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Original Article

Breeding ecology of the laughing dove *(Streptopelia senegalensis)* in the Taif City, Kingdom of Saudi Arabia

Ecologia reprodutiva da rola-do-senegal (*Streptopelia senegalensis*) na cidade de Taif, Reino da Arábia Saudita

M. Almalki[a]*

[a]Taif University, College of Science, Department of Biology, Taif, Saudi Arabia

Abstract

The Laughing Dove (*Streptopelia senegalensis)* is a columbid bird commonly found throughout most of Africa, the Middle East, Central Asia, India and Australia. Its preferred habitat includes scrubland, agricultural lands, and human settlements. Despite this species' extensive breeding range, very little information is available regarding its breeding ecology. The main objective of this study was to investigate the breeding features of the Laughing Dove in Taif City, Saudi Arabia between March and May 2018 and December 2018 and May 2019. The results indicate that this species constructs its nests at a mean height of 2.74 ± 0.1 m from the ground. The average number of nesting materials used for building a Laughing Dove nest was 109.3 ± 11.25. This study recorded that this species starts breeding in the middle of February. A clutch of two eggs comprised 72% of all the nests, with a mean of 1.75 ± 0.06 eggs per clutch. The average egg size was 25.27 ± 0.43 mm x 20.25 ± 0.19 mm, with an average egg volume of 5.01 ± 0.13 cm^3. In total, 39.5% of the eggs hatched, and 64.7% of hatchlings reached the fledgling stage, resulting in an overall breeding success of 25.6%. This study suggested that nest desertion and predation were the major factors contributing to nest failure.

Keywords: breeding biology, Palm Dove, Taif City, Saudi Arabia.

Resumo

A rola-do-senegal (*Streptopelia senegalensis*) é uma ave columbídea comumente encontrada na maior parte da África, Oriente Médio, Ásia Central, Índia e Austrália. Seu hábitat preferido inclui cerrado, terras agrícolas e assentamentos humanos. Apesar da extensa gama de reprodução desta espécie, muito pouca informação está disponível sobre sua ecologia reprodutiva. O principal objetivo deste estudo foi investigar as características reprodutivas da rola-do-senegal na cidade de Taif, Arábia Saudita entre março e maio de 2018 e dezembro de 2018 e maio de 2019. Os resultados indicam que esta espécie constrói seus ninhos a uma altura média de 2,74 ± 0,1 m do chão. O número médio de materiais de nidificação usados para a construção de um ninho de rola-do-senegal foi de 109,3 ± 11,25. Este estudo registrou que esta espécie começa a se reproduzir em meados de fevereiro. Uma ninhada de dois ovos compôs 72% de todos os ninhos, com média de 1,75 ± 0,06 ovo por ninhada. O tamanho médio dos ovos foi de 25,27 ± 0,43 mm x 20,25 ± 0,19 mm, com volume médio de ovos de 5,01 ± 0,13 cm^3. No total, 39,5% dos ovos eclodiram e 64,7% dos filhotes atingiram a fase de filhote, resultando em um sucesso reprodutivo geral de 25,6%. Este estudo sugeriu que a deserção do ninho e a predação foram os principais fatores que contribuíram para o fracasso do ninho.

Palavras-chave: biologia da reprodução, Palm Dove, Taif City, Arábia Saudita.

1. Introduction

The Laughing Dove (*Streptopelia senegalensis)*, also recognized as the Palm Dove (Jennings, 2010), is from the Columbidae family (IUCN, 2018). It is a small pigeon at 25-27 cm in length (Beaman and Madge, 2010), with an average weight of 84 grams (Gibbs et al., 2010). It is widely found throughout most of Africa, the Middle East, Central Asia, India and Australia (Baptista et al., 1997; BirdLife International, 2022). It is a resident of Arabia, and widespread breeding occurs annually (Jennings, 2010), aside from central Arabia (Al-Sirhan et al., 2022). The world's Laughing Dove population is estimated to be between 2.4 million and 8.2 million mature individuals

*e-mail: almalki.m@tu.edu.sa
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(BirdLife International, 2022). Jennings (2010) estimated that the population of Laughing Doves around the Arabian Peninsula might exceed 2 million pairs.

This dove species occupies a variety of habitats, including scrubland, farmland and human residential areas (Rocha, 2013; Stevenson and Fanshawe, 2020). It can be found anywhere in Arabia from sea level up to more than 3,000 meters in elevation and can survive in arid environments (Jennings, 2010). In Arabia, it is usually associated with human settlements such as towns, villages, oases and fields throughout most of the region, except for the centre of the Arabian Peninsula (Al-Sirhan et al., 2022). This species feeds primarily on the ground, occasionally foraging in small trees and shrubs (Gibbs et al., 2010). It feeds on fallen seeds, primarily from grasses, as well as vegetable debris, fruits, nectar, succulent shoots and some insects, and even human food waste (Satheesan et al., 1990; Adang et al., 2008; Gibbs et al., 2010). In Arabia, its diet comprises many kinds of seeds such as those of the Ghaf tree (*Prosopis cineraria*), a cucurbitaceous gourd, the saltbush (*Halopeplis*), maize and grass; it also scavenges in waste dumps (Jennings, 2010).

The breeding season of Laughing Dove is determined regionally, with breeding occurring all year long in most tropical regions but more seasonally in other areas (Gibbs et al., 2010). For instance, in Morocco, the doves breed from February to July (Hanane et al., 2011); in Tunisia, they breed from February until August (Boukhriss and Selmi, 2009); in Egypt, they breed between February and June; in Algeria, they breed from March until July (Brahmia et al., 2015); in Malawi and Turkey, the doves breed throughout the year (Biricik, 1997); in Zimbabwe and South Africa, they breed almost year-round (Gibbs et al., 2010); and in Australia, the main breeding season takes place between September and November (Frith et al., 1976). In Saudi Arabia, this dove species breeds throughout the year, but with a peak of activity that takes place between February and July (Jennings, 2010). The nest can be positioned anywhere but is usually in a bush or a tree; it also can be placed on the ledges of buildings (Baptista et al., 1997; Snow and Perrins, 1998; Gibbs et al., 2010; Jennings, 2010). The height of the nest ranges from 30 cm to 12 m; in one case, a nest was discovered at a height of 25 m on a building (Jennings, 2010). The nest is composed of a fragile platform of fine sticks, roots, twigs and dry grasses (Gibbs et al., 2010; BirdLife International, 2022) and is approximately 15 cm in diameter (Schodde et al., 1986). Both parents contribute to the nest-building process—the male collects the nest materials, which the female installs in the nest (Biricik et al., 1993; Gibbs et al., 2010). Usually, the female lays two eggs, and rarely, three or four eggs (Jennings, 2010). Both parents share the duties of incubating the eggs and feeding the chicks, but the male incubates the nest more often during the day than the female does (Biricik et al., 1993). The species is currently classified as 'least concern' on the IUCN Red List (IUCN, 2018). In addition, the population trend seems to be stable (BirdLife International, 2022). Moreover, this species is not currently known to face any significant threats (BirdLife International, 2022).

In Saudi Arabia, the Laughing Dove species is poorly documented, and details of its life history are lacking. To my current knowledge, there is no published research describing its breeding ecology in Saudi Arabia. This study aimed to provide a basic understanding of the Laughing Dove breeding ecology in Taif City, west of Saudi Arabia, and to determine factors contributing to nest failure.

2. Material and Methods

2.1. Study area

This study was performed in Taif City between March and May 2018 and December 2018 and May 2019. Taif is located to the west of the Kingdom of Saudi Arabia, between 21°16`N - 40°55`E (Figure 1). This area is known for its scenic views as well as its fertile valleys which are suitable for farming diverse fruits and vegetables. It lies at an elevation of around 1,700 meters above sea level on the slopes of the Al Sarawat Mountains and is characterized by a warm desert climate (UN-Habitat, 2019). The average low temperature is 16.4 degrees Celsius (°C), and the average high temperature is 30.3 °C. The average annual humidity level is 44%. The average annual precipitation is 171 mm (NCM, 2022). The present study was conducted in four chosen sites around Taif City. The first site is Saiysad National Park, situated in the north-eastern part of Taif, distinguished by acacia trees and the Saiysad dam. The second is the Al-Waht and Al-Wheit site, situated in the western part of the city of Taif, which is characterized by acacia trees, several small farms and Ikrima's dam. The third site contains the area between the city of Taif and Al Hawiyah town through As Sail Road, distinguished by acacia trees and small crop farms. The fourth site is the campus of Taif University, which is situated in Al Hawiyah, and is characterized by educational and administrative buildings, having green gardens with trees such as the Golden Wattle (*Acacia Pycnantha)*, Royal poinciana (*Delonix regia),* Green Buttonwood (*Conocarpus erectus)*, Pomegranate (*Punica granatum),* Common fig (*Ficus carica)* and long mulberry (*Morus macroura).*

2.2. Data collection

Two approaches were used to detect nests: 1) monitoring parental behavior through binoculars, and 2) checking

Figure 1. A map showing the location of the study area (Taif City).

potential available nest sites. For each nest found, the time, date, clutch size, measurements of the eggs, incubation and nestling period, nest height, type of tree and geographic coordinates were recorded, utilizing a GPS device. Additionally, each nest found was photographed. The mean clutch size was calculated from nests known to be completed or unchanged for at least five days before a loss. A sliding caliper (50 mm) was used to measure the egg length (L) and width (B) to the nearest 0.01 mm. Based on Catry et al. (2004), the egg volume (V) was calculated only for complete clutches, which is defined as $V = K_v \times L \times B^2$, where $K_v = 0.4866$. The incubation duration is the interval between clutch completion and the hatching of the eggs. Furthermore, the nestling duration is the interval between the birds hatching and leaving the nest. The incubation period was determined for nests with known laying dates, i.e. nests found before the first egg was laid. The nestling period was determined for nests with known hatching dates, i.e. nests found before the second egg was hatched. Nest heights were measured using metal meter ruler. In order to identify nesting sites, nest markers (small stone tower stacks) were established approximately 5 m from each nesting tree. The nests were checked three times a week during incubation and after the eggs were hatched, until the clutch failed, or the chicks left the nest. Nests were often observed from a distance before being approached, to prevent disturbance. Then, a long wooden stick (approximately 1.5 meters in length) with a mirror attached to the top end at a right angle was used to explore the nests and record the estimate of laying dates, the number of eggs, the number of chicks, and the hatching and fledging dates for each field visit. A ladder was used to observe nests located at much higher ground (e.g. at >2 m). Furthermore, the fate of the nests was evaluated based on the following parameters: (1) 'hatched' if at least one egg hatched, (2) subjected to 'predation' if eggs or chicks were not detected in the nest, (3) 'abandoned' if the parents were not present at the nest all day, and (4) 'unknown' if either the nest was not tracked or the eggs vanished before hatching or predation was proven. Nest hatching success is expressed as a proportion of nests that hatch. Finally, nests were collected and disassembled to quantify nest materials after the breeding season had ended.

2.3. Statistical analyses

Statistical analyses were performed using R version 4.2.0 (R Core Team, 2020). The data were tested for normality using Shapiro-Wilk's test before analysis (Shapiro and Wilk, 1965). In this test, the variances of the morphometric data were not different from a normal distribution ($p > .05$). The correlations between nest height vs. tree species, nest height vs. nest material and spring months vs. nest fate were tested using linear regressions. The statistical significance level for the entire statistical analysis was set at $p < .05$. All means are displayed as ± the standard error.

3. Results

3.1. Nest site

Most Laughing Dove nests were found in trees such as the *Acacia gerradii* (75%), Golden Wattle (*Acacia Pycnantha)* (15%), Royal poinciana (*Delonix regia)* (6%), Green Buttonwood (*Conocarpus erectus)* (1.5%) and Pomegranate (*Punica granatum)* (1.5%). Most nests of this species were discovered close to human habitation. The nests are typically simple flats. The species usually nests inside the trees, hidden by the top branches. This study did not record any nests for Laughing Dove in trees such as *Acacia tortilis ssp radiana, Acacia asak, Ziziphus spina-christi, Calotropis procera, Eucalyptus tereticornis, Jacaranda mimosifolia, Morus alba, Psidium guajava* and *Ficus carica*. The overall mean nest height during the study period was 2.74 ± 0.1 m (range 1.05-5.20 m, n = 67). The nest height did not change as breeding progressed through the spring season (March, April and May) (linear regression: $r^2 = 0.07$, $F_{2,62} = 2.34$, $p = 0.11$). In addition, there was no relationship between nest height and tree species (linear regression: $r^2 = 0.12$, $F_{4,60} = 2.01$, $p = 0.10$).

3.2. Nest composition

The birds in this study laid eggs either in freshly built nests or in old nests that had been reused. The nest materials consisted of twigs, thin grasses, plastic threads, and sometimes, iron wire. The overall mean of nest materials was 109.3 ± 11.25 (range = 42-212, n = 21). The number of nest materials used in the construction of the Laughing Dove nests is not influenced by nest height (linear regression: $r^2 = 0.06$, $F_{1,19} = 1.13$, $p = 0.30$).

3.3. Laying date, clutch size and egg dimensions

The first Laughing Dove egg was observed in mid-February 2019. No nests were reported in December or January during the study period, and only three nests were reported in February 2019. The monthly spring clutch distribution suggests 49.3% in March, 31.3% in April and 19.4% in May.

The mean clutch size was 1.75 ± 0.06 (range 1-3, n = 67 nests), with roughly a day between the first and second egg. Approximately 72% of the clutches contained two eggs, only one clutch with three eggs was detected in May 2019.

The mean length and width of the eggs were 25.27 ± 0.43 mm (range 22.25-28.20 mm; n = 17, median = 25.5 mm) and 20.15 ± 0.19 mm (range 18-21.1 mm; n = 17, median = 20.25 mm), respectively. The average egg volume was 5.01 ± 0.13 cm^3 (range 3.78-6.05, n = 17).

3.4. Incubation and nestling duration

Generally, the mean incubation duration during the spring season was 14.5 ± 0.56 days (range 13-17 days, n = 6). The mean spring nestling duration was 18.25 ± 0.62 days (range 17-20 days; mean = 18.25 ± 0.62, n = 4) (Figure 2).

3.5. Nesting success

Of the 43 nests tracked through this study, 17 (39.5%) were hatched (only 11 of 17 successfully fledged), 13 (30.2%) were subject to predation, and 13 (30.2%) were deserted. All 43 nests were built in trees. There was no relationship between nest fate and tree species (linear regression: $r^2 = 0.059$, $F_{2,44} = 1.37$, $p = 0.264$).

Figure 2. Showing (A) eggs of Laughing Dove; (B) Chicks of Laughing Dove, and (C) fledgling of Laughing Dove after leaving the nest.

3.6. Causes of nest failure

The domestic cats (*Felis catus)* noticed in this study fed on several Laughing Dove chicks. Moreover, some local people indicated that the Laughing Dove is considered a popular target of bird hunters and trappers. Many bullet shells were noticed close to doves' nest sites in areas such as Saiysad National Park and Al-Waheit. Furthermore, as an incidental observation, the Arabian Scops Owl (*Otus pamelae*) was observed once close to the doves' nests as a potential cause of nest failure in Saiysad National Park.

4. Discussion

This study has revealed basic information on the breeding biology of this poorly-understood species in one part of its breeding range in Saudi Arabia. The study reported that Laughing Doves prefer to build their nests at a height of 2.71 ± 0.09 m (range 1.05-5.20 m) from the ground on trees such as the *Acacia gerradii, Acacia pycnantha, Delonix regia, Conocarpus erectus and Punica granatum*. It is possible that this behaviour is a result of nesting trees' height, since tree height has a significant impact on nest height in many bird species (Boukhemza-Zemmouri et al., 2008; Taberner et al., 2012; Bensouilah et al., 2014). Nest sites for this species are highly flexible and include a wide variety of trees and bushes (from coastal mangroves to juniper at 3,000 metres); however, these birds often nest on buildings (Gibbs et al., 2010; Jennings, 2010). Boukhriss and Selmi (2009) reported that the mean nest height of this species in Southern Tunisia was 2.58 ± 0.09 m. Brahmia et al. (2015) found that in northeast Algeria, Laughing Dove nests averaged 4.21 ± 0.08 m (range 2.94 to 5.76 m) in height. Benghedier et al. (2020) reported that northeast of the Algerian Sahara, the nest height average was 3.58 ± 1.38 m (range 1.2 to 9 m) above the ground. In Arabia, Jennings (2010) reported that the height of the nest varied from 30 cm to 12 m; one nest was found at a height of 25 meters on a building. Moreover, the findings indicate that the majority of discovered nests were near human settlements. Hanane (2015) found that the nesting of this species highly correlated with the presence of humans. Furthermore, there is an association between this species and agriculture, trees (excluding forests), and human settlement (BirdLife International, 2022). Møller and Dıaz (2018) observed a strong relationship between human habitation and bird abundance and distribution. A human presence may provide birds with significant benefits in terms of food and water availability, as well as protection against predators and parasites (Díaz et al., 2013; Møller et al., 2016; Møller and Díaz, 2018).

The results indicate that the Laughing Doves in this study laid eggs either in newly-constructed nests or in previously-built nests that had been renovated. This finding is consistent with that of Biricik et al. (1989), who discovered that the same pair might raise multiple broods in the same nest. In addition, this study showed that the mean components of the nests were 109.3 ± 11.25 (range = 42-212) and included twigs, grasses, plastic threads, and occasionally, wire. Jennings (2010) reported that the Laughing Dove nest is comprised of thin sticks, roots, twigs, and small amounts of dry grasses, though there have been reports of nests mainly constructed of wire. Moreover, a nest of this dove species contains 100 to 140 twigs (Burton and Burton, 2002). A possible explanation for this difference in the number of nest materials might be that the nests are either freshly built or recycled.

This study reported that no Laughing Dove nests were discovered during December or January during the study period. Jennings (2010) demonstrated that this dove species might nest at any time during the year in Arabia; however, nesting activity usually peaks from February to July. Moreover, the results of this study show that clutch sizes range from one to three eggs, and more than 70% of the clutches are composed of two eggs. This result is consistent with other research which demonstrated that most nests consist of two eggs and rarely comprise three or four eggs (Jennings, 2010). In addition, the result of this study aligns with the studies of Boukhriss and Selmi (2009) and Hanane et al. (2011), who found that approximately 90.5% of the nests in Tunisia comprise two eggs. Additionally, the results revealed that the mean length and width of the eggs are 25.27 mm and 20.20 mm (n = 17), respectively. This is in contrast to the results of Schodde et al. (1986), who reported that the mean length and width of the eggs were 29 mm and 23 mm, respectively. Hanane et al. (2011) reported that

the mean length and width of the eggs were 28.15 mm and 21.45 mm, respectively. Moreover, Harrison and Castell (2004) stated that the mean length and width of the eggs were 25.3 mm and 19.3 mm, respectively. The results of these studies differ from the findings presented in this study. A possible explanation for this variation in egg size might be that they are influenced by ecological and environmental factors, among others (Heming and Marini, 2015).

Another important finding was that the incubation period during the spring season ranged from 13-17 days. Moreover, the spring nestling duration ranged from 17-20 days. Gibbs et al. (2010) indicated that it takes 12-13 days for the eggs to hatch and 15-17 days for the chicks to fledge. Similarly, Harrison and Castell (2004) reported that incubation takes 12-14 days, and that it takes 14-17 days for the chicks to fly.

This study showed that the Laughing Dove suffered high predation and nest desertion rates. Domestic cats have been confirmed to attack and eat Laughing Dove chicks. Additionally, a number of possible causes of nest failure were identified in this study, including hunting, and probably the Arabian Scops Owl. Jennings (2010) reported that several raptors, such as House crows, as well as Saw-scaled vipers (*Echis sp.*), have been reported as preying on Laughing Doves in Arabia. Moreover, Jennings (2010) reported additional hazards that include hunting and consuming contaminated food.

5. Conclusions

The results of this study provided valuable baseline data regarding the breeding ecology of the Laughing Dove in Taif City. For example, nest site, nest materials, laying date, clutch size, egg dimensions, incubation and nestling duration, and nest success were discussed. Moreover, the study revealed the high predation and desertion rates of Laughing Dove nests. Although this study has contributed valuable information regarding Laughing Doves' breeding ecology, several issues remain to be resolved. Future research should concentrate on: (1) studying the breeding ecology of this species year-round; (2) investigating the mate and site fidelity of the Laughing Dove by catching both parents, collecting blood samples, and ringing the birds with metal and colored rings, and (3) monitoring the incubation routines of males and females to determine the extent of each parent's cooperation during incubation and the feeding of the chicks. Such research would provide a deeper understanding of the behaviour and ecology of this species.

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