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EURASIAN COLLARED-DOVE (*Streptopelia decaocto*) NESTING PHENOLOGY, REPRODUCTIVE SUCCESS, AND NEST SITE CHARACTERISTICS IN SOUTHERN OKLAHOMA

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Abstract—Eurasian Collared-Doves (*Streptopelia decaocto*) have expanded their range across the U.S. since the late 1970's and early 1980's. Breeding data are sparse for this species in the U.S. We collected data on nesting phenology, nest site characteristics, nest materials, and nest success of Eurasian Collared-Doves in southern Oklahoma. Eurasian Collared-Doves began nesting in January and continued through July. They nested in conifers from January through April; and in deciduous trees from May through July following leaf out; and in barns throughout the field seasons. In 2014, we monitored 23 nests with a mean clutch size of 1.6 eggs, a mean of 0.7 hatched young, and a mean of 0.6 fledged per nest. In 2015, we monitored 15 nests with a mean clutch size of 1.9 eggs, a mean of 1.5 hatched young, and a mean of 1.3 fledged per nest. In both years combined, we monitored 38 nests with a mean clutch size of 1.7 eggs, a mean of 1.0 hatched young, and a mean of 0.8 fledged per nest. Eurasian Collared-Doves had a combined mean incubation period of 14.5 d (range = 11-18 d). Young fledged at a combined annual mean of 17 d (range = 15-19 d). In Bryan County, 39.5% of Eurasian Collared-Dove nests fledged ≥1 young during the 2014-2015 nesting season. Nests were lost due to inclement weather and depredation. Predators were domestic cats (*Felis catus*) and possibly Great-tailed Grackles (*Quiscalus mexicanus*) and Common Grackles (*Quiscalus quiscala*). Nests in southern Oklahoma had 25.5% lower nest success rates than Eurasian Collared-Dove nests in Arkansas. Nests were mainly constructed from twigs (34.6%), debris (bits of grass, feces, small egg shell pieces, and insects; 29.9%), and dry grass (19.9%).

INTRODUCTION

The Eurasian Collared-Dove (*Streptopelia decaocto*) historically occurred in India, Sri Lanka, and Myanmar (Romagosa and Labisky 2000). Beginning in the 16th century, this species expanded its range naturally or via anthropochore into Turkey and the Balkans (Fujisaki *et* *al.* 2010). Eurasian Collared-Dove population expansion likely occurred due to increased food supply from crop cultivation and habitat changes (Romagosa and McEneaney 1999). During the early 1900's, Eurasian Collared-Doves dispersed throughout Europe and parts of Africa (Fujisaki *et al.* 2010). From 1930 to 1950, they established populations across Europe with numbers steadily increasing over subsequent decades (Coombs *et al.* 1981, Svazas 2001).

In the early 1970's, a pet breeder brought Eurasian Collared-Doves to Nassau, Bahamas (Romagosa and McEneaney 1999). In the mid-1970's, the store where the breeder kept the doves was burglarized allowing individuals to escape. The breeder released the remaining birds after this incident, which subsequently dispersed to nearby islands (Romagosa and McEneaney 1999). This species first arrived in the U.S. in Florida between the late 1970's and early 1980's. It is hypothesized that the established breeding population in southern Florida was from the Bahamas (Romagosa and Labisky 2000, Fielder *et al.* 2012).

Once established in Florida, Eurasian Collared-Doves rapidly expanded their range across the continental U.S. via local and jump dispersal mechanisms (Fujisaki *et al.* 2010). Jump dispersal involves a group of individuals traveling a great distance and forming a new population. Through jump dispersal, Eurasian Collared-Doves established populations in Oklahoma. They were first observed in Oklahoma in 1995 in Muskogee (Bomberger-Brown and Tomer 2002). The Breeding Bird Survey found that from 1966-2013, Eurasian Collared-Doves saw an increase in population by 42.8% per year in Oklahoma (Sauer *et al.* 2014). For the U.S. as a whole, Eurasian Collared-Doves increased 32% in the same time frame. In the most recent 10-year span, 2003-2013, they increased by 60.8% per year in Oklahoma and 27.6% per year in the U.S. (Sauer *et al.* 2014). Subsequent populations filled in the newly created gaps (Romagosa and Labisky 2000). This dispersal pattern was observed in both European and U.S. populations (Fielder *et al.* 2012). European populations occurred in human-altered environments such as urban or suburban gardens and parks where suitable foraging, nesting, and roosting sites occurred (Coombs *et al.* 1981). Eurasian Collared-Doves selected similar habitats in the U.S. (Bomberger-Brown and Tomer 2002, Fielder *et al.* 2012). Eurasian Collared-Doves populate diverse habitats because they can consume a variety of seeds including larger seeds that other doves are unable consume (Hayslette 2006). Their diet includes waste grain, commercial seeds from bird feeders, and wheat and corn (Romagosa and Labisky 2000, Fielder *et al.* 2012, Romagosa 2012).

In the Eurasian Collared-Doves' ancestral range, its nesting season occurred from March to October (Rana 1975). In Europe, the nesting season occurred from February through early October (Robertson

1990). In the U.S., the nesting season typically occurs from February through August (Drennen 1997, Fielder *et al.* 2012). In Florida, an area with warmer winter months than Europe, nesting was observed during the winter months. McNair (1997) observed a Eurasian Collared-Dove hatchling in a nest in early January in Florida. After the hatchling fledged, McNair (1997) used the average incubation time and the observed fledging length to determine the first egg was likely laid in early December.

In their historical and European ranges, Eurasian Collared-Doves exhibited clutch sizes of 1-2 eggs (Rana 1975, Robertson 1990). In the U.S., they have a clutch size of 2 eggs (Romagosa 2012). In their historical range, incubation period ranged from 10-19 d, depending if eggs were laid during the dry, spring or wet, monsoon season (Rana 1975). During the spring season, the mean incubation period was 18.5 d; in the monsoon season mean incubation period was 13 d. In both Europe and the U.S., a mean incubation length of 15 d has been reported, though the range in the former was longer 14-19 d (Robertson 1990), and shorter for the latter, 14-15 d (Rose and Rose 1999, Fielder *et al.* 2012).

Eurasian Collared-Dove young fledged 12-18 d post-hatching in their historical range, with a mean of 16 d during the spring and 14 d during monsoon season (Rana 1975). In Europe, there is more variation in the time until fledging. In Hungary, Bozsko (1978) reported that young fledge 19-21 d post-hatching. Svazas (2001), in the Baltic States, documented that young fledge 17-20 d post-hatching. In England, Robertson (1990) observed young fledged at a mean of 18 d (range = 16-20 d) post-hatching. Eurasian Collared-Dove young fledged at a mean of 18 d (range = 17-18 d) after hatching in the U.S. (Fielder *et al.* 2012, Romagosa 2012). Robertson (1990) observed multiple broods per year in England. This pattern of multiple broods per year is also apparent in Eurasian Collared-Dove breeding pairs in the U.S. (McNair 1997).

In Eurasian Collared-Doves' historical European, and U.S. ranges, nests were built mainly in human-disturbed areas and in a variety of tree species and buildings. In their historical range, Eurasian Collared-Doves commonly built nests in deciduous trees (Rana 1975). In Europe and the U.S., they built nests in coniferous and deciduous trees and they will use barns or metal structures, such as utility poles and electrical substations (Fielder *et al.* 2012, Romagosa 2012).

Previous research on Eurasian Collared-Doves in the U.S. is limited, thus our research will expand on the nesting and reproductive data for Eurasian Collared-Doves in southern Oklahoma, as well as the U.S. (Romagosa 2012). Our objectives for this study were to: 1) determine nesting phenology, 2) determine clutch size, incubation length, hatching success, and fledging success, 3) monitor nest loss factors, and 4) determine nest site characteristics and nest construction materials.

STUDY AREA

In 2014-2015, we conducted nest searches between mid-January and July of each year in urban and exurban areas of Bryan County (E747533, N3754516.9) and Atoka County (E774227, N3810553.9), Oklahoma. Towns searched within Bryan County included Durant, Calera, Caddo, and Bokchito, whereas towns searched within Atoka County included Atoka and Tushka. We conducted nest searches in commercial and residential areas that included planted conifer trees, deciduous trees, and barns. Due to budgetary and logistical constraints, we were unable to search for nests after July in each year.

METHODS

In 2014-2015, we conducted systematic and opportunistic nest searches in urban and human-disturbed rural areas in southern Oklahoma. Nests were located by searching potential nest sites in parks, residential areas, commercial areas, and rural areas (Drennen 1997, Fielder *et al.* 2012). We recruited Southeastern Oklahoma State University students, and other citizen science volunteers, to help locate Eurasian Collared-Dove nests in the study area. Students in Southeastern Oklahoma State University's Wildlife Club, Ornithology class, and Zoology class were given information about this project and asked to help locate Eurasian Collared-Dove nests around campus and in nearby towns.

Nest searches began in mid-January and continued through late July (Fielder *et al.* 2012). Nests were located by searching in coniferous and deciduous trees, such as shortleaf pine (*Pinus enchinata*) and Shumard oak (*Quercus shumardii*), and by searching in areas around utility poles and among support beams of farm buildings (Fielder *et al.* 2012, Romagosa 2012). Eurasian Collared-Dove nests occur at varying heights (range = 3.5-12.5 m); therefore, trees were thoroughly searched at all heights (Romagosa 2012).

Nest locations were georeferenced using a Magellan eXplorist 500-model hand-held Global Positioning System unit. Nest coordinates were recorded in Universal Transverse Mercator units. Nest coordinates were uploaded into a Geographic Information System program (ArcMap Version 9.3, ESRI®, Redlands, California) to create maps showing annual Eurasian Collared-Dove nest distributions.

Nests were monitored two to three times per week to count clutch size and the number of hatchlings and fledglings per nest using a Tree Top Peeper Scope® (hereafter, TTP scope). The TTP scope was used to monitor nests more frequently as the nesting cycle progressed. Incubation, hatching, and fledging length were counted in days. Nest success was defined as ≥1 nestling fledged per nest.

We monitored nest loss factors including inclement weather and predators. Inclement weather was characterized by nesting pairs abandoning the nest or eggs/nestlings on the ground under the nest. Weather data from the previous day was used to determine if wind, cold, rain, or a combination had potentially caused the nest loss. Temperatures ≤0° C with snow and ice were classified as cold weather and high winds were classified as wind speeds ≥40 kph. To determine if a nest was depredated, we observed the condition of the nest after a nest loss event and if egg fragments or a nestling carcass was found.

When logistically possible we collected completed nests to document construction materials as a percent of the dry mass of a nest. Materials were weighed to the nearest gram on an electronic balance. For each nest, we measured the following parameters: depth; outer and inner circumference; and diameter at widest point and narrowest point. Depth was measured from the lowest point inside the nest to the highest point on the nest rim. Diameter at the widest/narrowest point was measured from the outside of the nest rim. We recorded whether the breeding pair re-nested in the same nest or if they built a new nest in the vicinity (Robertson 1990). We did not color-band individuals, but it was likely the same pairs observed were re-nesting based on observations of number of pairs at each property and pair activity while monitoring nests.

IBM SPSS Statistics version 20® was used to calculate descriptive statistics, means ± standard deviation, for each nest parameter (i.e., clutch size, number hatched, and number fledged). Due to small sample sizes, we used non-parametric Mann-Whitney *U*-test, with an *a priori* alpha level of 0.05, to compare means between years for clutch size, number hatched, and number fledged. We used a Chi-square test to compare percent nest success between years.

RESULTS

Nesting Phenology

We monitored 38 nests from 2014 (n = 23) and 2015 (n = 15). Eurasian Collared-Doves initiated nesting as early as January and continued through July, annually. To determine nest initiation dates, we backdated nests from the stage they were found to an approximate start date. The earliest nest initiation date in 2014 was January 28 and the latest nest initiation date was July 7. In 2015, the earliest nest initiation date was January 1 and the latest nest initiation date was July 2. Eurasian Collared-Doves exhibited a peak in nesting during April with 11 nests and again in June with 15 nests (Fig. 1). Due to spatial proximity of nests in April and June, it is probable that they are from the same Eurasian Collared-Dove pairs re-nesting. Later nesting attempts may have occurred, but were not observed due to budgetary and logistical limitations.

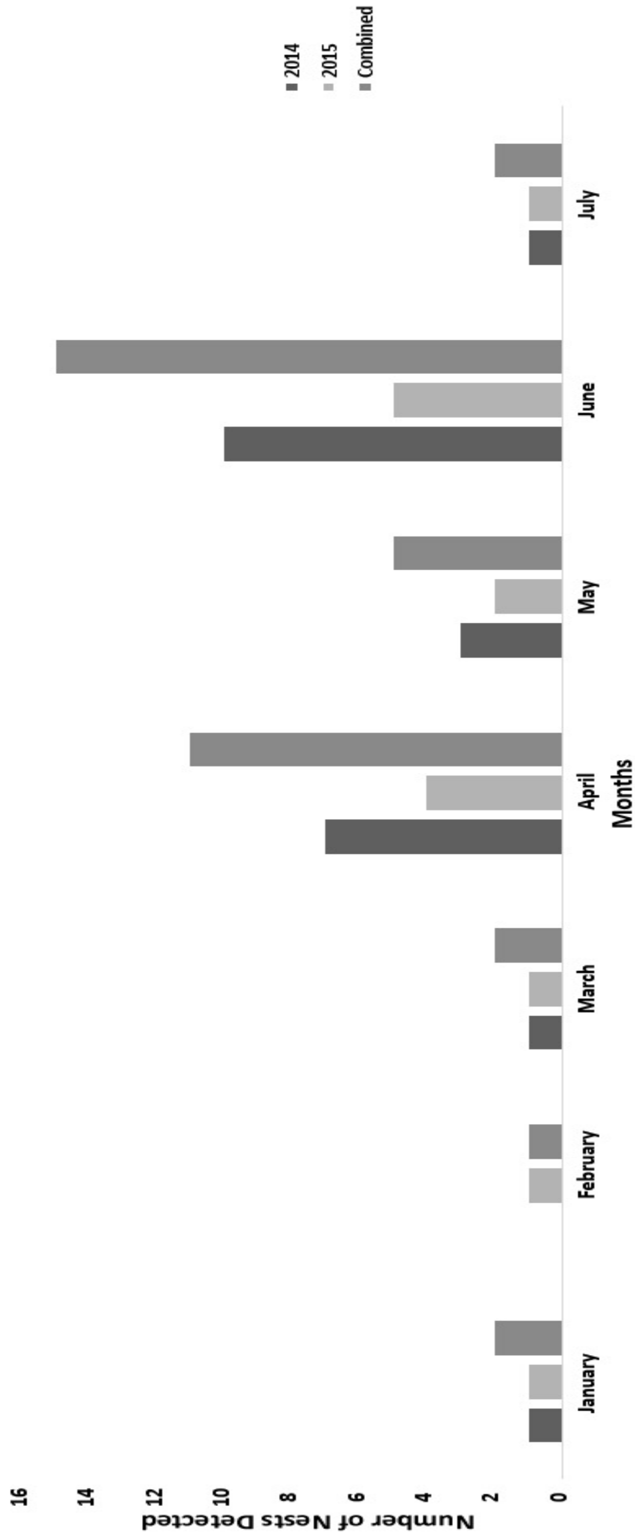

Figure 1. Eurasian Collared-Dove nesting phenology in south-central Oklahoma, 2014-2015.

Nest Site Selection

Eurasian Collared-Doves selected different trees species depending on the time of year. During the winter and early spring (January-April), Eurasian Collared-Doves nested in coniferous trees including shortleaf pine, longleaf pine (*Pinus palustris*), and eastern red cedar (*Juniperus virginiana*). Once deciduous trees leafed out in the spring, Eurasian Collared-Doves switched to Shumard oak, white mulberry (*Morus alba*), Bradford pear (*Pyrus calleryana*), common hackberry (*Celtis occidentalis*), American sycamore (*Planatus occidentalis*), and red maple (*Acer rubrum*). Ten of the 38 Eurasian Collared-Doves nests (26%) were placed on support crosspieces in storage barns throughout the nesting season. For all nests, mean nest height was 4.5 m (range = 1.7-12.5 m; Fig. 2).

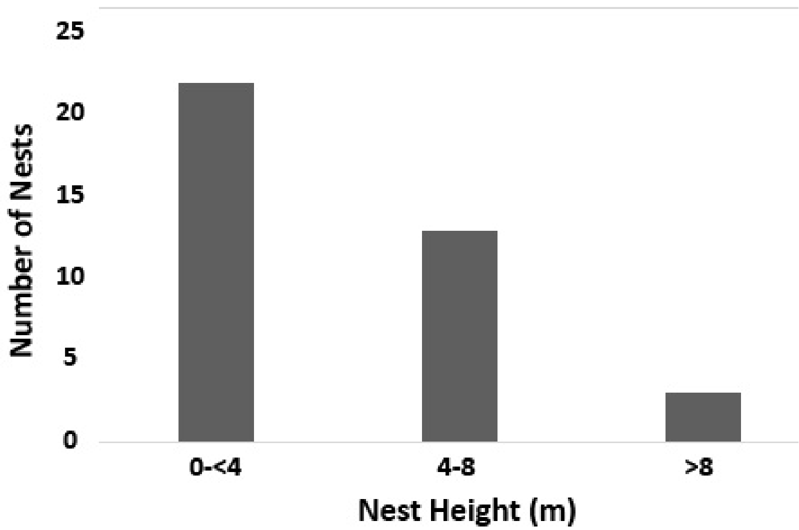

Figure 2. Eurasian Collared-Dove nest heights (m) in south-central Oklahoma, 2014-2015.

Nest Distribution

We located 33 Eurasian Collared-Dove nests throughout Bryan County. Fifteen nests (39.5%) were found in rural settings, such as trees in pastures, for each year. Eighteen nests (47.4%) were found in urban settings, such as trees in residential yards or business parking lots, for each year. Five nests (13%) were found within Atoka County in 2014. Of the three nests found in a rural area, two were in a cemetery, and one in a tree in a pasture. Several pairs nested in the same location within seasons. One pair nested four times in 2014 in Calera. In 2015, another pair nested twice in the same location, in Caddo.

Table 1. Eurasian Collared-Dove nest success parameters in south-central Oklahoma, 2014-2015.

Nest Parameter	2014 Mean ± SD	2015 Mean ± SD	Combined Mean ± SD
Clutch Size	1.6 ± 0.6 (*n* = 17, range = 1-2)	1.9 ± 0.3 (*n* = 11, range = 1-2)	1.7 ± 0.5 (*n* = 28, range = 1-2)
Number Hatched	0.7 ± 1.0 (*n* = 7, range = 1-2)	1.5 ± 0.7 (*n* = 10, range = 1-2)	1.0 ± 1.0 (*n* = 17, range = 1-2)
Number Fledged	0.6 ± 0.9 (*n* = 7, range = 1-2)	1.3 ± 0.9 (*n* = 8, range = 1-2)	0.8 ± 0.9 (*n* = 15, range = 1-2)

Nest Success Parameters

Four nests were excluded from all calculations due to our inability to monitor nest progression. An additional two nests were excluded from percent nest success analysis due to nesting cycle concluding after observations finished.

Eurasian Collared-Doves exhibited a combined mean clutch size of 1.7 eggs for both years (Table 1). In 2014, the mean clutch size was 1.6 eggs; whereas in 2015, mean clutch size increased to 1.9 eggs (Table 1). No significant difference was detected between clutch sizes for years (P = 0.54). Twenty-eight nests were used in clutch size calculations.

The combined mean incubation period for both years was 14.5 d (range = 11-18 d). In 2014, the mean incubation period was 12 d (range = 11-15 d). In 2015, the mean incubation period increased by an average of four days to 16 d (range = 15-18 d). There was a significant difference in incubation periods between years (Mann-Whitney U-test, U = 2.00, n = 15, P = 0.002).

Seventeen nests were used in the number hatched calculations. Eurasian Collared-Doves hatched a combined mean of one young for both 2014 and 2015 (Table 1). In 2014, a mean of 0.7 young hatched; whereas in 2015, mean young hatched more than doubled to 1.5. There was no significant difference for the number hatched between years (P = 0.056), although the P-value was marginally significant due to small sample size.

For both years, Eurasian Collared-Doves had a combined mean of 0.8 young fledged per nest (Table 1). In 2014, a mean of 0.6 young fledged and in 2015, the mean number fledged more than doubled to 1.3 young per nest. There was no significant difference between the number fledged between years (P = 0.13). Fifteen nests were used in the number fledged calculations. For 2014-2015, 39.5% of all nests (15/38) were successful and fledged ≥1 young. In 2014, seven of 23 nests (30.4%)

were successful; whereas in 2015, eight of the 15 nests (53.3%) were successful (Chi-square = 4.5, *df* = 1, *P* = 0.03). Eurasian Collared-Dove young fledged at a combined annual mean of 17 d post-hatching (range = 15-19 d). In 2014, young fledged at a mean of 16 d post-hatching (range = 15-17 d). In 2015, the mean fledging time increased by one day to 17 d post-hatching (range = 14-19 d). There was no significant difference in fledging time between years (*P* = 0.433).

Nest Loss Factors

Nest loss factors included predation, inclement weather, and abandonment (Table 2). One nest was abandoned and another nest was removed by a homeowner. Seventeen of the 38 nests observed failed, with 10 of 17 (58.8%) lost to depredation. In 2014, 14 of 23 nests failed; eight of the 14 (57.1%) nests were lost to depredation. In 2015, of the three nests that failed, two were lost to inclement weather and one was lost to depredation (Table 2). A domestic cat (*Felis catus*) was responsible for depredation of two nests. The other eight depredation events were by unknown predators.

Table 2. Eurasian Collared-Dove cause-specific nest mortality in south-central Oklahoma, 2014-2015.

Nest Number	Year	Reason Failed
1	2014	≤0° C
2		Abandoned
5		Predation
7		Winds ≥40 kph
8		Predation
9		Predation
12		Winds ≥40 kph and predation
13		Cat predation [a]
14		Predation
16		Nest removed by homeowners
17		Predation
18		Predation
20		Predation
21		Predation
25	2015	≤0° C
34		Cat predation
35		Winds ≥40 kph

[a] Pre-mature fledging.

Nest Characteristics

We collected five nests over both years to examine nest characteristics and construction materials. Eurasian Collared-Doves built nests with a mean depth of 1.3 cm (range = 0.5-2.7 cm; Table 3). The outer and inner circumference means were 65.5 cm (range = 48.4-100.5 cm) and 30.5 cm (range = 19.5-40.8 cm) respectively. The mean diameters at the widest point and narrowest point were 20.9 cm (range = 15.4-32.0 cm) and 9.7 cm (range = 6.2-13.0 cm) respectively. The mean total mass of a Eurasian Collared-Dove nest was 79.1 g (range = 24.7-211.8 g; Fig. 3).

The predominant nest construction materials used were twigs, which composed 34.6% of the dry mass of nests (Table 4). Other materials (i.e.,

Table 3. Eurasian Collared-Dove nest measurements in south-central Oklahoma, 2014-2015.

Measurement (*n* = 5)	Mean (cm) ± SD	Range (cm)
Depth	1.3 ± 0.8	0.5 - 2.7
Outer Circumference	65.5 ± 21.0	48.4 - 100.5
Inner Circumference	30.5 ± 7.9	19.5 - 40.8
Widest Point Diameter	20.9 ± 6.7	15.4 - 32.0
Narrowest Point Diameter	9.7 ± 2.5	6.2 - 13.0

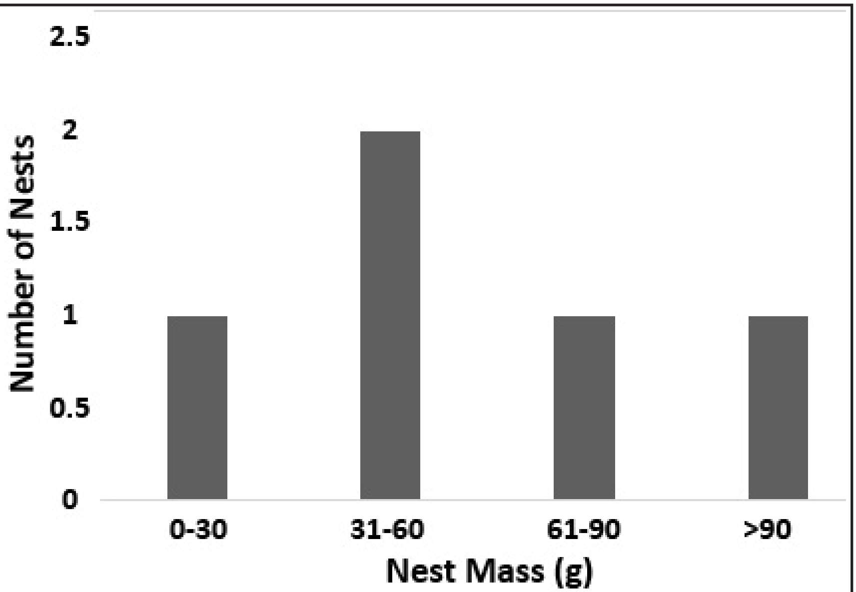

Figure 3. Eurasian Collared-Dove nest masses (g) in south-central Oklahoma, 2014-2015.

bits of grass, feces, small egg shell pieces, and insects) found in nests were classified as debris. Debris composed 29.9% of the dry mass of nests. Dry grass composed 19.9% of the dry mass of nests. If a nest was built in a cedar tree, needles from the tree were incorporated into the nest. These needles composed 14.2% of the dry mass of a nest. Other materials that were not as common were vines, pine needles, wire, and string (Table 4).

Table 4. Eurasian Collared-Dove nest construction materials as percent of dry mass in south-central Oklahoma, 2014-2015.

Nest Number	Nest Location	Twigs	Debris[a]	Dry Grass	Cedar Needles	Vines	Pine Needles	Wire	String
1	Eastern Red Cedar	43.5	49.0	7.5	0.0	0.0	0.0	0.0	0.0
2	Barn	3.6	63.4	26.5	0.0	0.0	0.2	0.2	0.1
3	White Mulberry	26.8	37.0	29.9	0.0	3.9	2.4	0.0	0.0
4	Eastern Red Cedar	0.0	0.0	30.8	69.2	0.0	0.0	0.0	0.0
5	Eastern Red Cedar	33.2	0.0	5.0	1.8	0.0	0.0	0.0	0.0
Mean Percent Dry Mass		34.6	29.9	19.9	14.2	0.8	0.5	0.0	0.0

[a] Bits of grass, feces, small egg shell pieces, and insects.

DISCUSSION

Nesting Phenology

Eurasian Collared-Dove nesting began as early as 1 January, and continued through late July annually. Though nest monitoring concluded in July, it is possible that Eurasian Collared-Doves continued to nest into the fall months. In England, Coombs *et al.* (1981) documented Eurasian Collared-Doves nesting from February to October. In Florida, Stevenson and Anderson (1994) documented Eurasian Collared-Doves nesting from February to December. In Arkansas at a similar latitude, Fielder *et al.* (2012) observed nests from late May to mid-August. E. Young (unpubl. data) observed nesting from February through September in Cowley County, Kansas, and from February through October in Kay County, Oklahoma. Courtship displays, copulation, and nest building were observed every month of the year for both of these counties (Young, pers. comm.).

Eurasian Collared-Doves exhibited a peak in nesting during April and June each year. Since the locations of nests during each of these months were within close proximity, this demonstrated that Eurasian Collared-Doves have multiple broods (Robertson 1990, Romagosa 2012). Eurasian Collared-Doves are monogamous and maintain their pair bond through a nesting season (Romagosa 2012). Coombs *et al.* (1981) marked Eurasian Collared-Doves and observed them six months later in the same area that they were marked. In Hungary, Bozsko (1978) reported that Eurasian Collared-Doves can have up to seven clutches which extended the nesting season into the fall months. In England, Robertson (1990) documented Eurasian Collared-Doves initiating a new nest while still attending nestlings from a prior nest attempt.

Nest Site Selection

Eurasian Collared-Doves used evergreens at the beginning of the nesting season, then deciduous trees were chosen, likely due to denser cover for nest concealment. Competition from Great-tailed Grackles (*Quiscalus mexicanus*) and European Starlings (*Sturnus vulgaris*) also determined where nesting occurred and what species of tree was used later in the season. Nest height averaged 4.5 m. In Arkansas, Fielder *et al.* (2012) documented Eurasian Collared-Dove nest height at a mean of 7.6 m (range = 3.0-10.1 m). In Cowley County, Kansas, and Kay County, Oklahoma, nest height ranged from 1.0-13.4 m (E. Young, pers. comm.). In India and Europe, Eurasian Collared-Doves' nest height ranged from 1.5-22 m with the majority of nests at heights 3.5-12.5 m (Rana 1975, Romagosa 2012). Eurasian Collared-Dove nests at lower heights (< 2.1 m) were more prone to nest loss. Sixty percent of nests 1.7-2.1 m failed. Nests within this height range were easily accessible to predators, such as domestic cats (Coombs *et al.* 1981, Romagosa 2012). We documented one domestic outdoor cat that was a known predator. Coombs *et al.* (1981) stated that Eurasian Collared-Doves' preference for urban areas, such as gardens, led to a higher predation risk by domestic cats.

Nest Distribution

Eurasian Collared-Doves were found nesting in rural and urban settings, near areas occupied by humans. Eurasian Collared-Dove pairs monitored in this study chose nesting locations that were also near food sources, such as bird feeders or gardens (Romagosa 2012, Alamazán-Núñez 2014). We observed other Eurasian Collared-Dove pairs away from human occupied habitats, but were unable to document nesting.

Nest Success Parameters

The difference in incubation periods between years could be due to increased precipitation in 2015 (Mesonet 2016). Eurasian Collared-Doves showed longer incubation periods during 2015 when precipitation was greater than in 2014. Temperature and wind speed were similar for both years and unlikely to have affected incubation length (Mesonet 2016). Conversely, Rana (1975) found a shorter incubation period during the monsoon season in India. In other studies, in the U.S. and Europe, Eurasian Collared-Dove mean incubation length was 15 d (range = 14-19 d; Robertson 1990, Fielder *et al.* 2012). This is similar to the 14.5 d mean incubation length observed in our study. Eurasian Collared-Doves generally have a clutch size of two eggs. Stevenson and Anderson (1994) observed two nests in Florida that held two eggs each. E. Young (pers. comm.) observed a clutch size of two for ca. 50 nests in Cowley County, Kansas, and Kay County, Oklahoma. In England, Robertson (1990) found 89% of Eurasian Collared-Dove nests had a clutch size of two.

Fledging occurred 15-19 d post-hatching. This range is similar to ranges observed in Eurasian Collared-Doves ancestral range and Europe (range = 12-18 d, range = 16-20 d; Rana 1975, Robertson 1990). The range observed in our study was broader when compared to other studies in the U.S., but Eurasian Collared-Dove young fledge at a similar mean number of days. In our study, Eurasian Collared-Dove young fledged at a mean 17 d compared to a mean 17-18 d in other U.S. studies. In Florida, Rose and Rose (1999) observed a Eurasian Collared-Dove nest that fledged young at 17 d. In Arkansas, Fielder *et al.* (2012) observed Eurasian Collared-Dove nests that fledged young at 17 or 18 d.

The behavior of multiple clutches per year has been recorded in other Eurasian Collared-Dove ranges (Bozsko 1978, Robertson 1990). Bozsko (1978) reported that Eurasian Collared-Doves in Hungary had averaged 4-5 clutches with a maximum of seven clutches per nesting season. In England, Robertson (1990) observed Eurasian Collared-Doves attempting 3-5 clutches per nesting season. Several pairs observed in this study nested more than once; one pair attempted four clutches in one nesting season (2014). This outcome may have been the result of the favorable nesting climate and food sources, such as backyard bird feeders in close proximity to nest sites. McNair (1997) concluded that having backyard bird feeders aided in a winter nesting attempt by a Eurasian Collared-Dove pair in Florida. At many of the properties where we conducted nest searching, homeowners had at least one bird feeder filled during the spring and summer months. Robertson (1990) concluded that Eurasian Collared-Doves feed on crops, such as grains, which allowed this species to have a long nesting season.

Nest Success

Nest success was higher in 2015 (53.3%) than in 2014 (30.4%). The significant difference in nest success between both years was due to fewer nest depredation events in 2015. Fewer nest depredation events could be due to more nests built in barns. Nests built in barns likely provided better protection from adverse weather conditions and better concealment from nest predators.

Nest Loss Factors

Almost half of the Eurasian Collared-Dove nests observed failed, with depredation responsible for the majority of nest failure. Domestic cats caused nest depredation on two occasions. In England, Coombs *et al.* (1981) documented that 12.5% of Eurasian Collared-Dove mortalities were caused by domestic cats. Common Grackles (*Quiscalus quiscala*) and Great-tailed Grackles were observed nesting and roosting in close proximity to Eurasian Collared-Dove nests. We did not observe these species depredating a nest, but it is possible they caused nest losses. In the U.S., Bent (1958) reported Common Grackles consuming eggs of various bird species. In Canada, Sealy (1994) observed Common Grackles removing nestlings from nests of passerines. In Texas, Blankinship (1966) observed Great-tailed Grackles consuming eggs and nestlings of other bird species. Eurasian Collared-Dove eggs and young have been observed taken by corvids, as well as Eurasian Collared-Doves mobbing a corvid trying to depredate a nest (Johnson and Donaldson-Fortier 2012, Romagosa 2012). House Crow (*Corvus splendens*), Hooded Crow (*Corvus corone*), and Jackdaw (*Corvus monedula*) have been documented depredating Eurasian Collared-Dove nests (Rana 1975, Robertson 1990, Górski and Antczak 1999). Blue Jay (*Cyanocitta cristata*), American Crow (*Corvus brachyrhynchos*), and Fish Crow (*Corvus ossifragus*) are known to nest in the area. Other potential nest predators observed in proximity to Eurasian Collared-Dove nests were western rat snake (*Pantherophis obsoletus*) and raccoons (*Procyon lotor*). DeGregorio *et al.* (2014) evaluated predators and nest survival in South Carolina. Twenty-eight percent of the depredation events were caused by rat snakes (DeGregorio *et al.* 2014). Ellis *et al.* (2007) documented a 58% depredation rate by raccoons on Great Black-backed Gulls (*Larus marinus*) and Herring Gulls (*Larus argentatus*) in New England. Ellis *et al.* (2007) also found these nests were 17 times more likely to be depredated by raccoons than nests in areas with no raccoon presence.

Nest Characteristics

Eurasian Collared-Dove nest composition varied among nests. Each nest was built using similar construction materials, such as twigs, dry grass, and debris. Debris would accumulate during the nesting cycle. In India, Rana (1975) observed nests composed of twigs, grass, and Eurasian Collared-Dove feathers. In Florida, Rose and Rose (1999) observed a nest composed of only twigs. In one nest in our study, the pair used a piece of wire and string as construction materials. Other studies observed the use string and/or wire in nests (Bozsko 1978, Coombs *et al.* 1981); however, string and wire can cause nestling mortality. Antczak *et al.* (2010) found that Great Grey Shrikes (*Lanius excubitor*) in Poland used plastic string as a main construction material in nests. Nine percent of Great Grey Shrike nestlings died of entanglement from the string used in the nests (Antczak *et al.* 2010). Townsend and Barker (2014) studied the use of anthropogenic materials, such as rope, wire, and plastic as nest construction materials in the American Crow; 5.6% of nestlings became entangled in these materials and died (Townsend and Barker 2014).

Nest size varied based on nest site selection. Nests built in barns were bigger than nests built in trees. Nests in barns were placed at the juncture of beams and allowed larger nest sizes (Fielder *et al.*

2012, Romagosa 2012). Nests in trees appeared structurally weak and usually eggs could be seen from the underside of the nest (Coombs *et al.* 1981). The size of nests built in trees depended on how close together the branches were and location in the tree. A tree that had more open branches could be built bigger than one built where the branches were close together.

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