NESTING ECOLOGY OF MOURNING DOVES IN CHANGING URBAN LANDSCAPES

A Thesis

by

ANNA MARIA MUÑOZ

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2004

Major Subject: Wildlife and Fisheries Sciences

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Approved as to style and content by:

Roel R. Lopez (Chair of Committee)	Nova J. Silvy (Member)
Cruz C. Torres (Member)	Robert D. Brown (Head of Department)

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ABSTRACT

Nesting Ecology of Mourning Doves in Changing Urban Landscapes.

(December 2004)

Anna Maria Muñoz, B.S., New Mexico State University

Chair of Advisory Committee: Dr. Roel R. Lopez

Texas A&M University (TAMU) supports a substantial breeding population of mourning doves (*Zenaida macroura*) with one of the highest nest densities in Texas. There has been a long history of mourning dove research on the TAMU Campus, with initial population studies conducted in the 1950's, and the most recent studies occurring in the 1980's. The TAMU Campus and surrounding areas have experienced substantial changes associated with urbanization and expansion over the last 50 years, altering mourning dove habitat on and around campus. The objective of this study was to examine mourning dove nesting and production in an urban setting and determine how microhabitat and landscape features affect nest-site selection and nest success. Specifically, I (1) examined trends in mourning dove nesting density and nest success on the TAMU Campus, and (2) identified important microhabitat and landscape features associated with nest-site selection and nesting success. Mourning dove nests were located by systematically searching potential nest sites on a weekly basis from the late-March through mid-September. Nests were monitored until they either failed or successfully fledged at least 1 young. A total of 778 nests was located and monitored on campus. All nest locations were entered into ArcView GIS. An equal number of nests were randomly generated in ArcView and assigned to non-nest trees to evaluate habitat variables associated with nest-site selection for mourning doves. Binary logistic regression was used to evaluate the significance of microhabitat and landscape variables to nest-site selection and nest success. Comparisons with data collected in 1950, 1978, and 1979 showed relatively similar nesting densities, but a significant decrease in nest success over time. A comparison of microhabitat features between actual nest trees and random locations (non-nest trees) indicated increasing values of tree diameter at breast height and tree species were important predictors of mourning dove nest-site selection. Landscape features found important in dove nest-site selection were proximity to open fields, roads, and buildings. Proximity to roads and buildings also were significant predictors of nest success. Combining significant microhabitat and landscape variables for nest-site selection increased the predictability of the model indicating a possible hierarchical nest-site selection strategy.

DEDICATION

Mom, Dad, Christina, Zion, and Karlos

Thank you for your love, friendship, and encouragement

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INTRODUCTION

The mourning dove (*Zenaida macroura*) is one of the most abundant and widespread birds found in North and Central America, and is the most abundant North American gamebird (Grue et al. 1983, Mirarchi and Baskett 1994). The breeding range of the mourning dove extends from the southern portions of Canada throughout the contiguous United States (U.S.) into Mexico and includes portions of the Caribbean and Central America (Aldrich 1993, Mirarchi and Baskett 1994). The mourning dove is a highly adaptable species that will nest in various habitats including woodlands, shelterbelts, grasslands, shrublands, agricultural lands, and urban areas (Grue et al. 1983, Sayre and Silvy 1993). Eng (1986) noted the wide breeding distribution of the mourning dove almost precludes describing habitat features with precision, but characterized the dove's primary habitat as consisting of woodland-grassland edge. Although tree nesting is most common, doves will readily nest on the ground in the absence of trees and shrubs and have been known to make use of various man-made structures (Eng 1986, Sayre and Silvy 1993).

In 1960, the U.S. Fish and Wildlife Service separated the distribution of mourning doves into 3 management units (eastern [EMU], central [CMU], western [WMU]), based on the migratory pattern of geographically distinct breeding populations (Kiel 1961). Texas is one of 14 states located in the CMU. Population trend data from Mourning Dove Call-count Surveys (Dolton and Rau 2004) indicated declines in mourning dove densities in the last 39 years. Furthermore, population trend data from

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the National Breeding Bird Survey indicated similar trends for mourning doves within the CMU, with significant decreases in the number of mourning doves heard and seen in Texas over the last 38 years (Dolton and Rau 2004). Reasons for these declines in the CMU may be attributed to reductions in nesting habitat associated with brush control, changing agricultural practices, and other habitat modifications (Tomlinson and Dunks 1993).

Mourning dove banding and recovery records for Texas indicate 4 sub-populations are found in the state: (1) permanent residents that live in Texas year-round, (2) birds that breed in Texas and migrate south in the winter, (3) birds that breed to the north and winter in Texas, and (4) birds that breed to the north and migrate through Texas on their way to wintering areas in Central America (Dunks 1977). The Texas A&M University (TAMU) main campus, situated in the Post Oak Savannah Ecological Region (Gould 1975), supports a substantial resident population of mourning doves and has one of the highest nest densities in Texas (Bivings and Silvy 1979). There has been a long history of mourning dove research on the TAMU Campus with initial population studies conducted in the 1950's (Swank 1952, 1955*a*, 1955*b*; Bivings and Silvy 1979, 1980, 1981, 1994; Bivings 1980; Silvy and Bivings 1981; Atherton et al. 1982; Morrow 1983; Morrow and Silvy 1982, 1983; Bivings et al. 1984; and Morrow et al. 1985, 1987, 1993). Swank (1952, 1955*a*) reported tree canopy, primarily of live oaks (*Quercus virginiana*), served as an excellent substrate for nesting mourning doves. The horizontal limbs and numerous diverging small twigs serve to anchor nests in place. In addition, live oaks retain green leaves year round, providing protection for nests constructed early in the breeding season prior to the emergence of leaves on other tree species.

While many bird species are considered to be sensitive to the impacts of urbanization (e.g., California gnatcatcher **[***Polioptila californica***]**, wren-tit [*Chamaea fasciata*]), the mourning dove generally has benefited from human-induced landscape changes (Mirarchi and Baskett 1994). Recent studies on avian composition and diversity along urban gradients indicated mourning doves respond positively to urbanization (Emlen 1974, Blair 1996, Bolger 2001, Hostetler and Knowles-Yanez 2003, Crooks et al. 2004). In California, for example, Crooks et al. (2004) found mourning doves and other "urban-enhanced" species to be 10 times more abundant on urban transects than in natural habitats. In Arizona, a study of desert and urban bird communities reported 90% of the increased bird biomass observed in urban areas could be attributed to granivorous birds like the mourning dove (Emlen 1974). Additional factors such as the increased availability of water and nesting substrate also were likely related to the mourning dove's increased use of urban areas (Swank 1955*a*, Emlen 1974).

Although the use of urban areas by mourning doves has been well documented, there is evidence that in areas of intense human use and development, mourning dove densities may actually decrease (Blair 1996). Marzluff et al. (2001) defined urban lands as those areas characterized by high building density and little garden or lawn space, whereas suburban lands consisted of moderate- to high-density housing where lawns and gardens were common. Blair (1996) found the average daily densities of mourning doves to be greater in suburban lands such as office parks, residential areas, golf courses, and open-space recreation areas than in urban lands containing high densities of buildings, pavement, and pedestrians. Nearly 25 years after Swank's (1952, 1955*a*, 1955*b*) research, Bivings (1980) reported the TAMU Campus and surrounding areas had experienced substantial changes associated with expansion and urbanization since the initial mourning dove studies. Furthermore, changes in tree age, structure, and distribution had further altered mourning dove habitat on campus. A need to understand the dynamics of mourning doves in a changing urban landscapes (i.e, from suburban to urban, "urban succession") is important, particularly with the projected increases in urbanization throughout the state (Murdock et al. 2003). Though urban development has been documented to benefit mourning doves, the progression of urban development (i.e., *urban succession* = continued construction of new buildings and urban infrastructure, changes in vegetative structure [older trees, less open space]) within these areas may result in decreased densities of nesting mourning doves in the state. Long-term mourning dove nesting data on the TAMU main campus provides a unique opportunity to evaluate changes in the nesting ecology of mourning doves in the face of a changing urban landscape. Such information is important in the management of mourning doves in areas of Texas with increasing urbanization.

Study Objectives

The purpose of this study was to examine mourning dove nesting and production in an urban setting to determine how microhabitat and landscape features affect nest-site selection and nest success. The specific objectives of the study were to:

1. Examine trends in mourning dove nesting density and nest success on the Texas A&M University Campus, and
2. Identify important microhabitat characteristics and landscape features associated with nest-site selection and nesting success on the Texas A&M University Campus.

STUDY AREA

My study was conducted on the TAMU main campus located in College Station, Brazos County (30.6° N, 96.3° W), in the Post Oak Savannah Ecological Region of central Texas (Gould 1975). Texas A&M University is a campus of approximately 43,000 students and consists of park-like fields, buildings, paved roads, and numerous trees and shrubs (Fig. 1). The campus is considered suburban land as defined by Marzluff et al. (2001). Representative tree species on campus include oaks (*Quercus spp.*), elms (*Ulmus spp.*), pines (*Pinus spp.),* and other ornamental shrubs and trees. The study area consisted of a 30-ha section of main campus (Fig. 1) similar to study sites used by Swank (1952, 1955*a*) and Bivings (1980). Over 30 different tree and shrub species were located within the study area with live oak being the predominant species, representing 65% of the total vegetation.

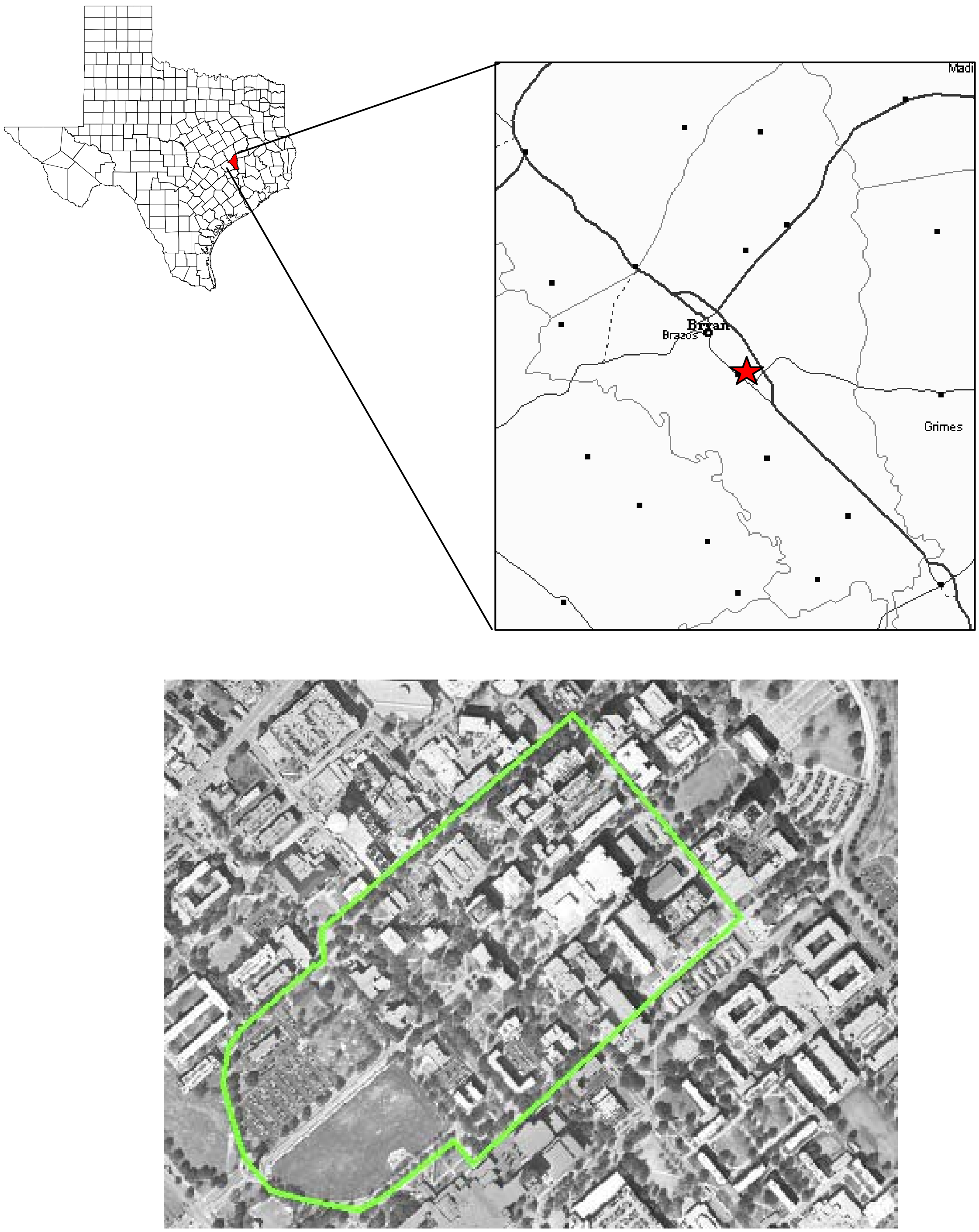

Fig. 1. Study area for nest searches of mourning doves, Texas A&M University, College Station, Texas, 2004.

METHODS

Data was collected from March 21, 2003 through September 24, 2003. Nest trees were defined as trees in which active nesting of mourning doves was observed. Trees within the study area in which nesting was never observed are defined as non-nest trees. The physical location of a nest is referred to as the nest-site, and nests were considered successful if a fledgling was observed to be ≥10 days old and/or fledglings were viewed in close proximity of the nest.

Nesting Demographics

Nest searching and monitoring was conducted by systematically searching (Bivings 1980) potential nest sites (i.e., all trees and shrubs) on a weekly basis from late-March through mid-September in 2003. Nest searches were conducted 2-3 times per week in areas of high nesting activity, and once per week in other areas if males were observed actively seeking mates. Applicable techniques using behavioral cues and precautions for minimizing researcher-induced mortality were followed (Martin and Geupel 1993). Nest sites were recorded and mapped when doves were observed actively building or incubating and were checked every 1-3 days thereafter for nest outcome (success or failure). Nests were considered to have successfully fledged when fledglings were ≥10 days old and/or fledglings were viewed in close proximity of the nest (Bivings 1980, Matthewson 2002). Young were aged according to changes in plumage as described by Hanson and Kossack (1963). Nests were considered failed if adults were not seen on the nest during 3 consecutive visits prior to the observation of nestlings and/or if broken eggshells, extensive nest damage, feathers, or nestling remains were found. When a nest failed or fledged, the site was checked for re-nests during subsequent visits. All nest locations were entered into ArcView GIS (ESRI Institute, Redlands, California, USA). An equal number of nests were randomly generated in ArcView and assigned to non-nest trees to evaluate habitat variables associated with nest-site selection for mourning doves.

Maximum nest density and nest success (%) were calculated and compared to estimates reported by Swank (1952, 1955*a*) and Bivings (1980). Maximum nest density represents the maximum number of active nests for a single day during the breeding season (Sayre and Silvy 1993). The maximum nest density estimate for 1951 (Swank 1952) was not included because monitoring activities were not conducted for the entire breeding season. The nest densities for 1979 and 1980 (Bivings 1980) were averaged to account for between-year variability. Nest success (%) was calculated between March-September for 1950, 1978, and 2003. Although nest success data were available for 1979, these data were not included due to increased nest failures associated with severe weather conditions (Bivings 1980).

Habitat Measurements

I evaluated nest-site selection and nest success at 2 different spatial scales: microhabitat and landscape. Evaluating habitat use at different spatial scales reduced the potential bias associated with arbitrarily defining what was perceived to be available to an animal (Porter and Church 1987). Furthermore, a multi-scale approach provided additional insight into habitat use at different scales (Aebischer et al. 1993, Garshelis 2000). Habitat measurements at each of these scales are presented.

Microhabitat Features. For each nest, data were collected on 6 microhabitat features: (1) tree species, (2) nest tree height (m), (3) nest height above the ground (m), (4) nest lateral distance (m) from tree trunk, (5) nest aspect (i.e., nest compass direction relative to the tree trunk), and (6) primary support substrate (Bivings 1980, Matthewson 2002). Nest orientation relative to the trunk were categorized in the 8 cardinal directions (north, northeast, east, southeast, south, southwest, west, or northwest). Primary support substrate was categorized as tree limb, tree fork, or other. Tree species were categorized as live oaks (LO), elms (EL), ornamentals (OR), and other trees (OT). In addition, an extensive Geographical Information System (GIS) database obtained from the Texas A&M University Department of Urban Forestry provided additional data including tree location, species, diameter at breast height (DBH), and tree canopy diameter (m).

Landscape Features. For each nest, distance to landscape features such as roads, buildings, and open fields were determined in ArcView 3.3 (ESRI Institute, Redlands, California, USA) using the Distance Matrix extension. GIS coverages of trees, roads, and buildings located were obtained from the TAMU Physical Plant Department. The open field coverage was created from a 0.30-m resolution digital orthophoto quadrangle taken in February 2002 and obtained from the City of Bryan, TX. I defined open field as an area ≥ 0.5 ha that was relatively undeveloped and had limited human disturbance during the breeding season (e.g., Simpson Drill Field). Finally, a 61-m x 61-m (0.37 ha) grid was generated and used to estimate building density (m^2), tree density (trees/ha), average DBH (cm), and average canopy diameter (m) for nests located within each grid square.

Spatial Analysis

Nest-site selection (actual nest vs. random potential nest site) and nest success (failed vs. successful) were evaluated using binary logistic regression at each spatial scale (Hosmer and Lemeshow 2000). Microhabitat characteristics (tree species [SPPCAT], DBH, canopy diameter [CANOPY], nest tree height [HEIGHT], nest height [NESTHT], distance from tree trunk [TRNKDST], nest aspect [ASPECT], support substrate [SUPPORT]) and landscape features (distance to roads [ROADS], distance to buildings [BUILDING], distance to open fields [OPENFLD], tree density [TREEDEN], building density [BUILDDEN], average canopy [AVGCANOP], average DBH [AVGDBH]) were evaluated in separate analyses to identify important mourning dove nesting variables at each scale (Table 1). For the nest-site selection models, I compared actual nest trees to random trees (non-nest trees, equal number of random "potential nest" locations were selected) at each scale. For the microhabitat scale model, only SPPCAT, DBH, and CANOPY were compared because other variables could not be measured from random locations. Similarly, nest success was evaluated at each scale by comparing failed nest trees to successful (i.e., fledge $\geq$1) nest trees. Significant ($P <$ 0.05) model variables at each scale were then combined into a single model to determine if the inclusion of spatial scales improved model predictability (Melles et al. 2003). All logistic regression analyses were performed using SPSS 11.5 (SPSS, Inc., Chicago, Illinois).

Table 1. Summary of binary logistic models used in evaluating nest-site selection and nest success at 2 spatial scales (microhabitat, landscape) for mourning doves on the Texas A&M University Campus, 2003. Significant ($P < 0.05$) model variables are underlined.

Nesting Parameter Spatial Scale	Predictor	Model Variables*
Nest-site Selection		
Microhabitat	Nest/Random	= SPPCAT + DBH + CANOPY
Landscape	Nest/Random	= ROADS + BUILDING + OPENFLD + TREEDEN + BUILDDEN + AVGCANOP + AVGDBH
Nest-success		
Microhabitat	Success/Failed	= SPPCAT + DBH + CANOPY + HEIGHT + NESTHT + TRNKDST +ASPECT+ SUPPORT
Landscape	Success/Failed	= ROADS + BUILDING + OPENFLD + TREEDEN + BUILDDEN + AVGCANOP + AVGDBH

* SPPCAT = tree species, DBH = diameter and breast height, CANOPY = canopy diameter, ROADS = distance to roads, BUILDING = distance to buildings, OPENFLD = distance to open fields, TREEDEN = tree density, BUILDDEN = building density, AVGCANOP = average canopy, AVGDBH = average DBH, HEIGHT = nest tree height, NESTHT = nest height, TRNKDST = distance from tree trunk, ASPECT = nest aspect, SUPPORT = support substrate

RESULTS

Nesting Demographics

A total of 778 nests was located and monitored on the TAMU Campus from 23 March–24 September 2003. Of the 778 nests, 190 were successful (fledged ≥1) and 588 failed. For nests that failed, 28% were abandoned between initial discovery and the first revisit. Peak initiation of nesting occurred in June and July and the maximum nest density (nests/ha) of 3.9 nests/ha was recorded on 16 July 2003. Nest success ranged from 0% in March 2003 to 42% in September 2003 (Table 2). Overall nest success was 23% with an estimated production of 319 fledglings. In my study, maximum nest densities were similar to historic studies (Swank 1952, Bivings 1980), however, there was a significant decrease in nest success over time (Fig. 2). Nest success was 23% in my study, compared to 57% in 1950 (Swank 1952) and 46% in 1978 (Bivings 1980).

Spatial Analysis

Of the 778 nests located within the study area, 12 located on man-made structures were eliminated from the microhabitat analyses. An additional 10 nests were eliminated due to insufficient nest-site information, leaving a total of 755 nests available for analysis of microhabitat characteristics. All nests were included in the landscape scale analyses.

Table 2. Mourning dove nesting rate and nest success by month on the Texas A&M University Campus, College Station, Texas, March–September 2003.

Month	*n*	Successful	Failed	Nest success (%)
March	10	0	10	0
April	154	26	128	17
May	161	28	133	17
June	174	51	123	29
July	177	52	125	29
August	76	22	54	28
September	26	11	15	42
Totals	778	190	567	23

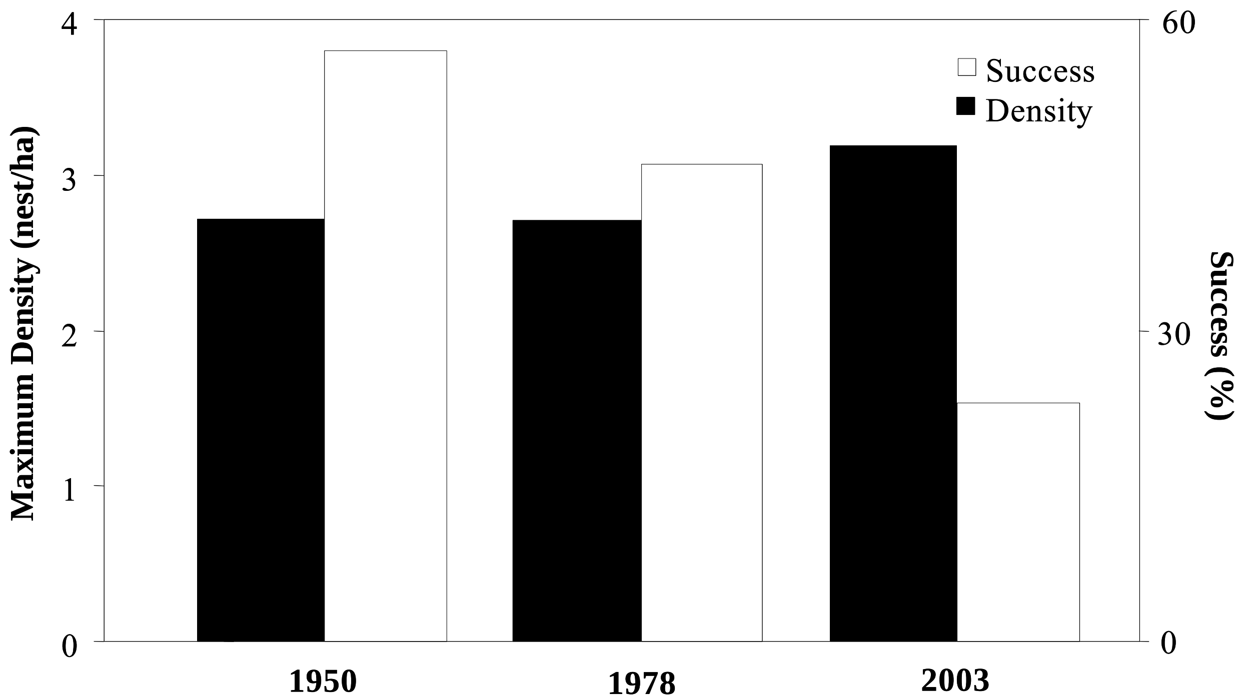

Fig. 2. Nesting demographics (maximum nest density [nests/ha], nest success [%]) for mourning doves on the Texas A&M University Campus, College Station, Texas, 1950–2003.

Nest-site Selection. At the microhabitat scale, mourning dove nest-site selection was best predicted by tree species (*P* < 0.001) and increasing values of DBH (*P* = 0.042, Figs. 3-4). Mourning doves preferred live oaks and avoided other trees; ornamentals and elms were used in proportion to availability (Fig. 3). Mean DBH was greater for nest trees compared to random trees. The microhabitat model correctly predicted 58% of the nest-site selection cases (Hosmer-Lemeshow goodness of fit test, $\chi^2 = 34.499$, $P < 0.001$).

At the landscape scale, mourning doves nest-site selection was best predicted by proximity to open fields (*P* = 0.006), roads (*P* = 0.002), and buildings (*P* < 0.001). Actual nests were closer to roads, further from buildings, and closer to open space than random locations (Fig. 4). The landscape model correctly predicted 57% of the nest-site selection cases(Hosmer-Lemeshow goodness of fit test, $\chi^2 = 50.523$, $P < 0.001$).

Combing important variables at each spatial scale (i.e., DBH, SPPCAT, OPENFLD, ROADS, and BUILDING) in a single regression model increased model predictability for mourning dove nest-site selection to 60% (Hosmer-Lemeshow goodness of fit test, $\chi^2 = 19.889$, $P = 0.011$).

Nest Success. In comparing nest success (failed vs. successful) for mourning doves at the microhabitat scale, I found none of the variables tested (*P* > 0.096) increased model predictability. At the landscape scale, however, nests closer to roads (*P* < 0.001) and further from buildings (*P* = 0.003) were important variables in predicting nest success (Fig. 5). The predictability of the landscape model was 74% (Hosmer-Lemeshow goodness of fit test, $\chi^2 = 13.045$, $P = 0.110$).

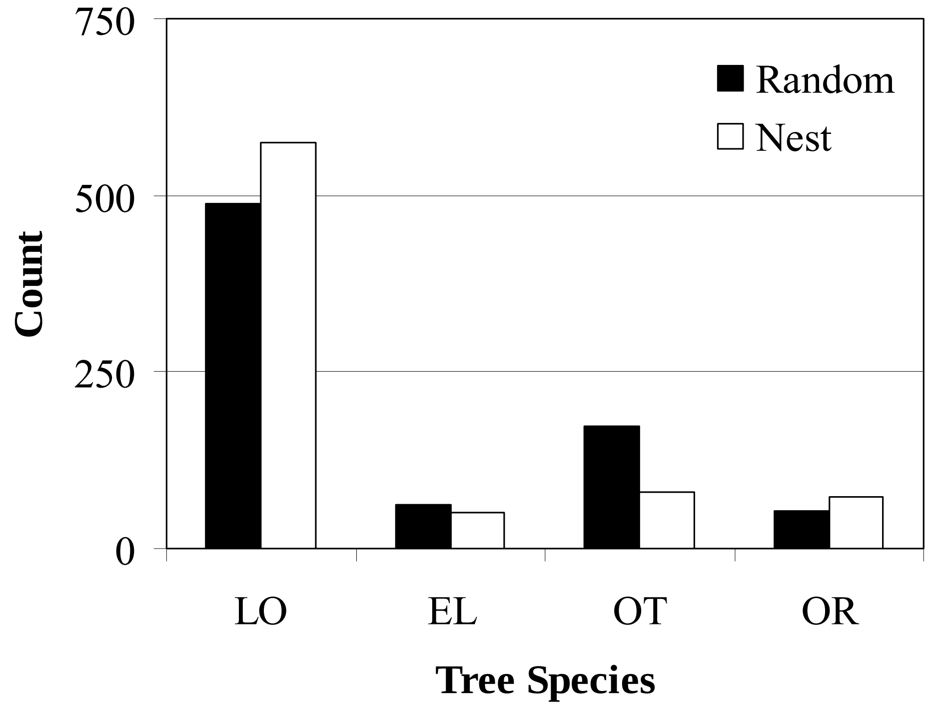

Fig. 3. Mourning dove tree selection between nest trees and random locations by tree category (live oak [LO], elms [EL], other trees [OT], and ornamentals [OR]), Texas A&M University, College Station, Texas, 2003.

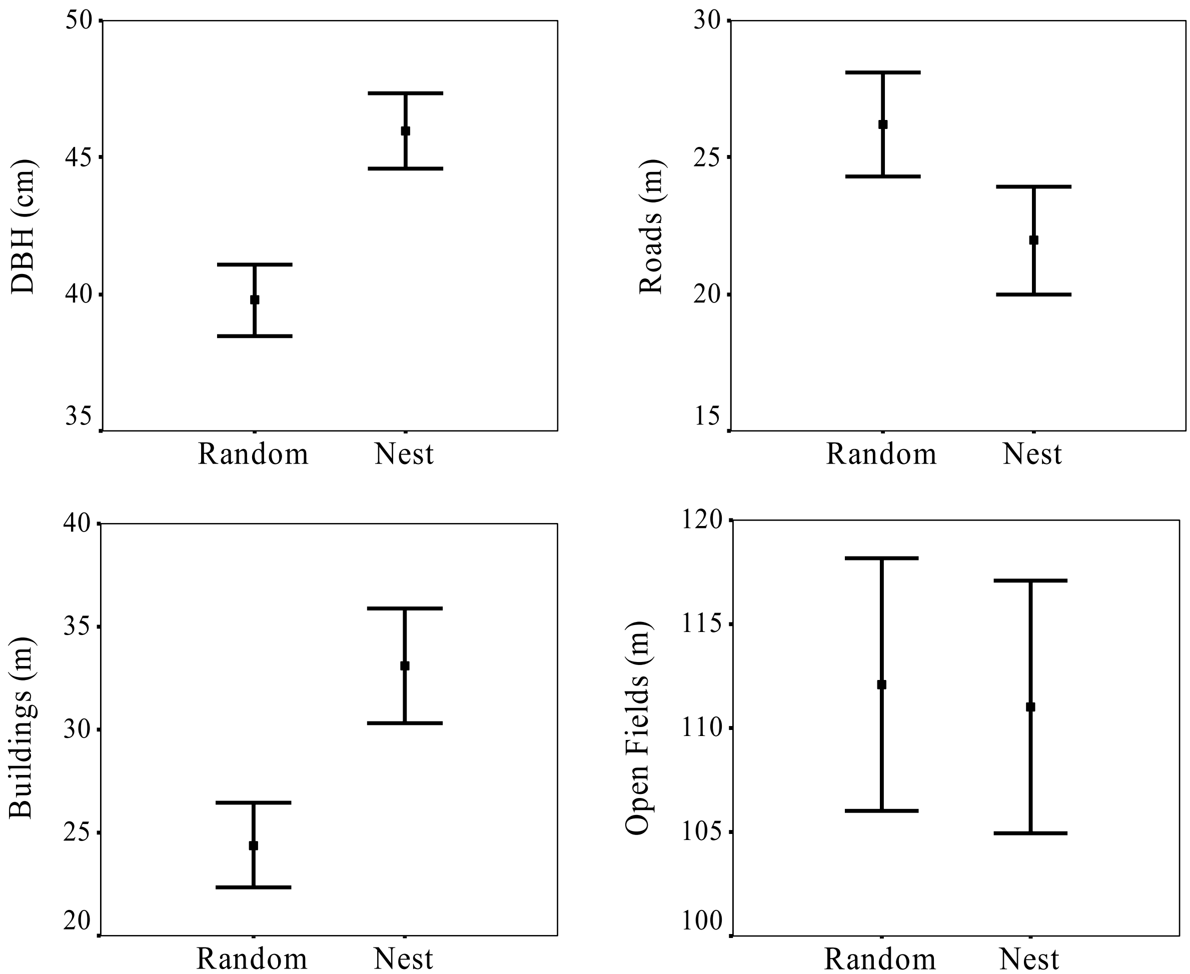

Fig. 4. Factors predicting mourning dove nest-site selection (mean = ▪, 95% CI represented by whiskers; DBH [top left], distance to road [top right], distance to buildings [bottom left], distance to open fields [bottom right]) between nests and random locations at all scales, Texas A&M University, College Station, Texas, 2003.

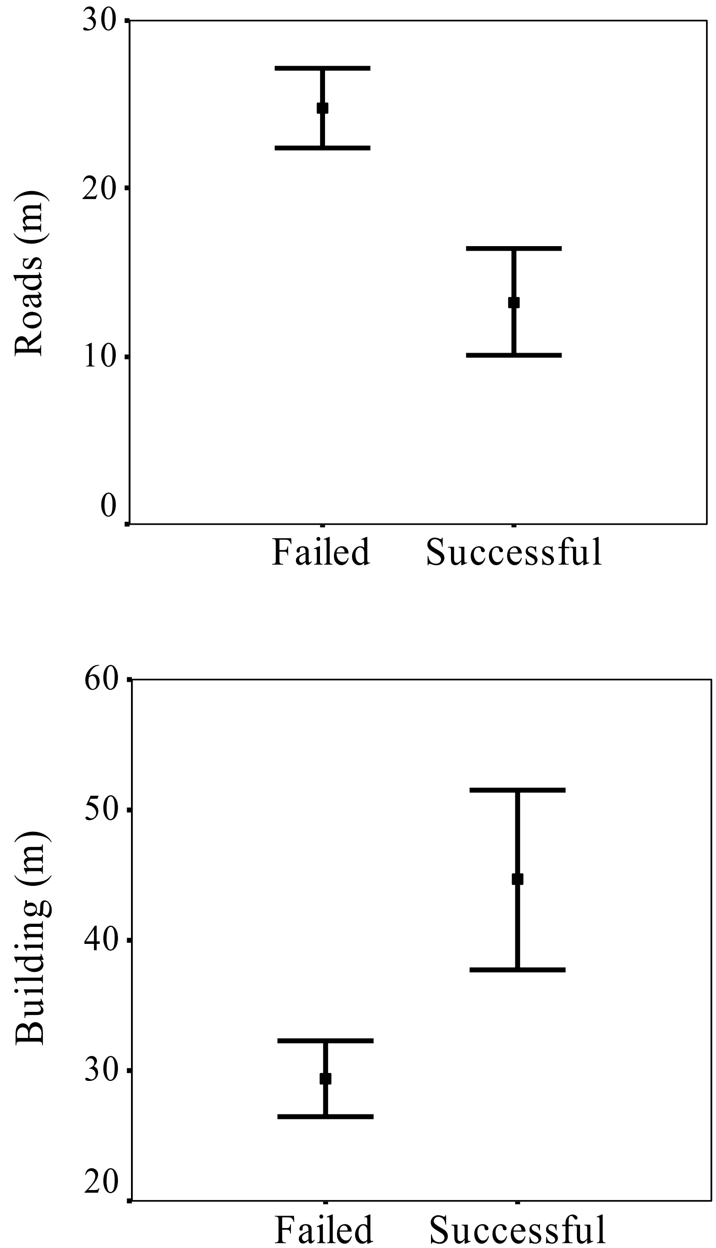

Fig. 5. Factors predicting mourning dove nest success (mean = ▪, 95% CI represented by whiskers; distance to roads [top], and distance to buildings [bottom]) between successful and failed nests at the landscape scale, Texas A&M University, College Station, Texas, 2003.

DISCUSSION

Nesting Demographics

Mourning dove nesting densities on the TAMU Campus have remained stable over the last 50 years, yet nest success has decreased significantly during this time. Bivings (1980) noted significant decreases in nesting success between 1950 (Swank 1952, 1955*a*) and his study (1978–1979) but was unable to identify a single factor to explain those differences. Bivings (1980) concluded that differences observed were due to “normal” fluctuations. The continued decrease in nesting success as indicated by my study, however, suggests more of a declining trend over the last 50 years. Observed mourning dove nest success declines on the TAMU Campus is further supported by population density declines reported by the National Mourning Dove Call-count Survey and the National Breeding Bird Survey (Dolton and Rau 2004). The specific reasons for the decline in nesting success on the TAMU Campus are unclear; however, information obtained on important predictors for nest-site selection and nest success may provide insight into this trend.

Nest-site Selection

The model with the greatest predictability for nest-site selection contained microhabitat and landscape variables, suggesting considerations of habitat at both scales was important during mourning dove nest-site selection. The importance of 2 different spatial scales may indicate a hierarchical nest-site selection strategy for mourning doves. Mourning doves may initially select for important urban-landscape features and then secondarily select for specific microhabitat features within this scale. Similar patterns in habitat selection have been reported for other bird species (e.g., western kingbird [*Tyrannus verticalis*], rofous treecreeper [*Climacteris rufa*], Bergin 1992, Luck 2002).

Microhabitat Features. At the microhabitat scale, increasing values of DBH and tree species were important predictors in mourning dove nest-site selection. Nest trees had an average DBH of 46 cm, significantly larger than random trees (mean DBH = 40 cm, Fig. 4). Structural stability is important to mourning dove nest success (Coon et al. 1981). Increasing values of DBH associated with nest-site selection may be a function of the increased structural stability associated with mature trees. The importance of structural stability also may contribute to the significance of tree species as a predictor of nest-site selection. The preference for live oaks by mourning doves has been well documented on the TAMU Campus (Swank 1952, Bivings 1980) and elsewhere in Texas (Matthewson 2001). Swank (1952, 1955a) reported the horizontal limb structure and numerous diverging small twigs of live oaks serve to anchor mourning dove nests in place. The year-round foliage of live oaks also provide excellent nesting habitat for mourning doves earlier in the breeding season prior to the emergence of leaves on other deciduous species. The structural characteristics and the year-round foliage of live oaks may help explain mourning dove preference for this tree species.

Landscape Features. Caldwell (1964) suggested tree characteristics alone may not be as important as the tree location in mourning dove nest-site selection. In my study, spatial proximity of open fields, roads, and buildings were important factors in mourning dove nest-site selection. I found nests were located closer to open fields and roads and further from buildings as compared to random locations. Armbruster (1973) noted the presence of bare or near bare ground close to potential nest trees appeared to be an important factor for nest-site selection. Other studies reported open fields with sparse ground cover was important in the collection of nesting materials (Swank 1955a) and feeding (Lewis 1993). Mourning doves locate food by sight or by observing other birds feeding (Lewis 1993), and a high percentage of bare or sparse ground cover can provide mourning doves with areas where seeds can be easily seen and accessed. Rosenberg et al. (1987) reported urban lawns (similar in description to my open field areas) were favored by ground foragers and granivores. Open fields with limited ground cover also allowed for increased detection of potential predators (George 1975). Distance to roads, like distance to open fields, may be important to mourning dove nest-site selection because of the feeding ecology of doves. Grit, an essential component of the mourning dove diet, is frequently secured along road edges (Lewis 1993). Furthermore, water, also an important component in the mourning dove diet, often collects in road drainages and potholes along roadways. In my study, doves were frequently observed drinking water along roadways.

Unlike distance to open fields and roads, I found distance to buildings to be negatively correlated in mourning dove nest-site selection on the TAMU Campus. This negative relationship may be due to increasing human disturbance associated with buildings, and decreasing open space associated with open fields and road corridors. Although the study area as a whole could be defined as a suburban landscape (Marzluff et al. 2001), the high building density in the northeastern and eastern sections of the study area are more representative of an urban landscape (Fig. 1). Mourning dove densities have been shown to decrease in urban areas with high building density and the associated increases in pavement and pedestrians (Blair 1996). Thus, urban development can be detrimental to mourning doves depending on the intensity and spatial structure/distribution of these changes. I would propose that light to moderate urban development may increase the diversity and abundance of resources available to mourning doves, however, intense development could decrease the amount of resources available to doves by reducing areas important to production, namely open spaces (e.g., open fields, roadways) and their related resources.

Nest Success

None of the microhabitat variables evaluated in my study were significant predictors of nest success. These findings are similar to those of Yahner (1983) who did not find microhabitat characteristics to be associated with nesting success of mourning doves in Minnesota. The high predictability (74%) of the nest success model containing only landscape features suggests mourning dove nest success may be greatly influenced by the proximity of landscape features. As with nest-site selection, nest success increased near roads and decreased near buildings. The potential reasons for the increased success associated with these variables are likely to be similar to those related to nest-site selection.

The insignificance of open fields in predicting nest success may indicate that open fields are more important for gathering nesting materials during the nest building phases. Furthermore, the selection of nest trees near open fields may decrease energy expenditures associated with nest building for mourning doves. For example, during nest building, males select small twigs and other materials and deliver them to the female who oversees nest construction (Nice 1922). Male mourning doves may take 30-40 trips in gathering nesting material to the nest building phase (Jackson and Baskett 1964). It is for these reasons that proximity to open fields may be more important for nest-site selection than nest success.

CONCLUSIONS

Nest-site Selection

Study results indicated mourning doves on the TAMU Campus may employ a hierarchical strategy for nest-site selection. Initially, the arrangement of landscape features may be more important than microhabitat characteristics associated with individual trees. In general, well-developed trees in sparse, open areas seemed ideal for mourning doves. Managers should be cautious in assuming that all urban landscapes are beneficial to mourning doves. I propose that light to moderate urbanization may benefit mourning doves initially, however, urban succession can result in (1) increased urban infrastructure (i.e., greater building density), and (2) the maturity of existing trees/vegetation (i.e., larger trees, closing of canopy). The net result for mourning doves may include a decrease in nest-site suitability. Continued urban development may have a dramatic impact on mourning dove populations at the state and national level.

Nest Success

Mourning dove nest success was almost exclusively influenced by the proximity of landscape features, illustrating the importance of urban succession in mourning dove nesting ecology. Declines in mourning dove nesting densities over the last 50 years may be explained by changes in urban landscapes moving from suburban to urban habitats. In reviewing dove trends in the TAMU studies, I found nest densities to be stable; however, nest success had declined in the last 50 years, which may be explained by processes operating at the landscape-level.

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