs	62
Total no. of Active Nests	31

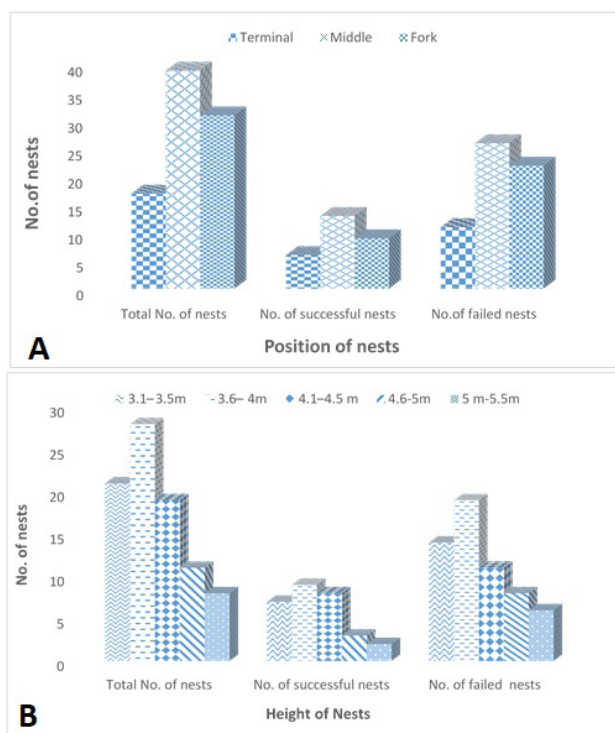


Fig. 1. Breeding success (total nests, successful nests and failed nests) of spotted dove (*Streptopelia chinensis*) at different positive (A) and heights (B) (terminal, fork and middle). Successful nests produced eggs/chicks whereas unsuccessful nests produced none.

Clutch size and incubation

The data on the clutch size of Spotted dove are given in Table II. Generally, eggs were laid only after 4-5 days of nest completion and the clutch size was always two eggs. Eggs were laid on an alternate day and were so arranged as by the parents sitting and easier covering was ensured. Spotted dove laid oval shaped eggs that were pure white in color. In general, the second egg laid was found to be heavier than the first one.

The incubation of spotted dove started with the egg laying, both the sexes sharing the duties. Incubation varied for about 14-15 days as male sits on the eggs for around 6 h per day while the female sits for the remaining 18 h.

Breeding success (hatching and fledging)

The data on reproductive success are given in Figure 2. In 31 active nests, 62 eggs were found during breeding season with 70.96% hatching success (Fig. 3A), while a low percentage of nestlings fledged i.e. (29.03%) was noticed. The percentage of fledging success (18%) was lower than the hatching success (44%). The reasons for fledging failure of spotted dove during breeding season

was human predation on nests (i.e., removing young from cavities), predators (i.e., snakes, civets, cats, and crows) (42.85%) and other egg loss was (13.26%).

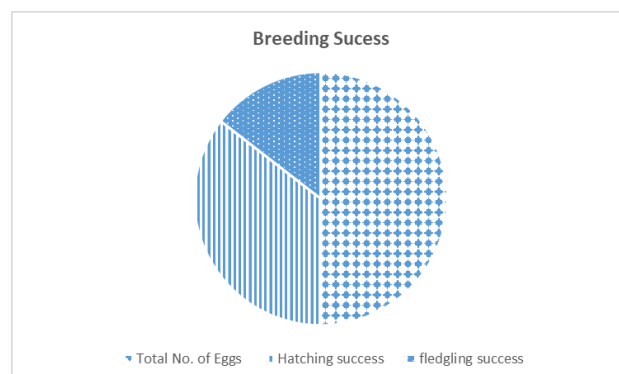


Fig. 2. Breeding Success (Total no. of eggs, hatching and fledging) of spotted dove in Village Takoro.



Fig. 3. Nidification (A), hatchling (B) and predation (C, D) of spotted dove in village Takoro at District Dir Lower, KP, Pakistan.

Hatching patterns and features

Mainly, the young ones hatched out at an interval of 26-28 h. Interestingly, the clutch size of spotted dove is two so young ones were lying at 180° angle i.e., north-south, east-west. Their young ones are fleshy pink in color. Mouth cavity was reddish in color, the back and claws were soft except lips. The eyes were closed, and faint whitish traces of down feathers were observed on dorsal and pelvic

feather tracts. The hatchlings were unable to stand or sit on their feet but could raise their necks and gape for food. The hatchlings were nidicolous and nestlings got fully fledged in about 15-21 days. Parental care for young ones was altricial, they never left their chicks unguarded, one partner was always around to guard them from predators, hot sun, rain, etc. They fed their young by shoving regurgitated food down the gullet of their young ones after they were 24 h old.

Egg and nestling loss

The data on egg and nestling losses of spotted dove are given in Table III. The fate of eggs and nestlings of all 31 active nests was recorded. The egg loss of spotted dove recorded due to hunters was (19.35%) (Fig. 3C, D) whereas this percentage value for possible predators (snakes, cats, civets and crows) were (12.90%). The nestling loss due to hunters was 34.48% whereas the predation loss rate and nestlings fell out from nests were 20.68% and 18.39%, respectively. We found that the hunters and predation rate were recorded higher at nestling stage than at the stage of egg loss. The major threats identified in our present study were the commercial use of spotted dove by hunters and local residents of the village that kept young ones of spotted dove for domestic usage and predators i.e., civets, snakes, cats, and crows.

Table III. Eggs and nestling losses in spotted dove (*Streptopelia chinensis*) in District Dir Lower, Khyber Pakhtunkhwa Province, Pakistan.

	No. (%)
Egg loss	
Number of eggs	62 (100)
Predated (Snakes, Cats, Civets and Crows)	8 (12.90)
Hunters	12 (19.35)
Hatched	42 (67.74)
Nestling loss	
Number of nestlings	87 (100)
Predated (Snakes, Cats, Civets and Crows)	21 (24.13)
Hunters	32 (36.78)
Fell out from nests	16 (18.39)
Fledged	18 (20.68)

DISCUSSION

The spotted dove is a common, and familiar species around human habitation in the village Takoro of District

Dir Lower, KP, Pakistan. The present study gives clear and interesting insight in spotted dove nidification and breeding success that was observed from March to July 2021 with a peak in May. In the previous study by Saxena *et al.* (2008) the breeding season in doves was found during the months of January to August whereas in Myitkyina, dove started breeding during the rainy season in July and August (Smythies, 1953).

Among 87 nests of spotted doves, 31 were active nests whereas 56 were failed nests in our study area. Our results are in agreement with the previous study of Khaing and May (2019) that spotted dove constructed the nest mainly by using twigs, dried stems of climbers, grasses, and roots. According to the study by Saxena *et al.* (2008) the dove started nest building during courtship period, they built the nest in early morning to noon successively for about 7-20 days by using twigs as a joint effort of partners with equal contribution. Meanwhile, a literature report shows that the dove constructed its nests early in the mornings and late in the afternoons during April (Collias, 1997).

However, the reproductive success of spotted dove in these trees varied with nidification success. There was no documented record found in previous studies. The clutch size of spotted dove was observed strictly two after the completion of successful nidification. Although, Saxena *et al.* (2008) also reported the two-clutch size of spotted dove as the male as well as female both defended their territory by chasing the intruders out of their defined space. Spotted dove laid eggs on alternate days only after 4-5 days of nest completion, similar to the rhythm of egg laying and hatching in mountain white crowned sparrows *Zonotrichia leucophrys*, a new world sparrow (Zerba and Morton, 1983).

The texture of egg was very fine but hard and it was in pure white color, with no glossy finish. Eggs were oval in shape but in general, it was observed that the second egg laid was heavier than the first one in spotted dove. Similarly, Khaing and May (2019), also reported two eggs in all three nests of spotted-dove in the branch of Khayay trees (*Manilkana hexandra*) and they were white in color as in the present study. According to Lack's hypothesis that the clutch is hereditary characteristic of each species (Prajapati and Patel, 2011).

Doves are strictly monogamous birds; the pair stays together until death. The male initiates the courtship behavior, moving about in circles around the female and sings a song (Saxena *et al.*, 2008), while the recorded sounds were 'ku-kroo-ku' or 'oot-raow-oo' for courtship behavior to please the female. During courtship period the pair was observed to stay quite close to each other, and indulge in bowing, billing, singing, and courtship feeding which lasts around a week.

Spotted dove starts incubation with egg laying that varies for about 14-15 days, both male and female share their duty during incubation period. Male sits on the eggs for around 6 h per day on average, while the female sits for the remaining 18 h. In the previous study [Saxena *et al.* \(2008\)](#) reported that incubation varied for about 13-14 days by the spotted dove. The day incubation was done by the male whereas the night incubation was done only by the female.

In our present study, one of the most interesting observation was their clutch size of two and that the new young ones hatched were laying at 180° angle i.e., one was at the north pole and the other was at the south; and one was at the west pole and the other at the east after an interval of 26-28 h. The previous study did not report such a result. While according to previous study by [Saxena *et al.* \(2008\)](#) hatching was synchronous, young hatched out one after the other at an interval of 22-26 h, in the order in which they were laid.

Hatchlings of spotted-dove were recorded altricial, similar to adults. The young ones were fleshy pink in color. They were nidicolous, required parents for protection from predators and environmental extremes. Parental doves never left their new hatchlings unguarded, one of the parents always nearby to guard them from predators, hot sun, rain, etc. After 24 h, doves fed their young ones by shoving regurgitated food down the gullet. Our results are in good agreement with [Frost \(2013\)](#) that nestlings of spotted-dove were semi-altricial, covered at first with wispy down and brooded and fed by both parents. Monogamy is practiced by these birds to aid with parental care. Western gulls *Larus occidentalis* have also been recorded to provide parental care ([Plerotti, 1981](#)). [Krebs \(1987\)](#) has undertaken similar comparative studies on parental care and mating systems reporting similar results.

In our study, 62 eggs were found during the breeding season with (70.96%) hatching success and a low percentage of nestlings fledged i.e. (29.03%). According to record of [Khaing and May \(2019\)](#), 66.67% spotted-doves were survived, resulting in four hatchlings from two nests. However, one nest (33.33%) failed due to unexplained reasons. The percentage of fledging success was lower than the hatching success in 31 active nests out of 87 total nests in our study area. No previous study found out the reasons of fledging failure in spotted dove. We identified the fledging failure of spotted dove during breeding was due to human predation on nests (i.e., removing young from cavities) and predators (i.e. snakes, civets, cats, and crows) (42.85%) and other egg loss (13.26%).

CONCLUSION

It is concluded that the nesting and breeding success of spotted dove is disturbed with the major threats i.e., fledgling failure, egg and nestling loss due to human predation on nests (i.e. removing young from cavities) and predators (i.e. snakes, civets, cats and crows). As a consequence of poaching for commercial purposes, the implementation of laws that prohibit illegal hunting and pet trade of birds is of paramount importance.

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Statement of conflicts of interest

The authors have declared no conflict of interest.

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